Equatives and Maximality[*]

Luka Crnič, Danny Fox

July 2, 2017

Abstract

There is one salient difference between equative constructions like *John drove as fast as Mary did* in English and Slovenian: while the former do not allow downward-entailing operators in the standard clause that would c-command the degree argument abstracted over, the latter do. This holds, however, only if the equative occurs without a multiplicative degree modifier. We show how the facts be captured on relatively simple assumptions about the make-up of equative constructions. Building on the insights of von Stechow (1984) and Rullmann (1995) about the distribution of downward-entailing operators in degree constructions, we argue that the behavior of equatives in Slovenian provides new support for the following two conclusions: (i) that maximality, although a component of equatives, is seperable from the other ingredients of the construction (in line with Heim 2006b, *pace* von Stechow 1984, Schwarzschild & Wilkinson 2002, and others) and (ii) that degree domains are always dense (the Universal Density of Measurement, Fox & Hackl 2006).

Contents

[*]Acknowledgments to be added.

1 Two puzzles

The starting point of the paper is a well-worn observation about clausal comparative and equative constructions in English: they do not allow a downward-entailing (DE) operator to occur in a standard clause in which it would c-command the degree argument that is abstracted over. Thus, while the sentences in (1) are acceptable,

(1) a. John drove faster [than Mary did].
    b. John drove as fast [as Mary did].

those in (2) and (3) are not.[1] These latter sentences contain, respectively, negation in the standard clause, (2), and vague DE quantifier *few other people*, (3). The same pattern can be replicated also with other DE operators.[2,3]

(2) a. *John drove faster [than Mary didn't].
    b. *John drove as fast [as Mary didn't].

(3) a. ??John drove faster [than few other people did].
    b. ??John drove as fast [as few other people did].

A shared property of most approaches to comparatives and equatives is that they derive this distributional pattern on interpretive grounds (e.g., von Stechow 1984, Rullmann 1995, Gajewski 2008). More to the point, it holds on most approaches that the sentences in (2) and (3) give rise to pathological meanings (they are either undefined, contradictory, or tautological) and are thus unacceptable. The sentences in (1) by contrast receive a well-formed meaning (contingent and defined) and are consequently acceptable.

Puzzle 1. A puzzle arises when we look at Slovenian equatives, which exhibit a slightly different behavior than their English counterparts. A translation of the equative sentence in (1) into Slovenian is provided in (4). The standard clause of the equative is headed by *kot*, which is also used in comparatives and which we gloss with *than*, while the matrix clause contains a demonstrative

[1]The facts are different for so-called phrasal comparatives and equatives, as exemplified in (i) (Brame 1983). We assume that phrasal comparatives like (i) involve a wide-scope interpretation of the nominal quantifier and are thus orthogonal to the issues investigated in this paper.

(i) John is taller than no one (*is).

[2]An apparent exception are the so-called class B modified numerals (see Geurts & Nouwen 2007, Nouwen 2010, Schwarz et al. 2012, among others, for discussion of their semantic properties). See also Fleisher 2016. This paper does not shed new light on this exceptional behavior.

(i) John drove faster [than at most two other people did].

[3]If a DE operator does not c-command the degree argument abstracted over in the standard clause, the sentences are acceptable. This is shown in (i), where *few mistakes* occurs in both the matrix and standard clause.

(i) More girls made few mistakes [than boys did].

tako that precedes the adjective (the demonstrative may be dropped, though this is dispreferred and is impossible if the equative is combined with a multiplicative modifier; see Toporišič 2006 for some examples and discussion).

(4) Janez se je peljal tako hitro [kot se je Marija].
Janez self aux drive dem fast than self aux Mary
'John drove as fast as Mary did.'

Surprisingly, at least given what we are led to expect in light of the behavior of English equatives, a sentence like (4) remains acceptable even with the presence in the standard clause of negation, (5), or another DE operator, (6). The meanings of these sentences correspond to their comparative variants, which lack the DE expression under discussion, as indicated in parentheses. (Similar observations have been reported for German by von Stechow 1984 and Penka 2010, 2016. Dutch seems to exhibit similar patterns as well – Fred Landman, Rick Nouwen, p.c. Since we did not have the opportunity to explore equatives in these other language sufficiently as well as for reasons of space, we largely ignore them in the following, though see footnote **??**.)

(5) Janez se je peljal tako hitro [kot se Marija ni].
John self aux drive dem fast than self Mary neg.aux
'*John drove as fast as Mary didn't.'
(⇔ John drove faster than Mary did.)

(6) Janez se je peljal tako hitro [kot se je malokdo].
John self aux drive dem fast than self aux few people.
'*John drove as fast as few people did'
(⇔ John drove faster than many/most people did.)

This is the first distributional asymmetry that we tackle in this paper: the contrast between English and Slovenian equative sentences with respect to allowing DE operators to occur in the standard clause.

Puzzle 2. Adding further to the mystery, not all equative sentences with a DE operator in the standard clause are acceptable. In particular, if we add a multiplicative modifier to the sentences in (5) and (6), as exemplified in (7) with *twice*, the resulting sentences are unacceptable.

(7) *Janez se je peljal dvakrat tako hitro [kot se Marija ni].
John self aux drive twice dem fast than self Mary neg.aux
'*John drove twice as fast as Mary didn't.'

This is the second distributional asymmetry that we tackle in the paper: the contrast between modified and unmodifed equative sentences in Slovenian with respect to allowing DE operators to occur in the standard clause. (As we will see, the patterns involving multiplicative modification are quite intricate. The statement here serves as a good starting point.)

	English	Slovenian
Equatives with DE operators	*	✓
Modified equatives with DE operators	*	*

Table 1: The acceptability of DE operators in simple standard clauses of (modified) equative constructions. (The facts pertaining to modification are more intricate, as we discuss in Section 4.)

2 Preview

We argue on the basis of these patterns for the following two conclusions:

(i) Maximality should be decoupled from the semantics of comparison operators (*pace* von Stechow 1984, Heim 2000, Rett 2014, and others) as well as from the lexical semantics of adjectives (*pace* Schwarzschild & Wilkinson 2002, Beck 2012, Dotlačil & Nouwen 2016, and others). This is in line with Heim (2006b).

(ii) All measurement scales are dense (Fox & Hackl 2006).

The argument for (i) is based on the availability of DE operators in the standard clause of Slovenian equatives (Puzzle 1). Specifically, we suggest that in Slovenian maximality can be freely dropped from the equative, yielding a comparative meaning (along the lines of Seuren 1973, Schwarzschild 2008, Gajewski 2008). The argument for (ii) is based on the effect of multiplactive modification on the acceptability of DE operators (Puzzle 2). Specifically, we argue that this modification is necessarily accompanied by maximality which leads to the observed pattern of acceptability only if density is assumed.

In the following, we provide a description of the main contours of our proposal, avoiding the specifics about composition. While a concrete compositional implementation of the proposal is put forward in subsequent sections, we believe that the essentials of the proposal are compatible with several other approaches to degree constructions. Although we do not discuss in any detail the range of approaches compatible with our proposal, we do highlight in places what approaches our proposal is *not* compatible with.

Maximality failure. In our account of the unacceptability of DE operators in the standard clause of English equatives, we build on von Stechow's (1984) suggestion that this follows from a maximality failure, that is, a maximality inference being triggered in the standard clause that cannot be satisfied (see also Rullmann 1995).

More to the point, we assume that an equative sentence like (8) has semantic components that can be highlighted with the paraphrase in (9) (cf. Schwarzschild 2008). The crucial components of this schematic representation for the purposes of this paper are underlined: existential closure at the matrix level (*some speed* in the informal paraphrase) and maximality in the standard clause (*the largest speed* in the informal paraphrase). We propose that these components of the semantics correspond to the contributions of separate functional morphemes in syntax (cf. esp. Heim 2006b, but also Schwarzschild 2008, 2010, Beck 2012, among others).

(8) John drove a fast as Mary did.

(9) Some speed *d* is such that
  (i) John drove (at least) *d* fast, and
  (ii) *d* is the largest speed such that Mary drove (at least) that fast.

Now, if a DE operator is contained in the standard clause, as in (10), we obtain a meaning that can be paraphrased by (11). Since there is no largest speed at which someone did not drive, the contribution of the standard clause is undefined, and so the sentence is unacceptable. This explains the data pertaining to the English equatives – DE operators are unacceptable in their standard clauses.

(10) *John drove as fast as Mary didn't.

(11) Some speed *d* is such that
  (i) John drove (at least) *d* fast, and
  (ii) *d* is the largest speed such that Mary did *not* drive (at least) that fast. [*undefined*]

Slovenian equatives. In contrast to English, we propose that Slovenian admits another interpretation of the standard clause of an equative, one that lacks a maximality inference. The meaning of (12), repeated from above, is stated in (13). This interpretation is consistent, and it corresponds to the comparative meaning of the sentence: if there is a speed such that John drove at least as fast as and Mary did not, then John must have driven faster than Mary did.

(12) Janez se je peljal tako hitro [kot se Marija ni].
'*John drove as fast as Mary didn't.'

(13) Some speed *d* is such that
  (i) John drove (at least) *d* fast, and
  (ii) *d* is ~~the largest speed~~ such that Mary did *not* drive (at least) that fast.

This constitutes our resolution of the first puzzle: Slovenian standard clauses may lack the operator that induces the maximality inference. This is developed in Section 3.

Modification. While Slovenian equatives may in principle contain a DE operator, this is *prima facie* not possible if the equative is modified, as repeated in (14). We submit that this is due to a maximality failure. However, the maximality failure is not induced in the standard clause, unlike in English, but rather stems from the multiplicative modification.

(14) *Janez se je peljal dvakrat tako hitro [kot se Marija ni].
'*John drove twice as fast as Mary didn't.'

Specifically, a paraphrase of the meaning of (14) is provided in (15), where maximality is introduced at the matrix level by the multiplicative modifer – crucially above the existential quantification and the standard clause.

(15) Two is less great than or equal to the largest number m such that some speed d is such that [*undefined*]
   (i) John drove (at least) $m \times d$ fast, and
   (ii) d is such that Mary did not drive (at least) that fast.

The meaning in (15) is undefined if density is assumed: for every speed d at which Mary did not drive d fast, you can find a lower speed d' at which she did not drive, and thus a larger number m' with which you can multiply a degree at which Mary did not drive to get John's speed ($m' \times d'$).

An account of unacceptability based on this observation, leads to intricate expectations when various modals are introduced into a standard clause. The predictions are derived and corroborated for Slovenian. Moreover, we show that similar predictions are not made for English, which seems to be desirable on empirical grounds.

This constitutes our resolution of the second puzzle and is discussed in Section 4. Section 5 points to identical behavior in examples in which the measurement scale appears to be discrete, providing support for the conclusion that all measurement scales are dense (Fox & Hackl 2006).

Comparatives. We have been silent in the preceding about the behavior of DE operators in the standard clauses of Slovenian comparatives. It turns out that it is identical to English: DE operators are unacceptable in the standard clauses of both languages. We discuss this fact in light of our proposal about Slovenian equatives in Section 6. Specifically, we discuss two common ways of analyzing this fact for comparatives (esp. von Stechow 1984, Gajewski 2008), how they relate to our proposal about equatives, and the variation between different degree constructions.

3 Composition of equatives

How do we get to the representations of the simple equative constructions described in the preceding section and repeated below in (17)? And how could the difference between the behavior of English and Slovenian equatives be encoded?

(16) John drove as fast as Mary did.

(17) Some speed d is such that
   (i) John drove (at least) d fast, and
   (ii) d is the largest speed such that Mary drove (at least) that fast.

We propose that the underlined material (existential quantification, maximality) is realized by separate functional morphemes in syntax. And that their presence, especially the presence of the maximality operator, may be subject to parametric variation.

Maximality. One possible first step towards analyzing the equative contruction, as well as other comparison constructions, is to treat both the matrix and the standard clause as degree predicates, which are combined by existential quantification (with the resulting requirement that their intersection be non-empty, cf. e.g. Seuren 1973, Schwarzschild 2008, 2010, Gajewski 2008, Alrenga & Kennedy 2014). This obviously results in trivial (hence incorrect) truth conditions in the absence of some further operator in the standard clause. For example, take sentence *John drove as fast as Mary did.* In the absence of a further operator in the standard clause, the sentence would have the syntactic structure in (18).

(18) [∃ [wh [λd [Mary drove d fast]]]] [λd [John drove d-fast]]]

On the standard definition of the existential quantification operator ∃ in (19), and the meanings of adjectives in (20), it would be assigned the meaning (21), which is extremely weak: there is a speed at which John and Mary drove. In fact, it is trivial on the assumption that the sentence can only be used if both John and Mary drove at some speed.

(19) $[\![\exists]\!](D)(D') = 1$ iff $\exists d\, [D(d) = D'(d) = 1]$

(20) $[\![\text{fast}]\!](d)(x) = 1$ iff $\text{speed}(x) \geq d$

(21) $\exists d\, [\text{speed(John)} \geq d \wedge \text{speed(Mary)} \geq d]$ [*trivial meaning*]

One way to avoid such trivial truth conditions is to generate a maximality operator in the standard clause. We implement this by taking the degree *wh* to start out as a complement of *max*, which is defined in (22). The base generated structure of the standard clause is thus the one provided in (23). (This syntax of the standard clause mirrors the one put forward by Heim 2006b for comparatives, though our semantic assumptions diverge.)

(22) $[\![\text{max}]\!]\, (d)(D) = 1$ iff $d = \max(D)$

(23) Base structure of the standard clause:
[Mary is [[max wh] fast]]

The *max* constituent (a generalized quantifier over degrees) must move out in order to obtain an interpretable structure, that is, it cannot be interpreted *in situ*. Finally, *wh* must move out of the *max* constituent to the edge of the clause (cf., e.g., Chomsky 1976). The standard clause is topped off by an existential quantifier (which one may treat as the meaning of the preposition *kot* in Slovenian and *as/than* in English, or perhaps as part of the meaning of the comparison morphology realized in the matrix sentence; cf., e.g., Schwarzschild 2010). The equative sentence thus has the structure provided in (24). (The existential quantifier consisting of the standard clause moves out of the matrix degree predicate for reasons of interpretability and ellipsis resolution.)

(24) [∃ [wh [λd [max d] [λd' [Mary drove d' fast]]]] [λd [John drove d fast]]]

The meaning of the structure in (24) is computed in (25): there is a degree that is identical to Mary's speed and John drove at least as fast as it. We thus obtain the meaning of equatives that is completely parallel to the one assigned to them by Schwarzschild (2008), and others.

(25) $([\![\exists]\!]([\![\text{[wh [}\lambda\text{d [max d] [}\lambda\text{d' [M drove d' fast]]]]}]\!]))([\![\text{[}\lambda\text{d [J drove d fast]]}]\!]) = 1$ iff

$\exists$d [d = max(λd. Mary drove d-fast) $\wedge$ speed(John) $\geq$ d] iff
speed(John) $\geq$ speed(Mary)

DE operators and maximality. In case the standard clause contains in addition to maximality also a DE operator, such as (26), we obtain either an undefined or a trivial meaning, depending on the scope of the DE operator relative to *max*.

(26) *John drove as fast as Mary didn't.

We first look at the structure of the sentence in which *max* takes scope above negation, provided in (27). The meaning that we get for this structure, computed in (28), is undefined for the reasons discussed above: there is no maximal speed at which Mary did not drive.

(27) [$\exists$ [wh [λd [[max d] [λd' [neg [Mary drove d' fast]]]]] [λd [John drove d fast]]

(28) $\exists$d [d = max(λd. $\neg$Mary drove d-fast) $\wedge$ speed(John) $\geq$ d]

On the other hand, if negation takes scope above *max*, as in (29), the meaning that we obtain is extremely weak: namely, that there is a speed different from Mary's speed such that John drove at least that fast. If the felicitous use of the sentence requires that John drove at some speed, this meaning is a (contextual) tautology.

(29) [$\exists$ [wh [λd [neg [[max d] [λd' [Mary drove d' fast]]]]]]] [λd [John drove d fast]]

(30) $\exists$d [d $\neq$ max(λd. $\neg$Mary drove d-fast) $\wedge$ speed(John) $\geq$ d]

Thus, no matter what parse is assigned to the sentence in (26), the sentence has a pathological meaning: it is either undefined or trivial. This arguably correctly captures the unacceptability of DE operators in the standard clause of an equative construction in English.

Maximality in adjective meanings. A similar conclusion is reached on approaches to semantics of adjectives, and consequently comparison constructions, that take adjectives to denote sets of sets of degrees (or intervals) along the lines of (31) (see, e.g., Schwarzschild & Wilkinson 2002, Beck 2012, Dotlačil & Nouwen 2016, but not Beck 2014).

(31) $[\![$fast$]\!]$(D)(x) = 1 iff speed(x) $\in$ D

On these approaches, on which maximality is encoded in the lexical meaning of the adjective, the standard clause with a DE operator has the meaning in (32): it corresponds to the set of sets of degrees that do not contain Mary's speed.

(32) $[\![$[wh [λD [neg [Mary drove D fast]]]]$]\!]$(D) = 1 iff speed(Mary) $\notin$ D

There are different strategies for integrating this meaning into the meaning of an equative sentence. None of the straightforward strategies, however, leads to a contingent interpretation. For example, on one prominent strategy (see esp. Beck 2012, Dotlačil & Nouwen 2016), the minimal set of degrees that satisfies the meaning of the standard clause is picked out by an application of a *min* operator, defined in (33). This meaning is, then, combined with the rest of the sentence, in ways that are irrelevant for the purpose at hand.

(33) $\text{min}(\mathscr{D}) = \iota D(\mathscr{D}(D) \wedge \neg\exists D' [\mathscr{D}(D') \wedge D' \subset D]$

It holds that *min* is undefined for the set picked out by (32): take any two singleton sets of degrees distinct from John's speed, say, {speed(John)-1mph} and {speed(John)+1mph}. Both are in the denotation in (32), but neither is a subset of the other. Accordingly, applying *min* to (32) leads to undefinedness, and an English sentence like **John drove as fast as Mary didn't* is correctly predicted to be unacceptable. (Strategies involving existential or universal quantification over the sets of degrees provided by the standard clause also clearly fail.)

But since this type of approach to adjective semantics and comparison unavoidably predicts unacceptability of equatives with DE operators in the standard clause, it obviously undergenerates when it comes Slovenian equatives – unless one assumes cross-linguistic variation in the lexical meanings of adjectives, in addition to the variation in how comparison constructions are put together (they would have to be put together differently in English and Slovenian given that the two languages would have different adjective semantics). It is not obvious that this kind of variation is warranted and desired. So we conclude that adjectives should not be analyzed as in (31), and continue to employ the semantics in (20). Importantly, as we will see immediately, the approach we started out with in this section is more flexible and more naturally parametrizable.

Dropping maximality. We saw that applying existential quantification to the standard and matrix clause yields trivial results if the standard clause lacks a maximality operator. Nonetheless, we may obtain a licit interpretation in the absence of a *max* operator – namely, when the standard clause contains a DE operator (cf., esp., Seuren 1973, Schwarzschild 2008, Gajewski 2008 on comparatives). We suggest that this is the case in Slovenian: while the Slovenian counterpart of (16) has the same representation as (16), given in (24) (otherwise we would obtain a trivial meaning), the equative containing a DE operator in the standard clause may have a representation that lacks the maximality operator, as given in (35).

(34) Janez se je peljal tako hitro [kot se Marija ni].
‘*John drove as fast as Mary didn't.’

(35) [∃ [wh [λd [neg [Mary drove d fast]]]] [λd [John drove d fast]]]

The interpretation of this structure is provided in (37): the existential quantifier takes the meanings of the standard clause (≈ the set of speeds at which Mary did *not* drive) and the matrix clause (≈ the set of speeds at which John drove) as its arguments, and conveys that there is a degree in their intersection (which is the case iff John drove faster than Mary).

(36) $(\llbracket\exists\rrbracket(\llbracket[\text{wh } [\lambda d \text{ [neg [M drove d fast]]]]}\rrbracket))(\llbracket[\lambda d \text{ [J drove d fast]]}\rrbracket) = 1$ iff
$\exists d [\neg(\text{speed(Mary)} \geq d) \wedge \text{speed(John)} \geq d]$ iff
$\text{speed(John)} > \text{speed(Mary)}$

This is represented graphically in Figure 1: the existential quantification gives us that the denotations of the matrix and the standard clause have a degree in common, which is possible if and only if John drove faster than Mary did (again, see Seuren 1973, Schwarzschild 2008 for comparatives).

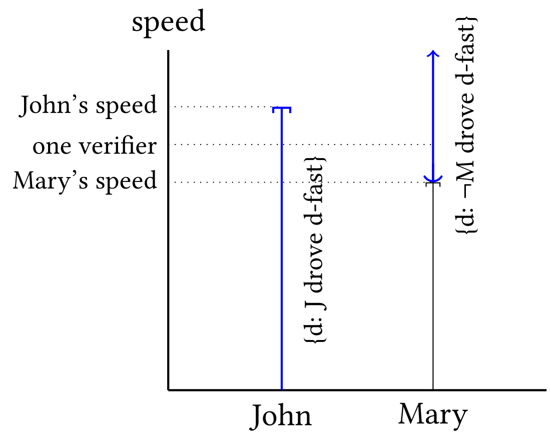

Figure 1: A representation of a possible state of affairs in which the existential quantification in (36) is verified, that is, in which there is a speed that John has but Mary does not.

The difference between English and Slovenian equatives is, we propose, in the availability of the parse in (35): it is available in Slovenian, but unavailable in English. We suggest that this is due to a variation in the properties of the degree *wh* in the standard clauses of equatives in the two languages: in English it is obligatorily accompanied by *max*, while in Slovenian it is accompanied by *max* only optionally (though *max* must be used even in Slovenian as a rescue mechanism to avoid pathological meanings when the standard clause lacks a DE operator).

(37) Variation in degree *wh* in standard clauses of equative constructions
   a. English: [max wh]
   b. Slovenian: [(max) wh]

4 Modification

How does multiplicative modification factor into the meaning of equatives? And why does it *prima facie* rule out occurrence of DE operators in the standard clauses of equatives in Slovenian? The idea underlying our proposal is that the culprit for the unacceptability of (38) is maximality.

(38) *Janez se je peljal dvakrat tako hitro [kot se Marija ni].
   '*John drove twice as fast as Mary didn't.'

But it cannot be maximality generated in the standard clause since we are assuming that this is optional in Slovenian. Rather, it is maximality induced by the multiplicative: a mutliplicative effectively requires its argument(s) to furnish a maximal element. In our paraphrase of the meaning of simple modified equative (39), given in (40), this is cashed out in terms of a maximality operator which takes the widest scope in the sentence (*the largest number*) .

(39) John drove twice as fast as Mary did.

(40) Two is less great than or equal to the largest number *m* such that
some speed *d* is such that
(i) John drove (at least) $m \times d$ fast, and
(ii) *d* is the largest speed such that Mary did drove (at least) that fast.

If there is no largest number *m* such that that there is a degree in the denotation of the standard clause *d* such that the largest degree in the matrix clause is $m \times d$, the sentence is predicted to be infelicitous. This is what we observe for the example in (38), which has the meaning in (41), repeated from (15).

(41) Two is less great than or equal to the largest number *m* such that
some speed *d* is such that
(i) John drove (at least) $m \times d$ fast, and
(ii) d is such that Mary did not drive (at least) that fast.

Namely, on the assumption of density, no multiplicative number *m* exists that would satisfy the above description: for every *m* and *d* that verify the two conditions in (41), we can find a lower d' (that is, $d > d' >$ Mary's speed) and, accordingly, a larger m' (that is, $m' > m$) such that they will verify the two conditions. Thus, the maximality inference induced at the matrix level in (41) results in an undefined meaning and is responsible for the unacceptability of (38).

Intricate predictions of the proposal are based on the observation that, in certain configurations involving modals in the standard clause, a largest multiplicative may in fact be found. This is illustrated in (42): there may exist a lowest speed such that John is not allowed to drive that fast (= minimal prohibited speed) and if such a speed exists, call it *d*, the number *m* such that $m \times d$ equals John's speed will be the required largest multiplicative. In such cases, modified equatives with a DE operator in the standard clause are predicted to be acceptable. This is borne out.

(42) Two is less great than or equal to the largest number *m* such that
some speed *d* is such that
(i) John drove (at least) $m \times d$ fast, and
(ii) d is such that he is not *allowed* to drive (at least) that fast.

Several choices need to be made in executing the above idea compositionally. There are two essential components to our execution: that multiplicative modifiers induce maximality, and that this maximality is computed above the standard clause, as indicated in the paraphrases in (41) and (42). More specifically, we opt for an implementation that (i) fits our assumptions about composition from the preceding section, and that (ii) is compatible with extant approaches to degree modification, especially, the approach put forward by Schwarzschild (2005).

Multiplicative head. Multiplicative modifiers can be used in constructions other than equatives. For example, the sentence in (43) contains a multiplicative head *times* that appears with two degree expressions, a number (*two*) and a measure phrase (*4m*). The meaning of the sentence is equivalent to that of (44).

(43) The length of this piece of wood is 2 times 4 meters.

(44) The length of this piece of wood is 8 meters

In order to analyze the sentence in (43), and to provide an adequate semantics of *times*, we first need to make an assumption about how the measure phrase *4m* is interpreted. In this, we will follow the proposal of Schwarzschild (2005) and take measure phrases to be quantifiers over degrees, specifically, to apply to degree predicates (or intervals) and return the value true if the extent of the degree predicate is at least as great as specified by the measure phrase:

(45) $[\![4\text{m}]\!](\text{D}) = 1$ iff $\mu(\text{D}) \geq 4\text{m}$

We can now assume that the sentence in (46-a) has to have the structure in (46-b), where *4m* moves for interpretability, and the interpretation in (47): this piece of wood measures at least 4m.

(46) a. The length of this piece of wood is 4 meters.
b. [4m [λd [the length of this piece of wood is d]]]

(47) $[\![4\text{m}]\!]([\![\lambda\text{d [the length of this piece of wood is d]}]\!]) = 1$ iff
$[\![4\text{m}]\!](\lambda\text{d. length(this-wood)} \geq \text{d}) = 1$ iff
$\mu(\lambda\text{d. length(this-wood)} \geq \text{d}) \geq 4\text{m}$ iff
$\text{length(this-wood)} \geq 4\text{m}$

Given this analysis of measure phrases, the multiplicative head *times*, which combines with the measure phrase, can be assigned the meaning in (48): it takes a multiplicative value *m* and a quantifier over degrees $\mathscr{D}$ as its arguments, and returns a new generalized quantifier over degrees true of a set of degrees *D* if the original quantifier ($\mathscr{D}$) was true of the set of degrees that you get by dividing the members of *D* by *m*.

(48) $[\![\text{times}]\!](\text{m})(\mathscr{D})(\text{D}) = 1$ iff $\mathscr{D}(\{\text{d} \mid \exists \text{d'} \in \text{D}\ [\text{d'} = \text{m} \times \text{d}\})$

If numerals would simply denote degrees, then sentence (43) would have the structure and interpretation in (49) and (50): the length of this piece of wood is at least 8m.

(49) [[[2 times] 4m] [λd [the length of this piece of wood is d]]]

(50) $([\![\text{times}]\!](2))([\![4\text{m}]\!]))([\![[\lambda\text{d [the length of this piece of wood is d]]}]\!]) = 1$ iff
$[\![4\text{m}]\!](\lambda\text{d. length(this-wood)} \geq 2 \times \text{d}) = 1$ iff
$\mu(\lambda\text{d. length(this-wood)} \geq \text{d}) \geq 8\text{m}$ iff
$\text{length(this-wood)} \geq 8\text{m}$

Numerals, however, we assume do not simply denote degrees.

Numerals. The interpretation we assume for a numeral is provided in (51). We assume that they apply to a predicate of degrees and convey that the maximal element in the predicate is at least as great as the respective number (see esp. Kennedy 2015).

(51) $[\![\text{two}]\!](D) = 1$ iff $\max(D) \geq 2$

Accordingly, the full structure of the sentence in (43) is the one provided in (52), where the numeral must move from its base position to the matrix level for interpretability (the elements contributed by the multiplied measure phrase are underlined). The meaning of the structure, given in (53), is equivalent to the one computed above: this piece of wood is at least 8m long.

(52) <u>[two [λn [[[n times] 4m]</u> [λd [the length of this piece of wood is d]]]]]

(53) $\max(\lambda n.\ \mu(\lambda d.\ \text{length(this-wood)} \geq d) \geq n{\times}4m) \geq 2$ iff
$\mu(\lambda d.\ \text{length(this-wood)} \geq d) \geq 8m$ iff
$\text{length(this-wood)} \geq 8m$

Modified equatives. Given these assumptions, the structure of a modified equative is provided in (55): the multiplicative phrase combines with the (existentially quantified) standard clause, which then applies to the matrix predicate (the elements contributed by the multiplicative are underlined). The numeral expression moves to adjoin to the matrix clause for interpretability.

(54) John drove twice as fast as Mary did.

(55) <u>[two [λn [[n times]</u> [∃ [wh [λd [max d] [λd' [M drove d' fast]]]]]] [λd [J drove d fast]]]]

The interpretation of the structure in (55) is provided in (56). The meaning that we get is that John's speed was at least twice as great as Mary's speed, which is the observed meaning.

(56) $\max(\lambda n.\exists d\ [d = \max(\lambda d.\ \text{Mary drove d-fast}) \wedge \text{speed(John)} \geq n{\times}d\ ) \geq 2$ iff
$\max(\lambda n.\ \text{speed(John)} \geq n \times \text{speed(Mary)}) \geq 2$ iff
$\text{speed(John)} \geq 2 \times \text{speed(Mary)}$

Importantly for our resolution of the second puzzle, it follows from our assumptions that (i) multiplicatives induce a maximality inference (encoded in the numeral) and that (ii) this maximality can only apply at the matrix level (crucially above the standard clause).

Second puzzle. If our analysis of multiplicatives and numerals is right, the sentence in (57) has the syntactic representation in (58).

(57) *Janez se je peljal dvakrat tako hitro se Marija ni.
'*John drove twice as fast as Mary didn't.'

(58) [two [λn [[n times] [∃ [wh [λd [neg [Mary drove d' fast]]]]]] [λd [John drove d fast]]]]

The structure in (58), however, does not have a defined meaning on the assumption that the set of degrees is dense. Specifically, there is no maximal degree in the set picked out by the sister to the numeral: the set of degrees *n* such that John's speed is greater than *n* times Mary's speed.

(59) $\max(\lambda n.\ \exists d\ [\neg(\text{speed(Mary)} \geq d) \wedge \text{speed(John)} \geq n{\times}d\ ) \geq 2$
$\Leftrightarrow \max(\lambda n.\ \exists d\ [d > \text{speed(Mary)} \wedge \text{speed(John)} \geq n{\times}d]) \geq 2$
$\Leftrightarrow \max(\lambda n.\ \text{speed(John)} > n \times \text{speed(Mary)}) \geq 2$

To see this, assume that we find such a maximal degree; call it *n*. So there must be a degree, call it *d*, such that *d* is greater than Mary's speed, and John's speed is equal to or greater than $n \times d$. But given density of measurement, there must be a degree between *d* and Mary's speed ($d > d' >$ Mary's speed). Cosequently, there must exists an n' that is greater than *n* such that John's speed is equal to $n' \times d'$. This contradicts the assumption that *n* is the maximal degree in the respective set. Consequently, the interpretation of the structure in (58) is undefined, hence unacceptable. This is graphically represented in Figure 2.

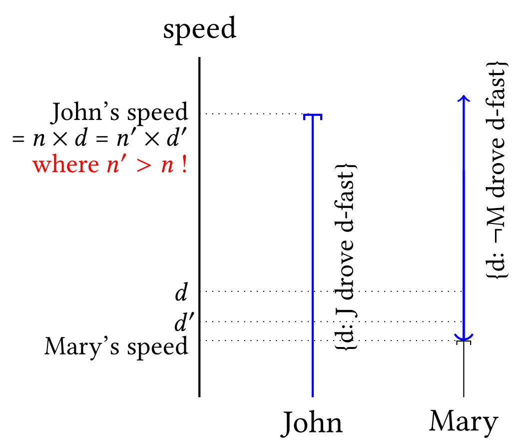

Figure 2: A representation illustrating that there is no maximal multiplicative that could modify the equative in (57) since there is no minimal degree in {d: ¬Mary drove d-fast}.

This resolves the second puzzle: the numeral that starts out in the multiplicative requires its prejacent to be able to furnish a maximal value; this is not possible on the assumption of density of measurement scales if the standard clause contains negation.

Prediction: Modal obviation. While indeed the nature of standard clauses in examples like **John drove twice as fast as Mary didn't* in Slovenian prevent there to be a maximal multiplicative that could be used in the sentence – due to the lack of a minimal degree in the standard clause –, this does not hold when there is an intervening existential modal between the negation and the abstracted over degree argument, or a universal modal c-commanding the DE operator. In these cases, the standard clause may furnish a minimal degree (cf. Fox & Hackl 2006).

In light of this, we predict that appropriately placing a modal in the standard clause of an equative that contains a negation may rescue an otherwise infelicitous multiplicative modification of the equative. This prediction is borne out, as we show with examples (60) and (61): in (60) negation occurs above an existential modal, while in (61) it occurs below a universal modal.

(60) Janez se je peljal dvakrat tako hitro [kot se ne bi smel].
John self aux drive twice dem fast than self neg aux allowed
'*John drove twice as fast as he wasn't allowed to.'

(61) Janez se je peljal dvakrat tako hitro [kot sem zahteval, da se ne pelje].
John self aux drive twice dem fast than aux.1sg demanded that self neg drive
'*John drove twice as fast as I demanded that he does not drive.'

The representations described in the preceding section yield licit interpretations. We discuss only the negation over the existential modal in the following since the case of universal modal taking scope above negation is semantically equivalent to it. Because the numeral must take scope at the matrix level, the sentence in (60) has the structure in (62). Its interpretation is given in (63): it corresponds to the proposition that the maximal degree *n* such that John's speed is at least as great as *n* times a prohibited speed is at least two. This corresponds to the perceived meaning of the sentence. Figure 3 illustrates the case where the standard clause indeed furnishes a minimal element, which consequently allows there to be a maximal multiplicative modifier for the equative sentence.

(62) [two [λn [[n times] [$\exists$ [wh [λd [neg [$\Diamond$ [M drove d' fast]]]]]]] [λd [J drove d fast]]]]]

(63) $\max(\lambda n.\ \exists d\, [\neg\Diamond[\text{speed(John)}\geq d] \wedge \text{speed(John)} \geq n\times d]) =$
$\max(\lambda n.\ \exists d\, [\Box[d > \text{speed(John)}] \wedge \text{speed(John)} \geq n\times d]) \geq 2$

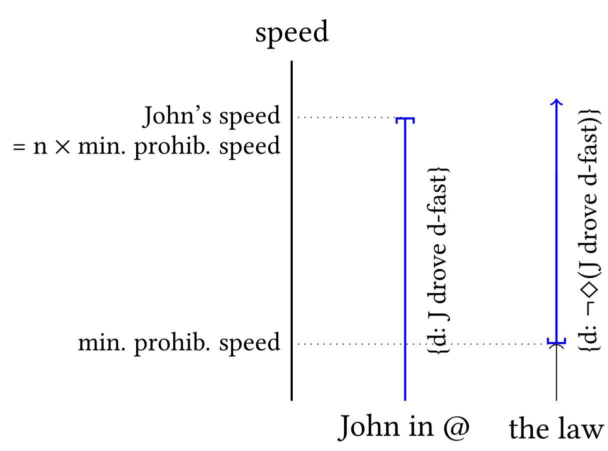

Figure 3: A representation illustrating that there may be a maximal multiplicative that modifies the equative in (60) since there can be a minimal degree in {d: ¬◇John drove d-fast}.

Importantly, if modals are placed differently, say, if a (non-neg-raising) universal modal is placed in the scope of negation rather than above it, the modified equatives are unacceptable, as exemplified in (64). This is again predicted by our proposal. Specifically, it follows from the fact that there cannot be a lowest speed such that John was not required to drive that fast – though there may be a lowest speed such that John was not allowed to drive that fast – and, accordingly, the application of *max* is undefined, as given in (65).

(64) *Janez se je peljal dvakrat tako hitro [kot ni bilo potrebno].
John self aux drive twice dem fast than neg.aux be required
'*John drove twice as fast as it wasn't required.'

(65) $\max(\lambda n.\ \exists d\ [\neg\Box[\text{speed(Mary)} \geq d] \wedge \text{speed(John)} \geq n \times d]) =$
$\max(\lambda n.\ \exists d\ [\Diamond[d > \text{speed(Mary)}] \wedge \text{speed(John)} \geq n \times d]) = \text{undefined}$

Thus, the approach that we put forward above receives further support from the impact that modals have on the interpretation and acceptability of modified equative sentences with negation in the standard clause. All in all, the patterns that we describe mirror the results of Fox & Hackl (2006) for modal obviation in other degree constructions. And this holds even though we stick to the classic notion of maximality.[4]

Lack of modal obviation in English. It is important to highlight that no modal obviation is predicted for English equative sentences under the assumptions outlined above. Recall that we proposed that the crucial difference between English and Slovenian is in the obligatory vs. optional presence of *max* in the standard clause, as repeated below.

(66) Variation in degree *wh* in standard clauses
a. English: [max wh]
b. Slovenian: [(max) wh]

[4]Another prediction of the proposal is that modal obviation may also be achieved by properly placing a modal in the matrix clause. For example, if a universal modal is generated in the matrix clause, and if the numeral takes scope above it, a modified equative with a DE operator in the standard clause may have a consistent interpretation, paraphrased in (i). This interpretation requires there to be a minimal speed such that Mary does not drive as fast as it in any of the possible worlds.

(i) Two is less great than or equal to the largest number *m* such that
it is *required* that some speed *d* is such that
(a) John drove (at least) $m \times d$ fast, and
(b) d is such that Mary did not drive (at least) that fast.

Tentatively, the predicted felicity appears to be borne out, as indicated in (ii), though further empirical study is mandated. The sentence in (ii) can be marginally used in a context in which, say, Mary is not driving 50mph (since she is driving a truck) but may be driving at any speed below 50mph. We can make sense of marginality by assuming that the numeral prefers to receive scope below the modal.

(ii) ?Janez se mora peljati dvakrat tako hitro kot se Marija ne.
John self must drive twice dem fast as self Mary not
'*John is required to drive twice as fast as Mary didn't.'

In the examples of modal obviation in modified equatives that we discussed, a consistent interpretation was possible because there was a parse of the sentence on which there was no *max* operator in the standard clause. This strategy is ruled out in English due to (66). Accordingly, the sentence in (67) may only have one of the representations in (68) and (69).

(67) *John drove (twice) as fast as he isn't allowed to.

(68) [two [λn [[n times] [∃ [λd [max d] [λd' [neg [◇ [Mary drove d' fast]]]]]] [λd [John drove d fast]]]]]

(69) [two [λn [[n times] [∃ [λd [neg [max d] [λd' [◇ [Mary drove d' fast]]]]]] [λd [John drove d fast]]]]]

Again, as discussed above, the problem with these structures is that they either have an undefined meaning, (68) (as originally pointed out by von Stechow 1984), or a tautologous meaning, (69).

This concludes our discussion of the two puzzles. We attributed the difference between English and Slovenian standard clauses with respect to whether they may contain a DE operator to whether a maximality operator must occur in the standard clause: this is the case in English, but not in Slovenian. Finally, modification of standard clauses by a multiplicative introduces a maximality operator into the interpretation of the equative, which is then acceptable only if the standard clause containing a DE operator also contains an appropriately placed modal. The summary of our assumptions and their consequences is in (70).[5]

(70) Summary of our proposal about equatives
   a. English: *max* obligatory; DE operators unacceptable.
   b. Slovenian: *max* optional; DE operators acceptable in the absence of *max*.
   c. Multiplicatives: *max* introduced by the numeral higher in the clause; DE operators acceptable only with appropriately placed modals.

[5] Penka (2010, 2016) discusses felicitous examples of DE operators in German equatives (see also von Stechow 1984). One such example is provided in (i).

(i) Hans ist so gross wie niemand sonst es ist.
John is as big as no one else it is
'*John is as tall as no one else is.'

A salient feature of all these examples seems to be that while negative indefinites and their ilk (*no one, never, not anymore*) are acceptable in them, plain negation is not. Although further empirical study is necessary (e.g., there may be a preference for phrasal variants of these sentences), one potential way of dealing with this variation would be to assume that German is just like what we propose for English, but that the *max* operator is not the one we adopt in the main text but rather *max* based on informativity. Namely, as discussed by Fox & Hackl (2006) and Abrusán & Spector (2011) for *how many* questions, on such a construal of *max*, negative indefinites may participate in obviation of maximality failures, as illustrated in (ii) (see Penka 2016 for a slightly different take).

(ii) How many children does none of these women have?

5 More on density

The facts about the distribution of DE operators in the standard clauses of equatives remain the same when we switch to examples that appear to be based on discrete scales. For example, consider (71). As with other examples discussed so far, the appearance of negation in the standard clause does not result in unacceptability, but rather in a comparative meaning indicated at the bottom of the example.

(71) Janez ima toliko otrok [kot jih Marija nima].
John has dem-many kids than them Mary neg.has
'*John has as many kids as Mary doesn't have.'
(⇔ John has more kids than Mary does.)

Inserting a multiplicative modifier in the structure results in unacceptability, as shown in (72). This is unexpected on the above proposal – unless the scale of measurement is dense. If the scale is the discrete scale of natural numbers, there would exist a minimal number *d* such that Mary does not have *d* children – this would be the smallest natural number such that Mary has fewer children than that number. Consequently, there would be a maximal multiplicative *n* with which you can multiply *d* and get the number of John's children. The sentence would have a consistent meaning and should be acceptable.

(72) *Janez ima dvakrat toliko otrok [kot jih Marija nima].
John has twice dem-many kids than them Mary neg.has
'*John has twice as many kids as Mary doesn't have.'

Furthermore, this unacceptability disappears in the presence of an appropriately placed modal in the standard clause. This is shown in (73), where there is an existential modal occurring in the scope of negation in the standard clause.

(73) Janez ima dvakrat toliko otrok [kot jih ne bi smel imeti].
John has twice dem-many kids than them neg aux allowed to have
'*John has twice as many kids as he is not allowed to have.'

On the other hand, if a modal is placed differently, say, if we replace the existential modal in (73) with a universal modal, the sentence is unacceptable (even in a context in which regulation about how many children you are (not) required to have would be sensible).

(74) *Janez ima dvakrat toliko otrok [kot jih ni potrebno imeti].
John has twice dem-many kids than them neg.aux required to have
'*John has twice as many kids as he is not required to have.'

These intricate patterns, which mirror those discussed in the preceding section, are naturally predicted on the assumption that all scales of measurement are dense, as argued by Fox & Hackl (2006) – and are mysterious otherwise. For this reason, we take the behavior of Slovenian equatives to provide yet further support for the universal density of measurement.

6 Comparatives

A translation of well-formed *John drove faster than Mary did* into Slovenian is provided in (75): the standard clause is headed by *kot*, which we find in the equative as well, while the adjective bears comparative morphology.

(75) Janez se je peljal hitreje [kot se je Marija].
Janez self aux drive faster than self aux Mary
'John drove faster than Mary did.'

When it comes to the distribution of DE operators in their standard clause, Slovenian comparatives behave just like their English counterparts: an occurrence of a DE operator, as in (76) and (77), makes the sentences are unacceptable.

(76) *Janez se je peljal hitreje [kot se Marija ni].
Janez self aux drive faster than self Marija neg.aux
'*John drove faster than Mary didn't.'

(77) *Janez se je peljal hitreje [kot se je malokdo].
Janez self aux drive faster than self aux few people
'*John drove faster than few people did.'

Now, if comparatives have a maximality-based semantics (von Stechow 1984, and many others following him), and if maximality is optional, just as in Slovenian equatives, this behavior is unexpected. However, either of these two assumptions may be dropped. First: we present Gajewski's (2008) account of the unacceptability of DE operators in the standard clauses of comparatives, an account that builds on a negation-based analysis of comparatives. Second: the unacceptability of DE operators can also be derived on maximality-based accounts, though we would need to assume that maximality is obligatory. We discuss potential motivations for this assumption. All in all, we remain agnostic about which of these two strategies is more adequate.

6.1 Negation-based analysis of comparatives

On one approach to comparison constructions, the difference between simple equative and comparative sentences lies solely in the degree operator occurring in the standard clause: while in equatives this is a maximality operator, in equatives this is a negative operator (see Schwarzschild 2008 for the same assumption about the difference between equatives and comparatives, and Seuren 1973, Gajewski 2008, Alrenga & Kennedy 2014 for discussion of comparatives). Accordingly, the sentence in (77) has the meaning along the lines of (78).

(78) *John drove faster than Mary didn't.

(79) Some speed *d* is such that
  (i) John drove (at least) *d* fast, and
  (ii) *d* is not such that Mary did not drive (at least) that fast.

(⇔ Mary drove (at least) *d* fast)

As pointed out by Gajewski (2008), this meaning is trivial in any context in which it is presupposed that John and Mary are driving at some speed, which may be the presupposition of sentence (78). This explains the unacceptability of DE operators in the standard clauses of comparatives.

Negative operator. More precisely, we can follow Seuren (1973), Schwarzschild (2008), Gajewski (2008), and others, in assuming that the standard clause of a comparative contains a negative operator. We define this operator as in (80). (Note that our characterization of the negative operator corresponds to Heim's 2006a *little* operator.)

(80) ⟦NEG⟧(d)(D) = 1 iff ¬[D(d)]

This means that the comparative sentence in (81) has the LF in (82): the degree *wh* starts in the complement of NEG, and both the NEG constituent and *wh* must move for interpretability at LF. (The structure obviously parallels that of equatives, given in (24), with NEG replacing *max*.)

(81) John drove faster than Mary did.

(82) [∃ [wh [λd [NEG d] [λd' [Mary drove d' fast]]]] [λd [John drove d fast]]]

The interpretation of (82) is provided in (83): there is a speed such that John drove at least that fast but Mary did not, that is, John's speed is greater than Mary's speed.

(83) ∃d [John drove d-fast ∧ ¬Mary drove d-fast]

DE operators in comparatives. If a DE operator occurs in the standard clause, as in (84), the sentence has an interpretation that is trivial, given in (86). Namely, it merely conveys that there is a speed such that John and Mary drove at least as fast as that speed. This is true in any context in which John and Mary drove, which is arguably the presupposition of the sentence.

(84) *John drove faster than Mary didn't.

(85) [∃ [wh [λd [NEG d] [λd' [neg [Mary drove d fast]]]]]] [λd [John drove d fast]]

(86) ∃d [John drove d-fast ∧ Mary drove d-fast]

Unlike in the case of equatives, dropping the negative operator is not an option. This is because if we were to drop the negation in (85), we would obtain the representation in (87). This corresponds to an equative structure and should be spelled out as such.

(87) [∃ [wh [λd [neg [Mary drove d fast]]]]] [λd [John drove d fast]]

***Max* as a rescue mechanism?** An assumption of another *max* operator in the structure in (85), as given in (89), would, however, yield a contingent interpretation. This is computed in (90): the two negation operators cancel each other out, so the meaning that we obtain is that John drove at least as fast as Mary did. Note, however, that this meaning is equivalent to that of an equative structure that lacks either a NEG or a *max* operator, as discussed above.

(88) *John drove faster than Mary didn't.

(89) [∃ [wh [λd [NEG d] [λd' [neg [[max d'] [λd" [M drove d" fast]]]]]]] [λd [J drove d fast]]

(90) ∃d [d = max(λd. Mary drove d-fast) ∧ speed(John) ≥ d]

We suggest that this equivalence between equatives and comparatives with DE operators in the standard clause would be problematic. More specifically, the sentence on this parse should be as unacceptable as the sentence in (91-a) (Spector 2014a; cf. also Magri 2009, 2011, Meyer 2013). In (91), we have two contextually equivalent sentences. The structurally more complex one, (91-a), is marked.

(91) [Context: Talking about two children who are brothers and sisters and have no other siblings. Obviously they share their last name.]
   a. #Both of these kids have a beautiful last name.
   b. These kids have a beautiful last name.

While the precise reason for the markedness of the above example is debatable and the range of such data needs to be further investigated (see Meyer 2013, Spector 2014a for related discussion), the following descriptive generalization is good enough for our purposes (where S' is a structural alternative to S iff S' can be derived from S by substituting constituents of S' with its subconstituents, or with elements from the lexicon, Katzir 2007). Thus, since the structure in (88) would violate the principle in (91) – namely, it would have the same meaning as its alternative that lacks the two negation operators – it is ruled out.

(92) Condition on felicity:
   If S is strictly simpler than S', and S and S' are contextually equivalent, S' is unacceptable. [where S is strictly simpler than S' iff S is a structural alternative of S' and S' is not a structural alternative of S', see Katzir 2007]

This constitutes one potential account of the asymmetry between Slovenian equative and comparative sentences with respect to acceptability of DE operators in the standard clause. This difference springs from the fact that comparatives already contain a DE operator and having another one results in a trivial interpretation (as proposed by Gajewski 2008).

6.2 Maximality-based analysis of comparatives

If we adopt a maximality-based analysis of comparatives, the behavior of DE operators in their standard clauses would be correctly predicted by stipulating that the maximality operator occurs obligatorily therein, unlike in Slovenian equatives. We show this in a simple extension of the above proposal. We conclude the section by discussing a potential motivation for this stipulation.

Comparatives and differentials. Our starting point are modified comparative sentences. Consider the sentence with a differential modifier *10mph* in (93): it conveys that John's spead is at least as great as Mary's speed plus 10mph, as given in (94).

(93) John drove 10 mph faster than Mary did.

(94) $\exists$d [speed(John) $\geq$ d $\wedge$ d = max(λd. Mary drove d-fact)+10mph]

Building on our analysis of equative sentences, and on our assumptions about measure phrases, this meaning can be captured if we assign the sentence the structure in (95), which mirrors closely the structure that we assigned to equative sentences modified by multiplicatives. In this structure, the differential phrase attaches to the standard clause (the material corresponding to the differential modifier is underlined).

(95) <u>[10mph [λm [[diff m]</u> [$\exists$ [wh [λd [max d] [λd' [M drove d' fast]]]]]] [λd [J drove d-fast]]]]

We define *diff* as a modifier of quantifiers over degrees, in parallel to our treatment of the multiplicative head *times*: it takes a degree *m* and a quantifier over degrees $\mathscr{D}$ as its arguments, and returns predicates over degrees *D* such that subtracting *m* from every element in *D* yields a predicate of which $\mathscr{D}$ holds.

(96) $[\![$diff$]\!]$(m)($\mathscr{D}$)(D) = 1 iff $\mathscr{D}$({d | $\exists$d'$\in$D [d' = m+d]})

With this characterization in hand, we can compute the meaning of the structure in (95), which is that John's speed is greater than or equal to Mary's speed plus 10 mph. The meaning of *10mph* parallels what we assign to other measure phrases, cf. (45) above.

(97) $[\![$10mph$]\!]$(λm. $\exists$d [d = max(λd. Mary drove d-fast) $\wedge$ speed(John) $\geq$ m+d]) = 1 iff
μ(λm. $\exists$d [d = max(λd. Mary drove d-fast) $\wedge$ speed(John) $\geq$ m+d]) $\geq$ 10mph iff
μ(λm. speed(John) $\geq$ max(λd. Mary drove d-fast)+m) $\geq$ 10mph iff
speed(John) $\geq$ speed(Mary) + 10 mph

In cases in which there is no overt differential modifier, such as (98), we continue to assume that a differential modifier is present, though it is covert, and its degree argument is subject to existential closure (cf. e.g. von Stechow 1984). This means that the sentence in (98) has the representation in (99). (We do not introduce another existential quantifier into our representations, but rather indicate existential closure by using *d**.)

(98) John drove faster than Mary did.

(99) [[diff d*] [$\exists$ [wh [λd [max d] [λd' [Mary drove d' fast]]]]]] [λd [John drove d-fast]]

The meaning of the sentence in (99) on our above assumptions corresponds to the standard comparative meaning, as computed in (100): John's speed is at least as great as Mary's speed plus some other speed.

(100)$\exists d^*$ [speed(John) $\geq$ speed(Mary)+d^*]

Maximality and DE operators. If the maximality operator obligatorily occurs in the standard clause of a comparative, DE operators should not be able to occur in the standard clause of a comparative. We are thus left with the following representation of a sentence like **John drove faster than Mary didn't* and its Slovenian counterpart:

(101) [[diff d*] [∃ [wh [λd [neg [Mary drove d fast]]]]]] [λd [John drove d-fast]]

The meaning of the structure is defined and consistent, as given in (102): John's speed is greater than Mary's speed. Significantly, on the assumption of density of measurement, this meaning is equivalent to the meaning of the parallel equative sentence, (35), repeated below.[6]

(102) $\exists d$ [$d >$ speed(Mary) $\wedge$ $\exists d'$ [speed(John) $\geq d+d'$]]
$\Leftrightarrow$ speed(John) $>$ speed(Mary)

(103) $\exists d$ [$\neg$(speed(Mary)$\geq d$) $\wedge$ speed(John) $\geq d$]
$\Leftrightarrow$ speed(John) $>$ speed(Mary)

Since (76) is unacceptable, the representation in (101) must for some reason be unavailable. We already encountered one potential reason above: the unacceptability of (76) can be taken to result from the deviance of structurally more complex expressions that have meanings that are contextually equivalent to those expressed by their simpler counterparts (Katzir 2007, Meyer 2013, Spector 2014b; though see footnote 6).

More specifically, we suggest that the unacceptability of the comparative is covered by the condition in (92). Specifically, the comparative structure in (101) has the equative structure in (104) as a formal alternative (the latter lacks a *diff* phrase). Since the two are contextually equivalent, the comparative is unacceptable according to (92).[7]

[6]An alternative explanation of why DE operators are unacceptable in standard clauses of comparatives, one that also capitalizes on the obligatory presence of a covert differential modifier in comparatives, may build on the intuition expressed in Section 4: that numerals and perhaps measure phrases more generally require there to be a determinate object whose extent they specify or measure. Accordingly, since comparatives, in contrast to equatives, are always accompanied by a differential and, consequently, a potentially existentially closed measure operator (corresponding to the denotation of a measure phrase), they effectively always require the existence of a maximal element in the set modified by the (existentially closed) measure operator. This is impossible if the standard clause contains a DE operator (at least in the absence of an appropriately placed modal). This type of approach builds on the same features of comparatives that we do, and is not obviously empirically distinguishable from what we say in the main text.

[7]In cases where there is a minimal element in the meaning of the standard clause – that is, in modal obviation cases – the two constructions have slightly different meanings: the equative conveys that the matrix predicate holds of this minimal element, while the comparative conveys that the matrix predicate holds of the minimal element plus some differential degree. And since the two meanings are not equivalent (the latter is stronger than the former), we predict that the comparative may be acceptable (at least if the context admits the pertinent minimal element). This prediction is tentatively borne out, though further empirical study is mandated.

(i) [Scenario: there is a minimal prohibited speed, say, 50 mph.]
?Janez se je peljal hitreje [kot se ne bi smel].
John self aux drive faster that self neg aux allowed

(104)[∃ [wh [λd [neg [Mary drove d fast]]]] [λd [λd [John drove d fast]]]]

On the other hand, since an equative sentence with a DE operator in the standard clause does not have the comparative sentence as a structural alternative – namely, you cannot get from the equative sentence to the comparative one by merely replacing its constituents with their subconstituents or elements from the lexicon –, nor any other alternative that would be contextually equivalent to it, it is not supposed to be marked according to the condition in (103). This explains why comparatives, but not equatives, with DE operators in their standard clauses are unacceptable.

Scalar implicatures of equatives. There is an issue facing this approach: equatives tend to trigger the inference that the comparative variant of the sentences is false, as described in (105).

(105) John drove as fast as Mary did.
⇝ John did not drive faster than Mary did.

This inference bears the signature of a scalar implicature (say, it can be cancelled, and it disappears in the scope of DE opeators). It is standardly derived by negating the comparative alternative of the sentence (cf., e.g., Rett 2014, and many others). The assumption that equatives are less complex than comparatives (and thus that the latter are not structural alternatives to the former) makes the derivation of the scalar implicature in (105) difficult, however.

One way of dealing with this difficulty is to assume that an equative sentence may have a parse with a covert multiplicative modifier (paraphrasable with *one time*), as given in (106). (We do not assume that the covert degree argument of the modifier needs to move out of its base position, like numerals do, though this is not crucial.)

(106) [[times 1] [∃ [wh [λd [[max d] [λd' [Mary drove d' fast]]]]]] [λd [John drove d-fast]]

This structure has structures in which 1 is replaced by a higher number as alternatives. All of these alternatives have a stronger meaning than (106), and may thus be negated by the mechanism responsible for generating scalar implicatures. Accordingly, the equative sentence is correctly predicted to have an implicature along the lines of (105): John drove as fast as Mary did, and he did not drive n times as fast as she did, for every $n > 1$ – which is equivalent to John driving exactly as fast as Mary did. In order to derive the preference to generate such an implicature, we would have to assume that structures like (106) constitute the preferred parse of an equative sentence (perhaps due to having a stronger meaning once the scalar implicature is factored in).

This constitutes the second potential account of the asymmetry between Slovenian equative and comparative sentences with respect to acceptability of DE operators in the standard clause. Specifically, on a maximality-based approach to comparatives, an instance of which we sketched above, the unacceptability of DE operators in the standard clauses of comparatives would be expected if maximality in the standard clause were obligatory. Rather than providing a reason for this obligatoriness, we sketched a possible reason for why comparatives that contain a DE opera-

'*John drove faster than he wasn't allowed to.'

tor and lack *max* might be ruled out on economy grounds – their meanings would be equivalent to those of their structurally simpler alternatives, the equatives.

7 Conclusion

Slovenian equatives exhibit behavior that is quite different from their English counterparts as well as from comparatives in both languages: their standard clause may contain a DE operator that c-commands the abstracted over degree argument. However, this holds only if the equative is not modified by a multiplicative. If it is modified, the equative is unacceptable unless it contains an appropriately placed modal in the standard clause.

	English	Slovenian
Equatives with DE operators	*	✓
Modified equatives with DE operators	*	* (✓ modal obviation)

Table 2: The acceptability of DE operators in standard clauses of equative constructions.

Building on the approach of von Stechow (1984) to these issues, we argued that this behavior supports the proposal that maximality – which plays the central role in ruling out DE operators in the standard clause – should neither be encoded in the lexical semantics of the comparison operators (*pace* von Stechow 1984), nor in the lexical semantics of adjectives (*pace*, e.g., Schwarzschild & Wilkinson 2002, Beck 2012, Dotlačil & Nouwen 2016). Rather, it is realized by a separate morpheme. And there may be cross-linguistic variation with respect to whether this morpheme is obligatory in the standard clause of a comparison construction. In particular, this morpheme occurs obligatorily in English, but not Slovenian, standard clauses, as captured in (107).

(107) Variation in degree *wh* in standard clauses of equative constructions
  a. English: [max wh]
  b. Slovenian: [(max) wh]

Furthermore, the effect of multiplicative modification is derived if we assume that numerals in degree modifiers require the predicate they modify to at least potentially furnish a maximal degree. This is not possible if the equative contains a DE operator in the standard clause (but no appropriately placed modal). Finally, we suggested that DE operators are unacceptable in standard clauses of comparatives because they either give rise to trivial meanings or they run afoul of independent pragmatic principles, depending on the theory of comparatives.

A crucial ingredient in our proposal was the assumption that the scales of measurement are dense. Since the intricate patterns that we describe obtain also with equatives based on apparently discrete scales, we are lead to believe that the appearance of discreteness is misleading, and that density of measurement should be assumed to be universal (Fox & Hackl 2006).

Last but not least: another set of arguments that may support splitting maximality off from the lexical semantics of degree operators has been prominently discussed in recent years: the interpretation of quantifiers in standard clauses of comparison constructions (see esp. Heim 2006b).

While the proposal that we put forward does not capture all the intricacies observed in the literature on this topic, we believe that this could be achieved by incorporating into our proposal a more sophisticated treatment of maximality. We cannot pursue this issue further here, not least since we think this pursuit is likely to obscure our main proposal.

References

Abrusán, Márta & Benjamin Spector. 2011. A semantics for degree questions based on intervals: Negative islands and their obviation. *Journal of Semantics* 28.

Alrenga, Peter & Christopher Kennedy. 2014. No more shall we part: Quantifiers in English comparatives. *Natural Language Semantics* 22(1). 1–53.

Beck, Sigrid. 2012. DegP scope revisited. *Natural Language Semantics* 20(3). 227–272.

Beck, Sigrid. 2014. Plural predication and quantified 'than'-clauses. In Luka Crnič & Uli Sauerland (eds.), *The Art and Craft of Semantics: A Festschrift for Irene Heim*, vol. 1, 91–115. MITWPL.

Brame, Michael. 1983. Ungrammatical notes 4: Smarter than me. *Linguistic Analysis* 12. 323–328.

Chomsky, Noam. 1976. Constraints on rules of grammar. *Linguistic Analysis* 2. 303–351.

Dotlačil, Jakub & Rick Nouwen. 2016. The comparative and degree pluralities. *Natural Language Semantics* 24(1). 45–78.

Fleisher, Nicholas. 2016. Comparing theories of quantifiers in* than* clauses: Lessons from downward-entailing differentials. *Semantics and Pragmatics* 9.

Fox, Danny & Martin Hackl. 2006. The universal density of measurement. *Linguistics and Philosophy* 29. 537–586.

Fox, Danny & Roni Katzir. 2011. On the characterization of alternatives. *Natural Language Semantics* 19(1). 87–107.

Gajewski, Jon. 2008. More on quantifiers in comparative clauses. In *Semantics and Linguistic Theory*, vol. 18, 340–357.

Geurts, B. & R. Nouwen. 2007. *At least* et al.: the semantics of scalar modifiers. *Language* 83(3). 533–559.

Heim, Irene. 2000. Degree operators and scope. In *Proceedings of SALT 10*, 40–64. CLC Publications, Cornell University.

Heim, Irene. 2006a. Little. In *Proceedings of SALT*, vol. 16, 35–58.

Heim, Irene. 2006b. Remarks on comparative clauses as generalized quantifiers. Manuscript, MIT.

Katzir, Roni. 2007. Structurally defined alternatives. *Linguistics and Philosophy* 30. 669–690.

Kennedy, Christopher. 2015. A "de-fregean" semantics (and neo-gricean pragmatics) for modified and unmodified numerals. *Semantics and Pragmatics* 8(10). 1–44.

Magri, Giorgio. 2009. A theory of individual level predicates based on blind mandatory scalar implicatures. *Natural Language Semantics* 17. 245–297.

Magri, Giorgio. 2011. Another argument for embedded scalar implicatures based on oddness in downward entailing environments. *Semantics and Pragmatics* 4(6). 1–51.

Meyer, Marie-Christine. 2013. *Ignorance and Grammar*: Massachusetts Institute of Technology dissertation.

Nouwen, Rick. 2010. Two kinds of modified numerals. *Semantics and Pragmatics* 3.

Penka, Doris. 2010. *Negative indenites.* Oxford: Oxford University Press.

Penka, Doris. 2016. Degree equatives - the same as comparatives? Slides at the Workshop on Equatives.

Rett, Jessica. 2014. Measure phrase equatives and modified numerals. *Journal of Semantics* ffu004.

Rullmann, Hotze. 1995. *Maximality in the semantics of wh-constructions*: University of Massachusetts Amherst dissertation.

Schwarz, Bernhard, Brian Buccola & Michael Hamilton. 2012. Two types of class b numeral modifiers: A reply to nouwen 2010. *Semantics and Pragmatics* 5.

Schwarzschild, Roger. 2005. Measure phrases as modifiers of adjectives. *Recherches linguistiques de Vincennes* (34). 207–228.

Schwarzschild, Roger. 2008. The semantics of comparatives and other degree constructions. *Language and Linguistics Compass* 2(2). 308–331.

Schwarzschild, Roger. 2010. Comparative markers and standard markers. In Michael Y. Erlewine & Yasutada Sudo (eds.), *Proceedings of the MIT Workshop on Comparatives*, vol. 69, 87–105. MIT Working Papers in Linguistics.

Schwarzschild, Roger & Karina Wilkinson. 2002. Quantifiers in comparatives: A semantics of degree based on intervals. *Natural language semantics* 10(1). 1–41.

Seuren, Pieter AM. 1973. The comparative. In *Generative grammar in Europe*, 528–564. Springer.

Spector, Benjamin. 2014a. Global positive polarity items and obligatory exhaustivity. *Semantics and Pragmatics* 7(11). 1–61.

Spector, Benjamin. 2014b. Scalar implicatures, blindness and common knowledge – comments on magri (2011). In Salvatore Pistoia Reda (ed.), *Pragmatics, Semantics and the Case of Scalar Implicatures*, 146–169. Palgrave Macmillan.

von Stechow, Arnim. 1984. Comparing semantic theories of comparison. *Journal of semantics* 3(1). 1–77.

Toporišič, Jože. 2006. *Besedjeslovne razprave.* ZRC SAZU.