Damien Fleury and Lucia M. Tovena — Université Paris Cité

Extending the benchmark for the monotonicity of superlatives

Bumford and Sharvit (2022) claimed to give a benchmark for testing the monotonicity properties of definite superlatives. Their discussion does not include approaches to modal superlatives though, e.g. *Mary was the nicest possible*. This paper takes up from there. We cross examine the monotonicity of the modal superlative operators recently proposed by Loccioni (2018, 2019)—and Romero (2013) she relies on—and Tovena and Fleury (2023, 2024). They pass the test, but the matter goes beyond that. The empirical issue of the licensing power of superlatives is back on the agenda (see Hoeksema 2012 i.a.), as well as the issue of the characterisation of their logical properties.

Highlights from Bumford and Sharvit (2022) Let's recall some key points from Bumford and Sharvit's exam of three superlative operators. The first one, called est^{vF} and taken from von Fintel (1999) and Gajewski (2010), applies to a degree predicate R of type $\langle d,et\rangle$ that relates individuals and degrees, a property of entities P, and an entity x. It states that x is the entity who attains the highest degree (via R) among the entities who are P. When combined with R, the operator has the right monotonicity properties to license NPIs. However, it is devised for the absolute reading of the superlative, and Bumford and Sharvit do not succeed in adapting it to the relative reading. The second operator, est^{H1} from Heim (1999), applies to a predicate of degrees R of type $\langle d,et\rangle$ and to an entity x. Operator est^{H1} collapses in predicate R the information that an entity both reaches a degree d and is in the extension of some specific property. It indicates that x is the entity that reaches the highest degree (via R). Such an operator allows for both absolute and relative readings of the superlative, but does not have the right monotonicity properties. The third operator, est^{H2} also from Heim, applies to a collection C of (intensional) degree properties of type $\langle s,dt\rangle$ and to an element P of this collection. It states that P is the property associated with the greatest degree in the world of evaluation, among the properties of collection C. Such C plays the role of comparison class and can be expressed as a sort of relative clause in the case of a construction with antecedent-contained deletion (ACD). This operator est^{H2} has the right monotonicity properties, but Bumford and Sharvit try without success to adapt it to allow for an absolute reading in such a construction. In short, their assessment of existing proposals is rather negative. They propose an alternative version that does not cover modal superlatives, we therefore do not discuss it.

Loccioni (2019) and Romero (2013) Our review of modal superlatives starts with Loccioni (2019) and Romero (2013), who adopt a version of the operator est^{H2} from Heim for modal superlatives, at least nominally. They base their analyses on constructions with ACD, although they differ on how they go about in constructing the antecedent. They first collect degrees reached by entities in possible worlds into a set without keeping track of who/where reached them. Then, i) Romero aims at interpreting *possible*+gap$_{ACD}$ as an amount relative. She raises this set from type $\langle d, t\rangle$ to type $\langle dt, t\rangle$ so that an est^{H2}-like operator can apply, and compare the degree properties with one property in the real world, and get the modal superlative interpretation for the attributive use. ii) Loccioni (2018, 2019) aims at building a degree phrase that is a free relative denoting a single maximal degree. She uses the set to identify the maximal degree reached across possible worlds, which is then verified by a degree property in the real world, to get the modal superlative interpretation for the predicative use. Their superlative operators have the right monotonicity properties (shown in the talk). Loccioni (2019) and Romero do not tackle NPI licensing, but Loccioni (2018) points out that superlatives are licensors in English but not in Italian and Spanish.

However, there are semantic and compositional problems in their analyses, as noted by Tovena and Fleury (2024). First, Romero and Loccioni (2019) only provide interpretations with the

strong constraint that the individuals considered through possible worlds necessarily have a counterpart in the actual world. For instance, in the predicative example *Lenuccia is the kindest possible*, in Loccioni (2019), the kindness of Lenuccia in the actual world is compared to the kindness of "herself" in possible worlds. Romero compares John climbing a mountain in possible worlds just to John climbing a mountain in the actual world, in the attributive example *John climbed the highest possible mountain*. A constraint that boils down to having a counterpart is there in the so-called generic case too, where Romero implements a wide scope universal $\forall y$ on individuals. Second, by introducing sets of degrees (type $\langle d,t\rangle$), or sets of degree properties (type $\langle dt,t\rangle$), Loccioni (2019) and Romero lose information on the relation between individuals, worlds and amounts. These shortcomings in the way information is collected and used are arguably due to the ACD approach to modal superlative clauses, broadly adopted since Larson (2000). One question for syntacticians is whether an alternative syntactic analysis can be found.

Tovena and Fleury (2024) Tovena and Fleury's analysis (2023, 2024) relies on a comparison class that is an equivalence relation of world-individual pairs sorted by the amount they are associated with. The class is built using a function F that represents necessary and sufficient information to carry out the comparison, see (1a), and is distinct from the modal superlative operator SUP responsible for the comparison itself, see (1b).

(1) a. $F : \lambda c' \lambda q' [\, c' = \{(w', x') : w' \in Acc(w) \wedge Q(w', x', q')\}]$

b. $\text{SUP}_{mod} : \lambda F \lambda x [\, \exists q [\, \exists c [\, (w, x) \in c \wedge F(c)(q)] \wedge \forall c' [\, (\exists q' [F(c')(q')] \wedge c \neq c') \rightarrow q' < q]]]$

F associates an amount with a set of world-individual pairs grouped into equivalence classes and can work as a comparison class. Q in (1a) expresses the restriction verified for any individual in any world, without hierarchising the two. Grouping world-individual pairs by amount in c' reflects the equative reading. SUP expresses the facts that for a given function F and entity x, there exists one amount q associated with x, and that amounts associated with the other x' are smaller. Note that in (1b), the two distinct classes c and c' are necessarily associated (via F) with distinct amounts. The formalisation of the condition $c \neq c'$ and of the strict inequality $q' < q$ are somewhat redundant but allow a uniform approach to the SUP operators when considering the cases of ordinary superlatives for which some of the entities being compared may happen to be associated with the same amount. By construction, F keeps information on the relation between individuals x', groups c' of world-individual pairs and amounts q'. This makes possible the abstraction λx, which is not available in est^{H2} style. Before we test the monotonicity properties of SUP_{mod}, (1b) is revised as in (2a). The subformula that makes it possible to associate the amount q with the equivalence class of pairs of individual x in evaluation world w, is a presupposition of existence of q (2b), and has to be taken out, in line with von Fintel (1999).

(2) a. SUP_{mod} (revised) : $\lambda F \lambda x [\, \forall q, q', c' [\, (\exists c [(w, x) \in c \wedge F(c)(q) \wedge F(c')(q') \wedge c \neq c']) \rightarrow q' < q]]]$

b. Presupposition : $\exists q [\, \exists c [\, (w, x) \in c \wedge F(c)(q)]]$

To prove that the operator SUP_{mod} is Strawson downward-entailing (SDE), assume the Strawson entailment $F_1 \Rightarrow F_2$. The antecedent of the implication in (2a) expressed for F_1 implies the antecedent expressed for F_2, which is the key to demonstrating $\text{SUP}_{mod}(F_2) \Rightarrow \text{SUP}_{mod}(F_1)$. Conversely, suppose $F_1 \Rightarrow F_2$, with $F_1 \neq F_2$. Then, there necessarily exists a class c^* and an amount q^* s.t. $F_2(c^*, q^*)$, and there exists no c' satisfying $F_1(c', q^*)$. Take the particular case where q^* is greater than all the amounts q' reached by F_1. Let entity x be s.t. $\text{SUP}_{mod}(F_1)(x)$. Such x reaches a certain amount q' which is strictly less than $q*$. Hence, we cannot have $\text{SUP}_{mod}(F_2)(x)$, and this shows that SUP_{mod} is not SUE.

Discussion Loccioni (2018) applies the -ER operator (*più*) to get and order equivalence classes of individuals with the same degree, when dealing with absolute superlatives. When dealing with modal superlatives, *più* orders just degrees, because the information on their association with individuals has been lost, and with that is lost the notion of equivalence class. Equivalence

classes are also the strategy adopted by Tovena and Fleury (2024), but they are built by grouping world-individual pairs, and are used for the semantics of the modal superlative operator. The result preserves the level of information needed to get the right truth conditions without using ACD. The monotonicity properties of the operator are not tackled, but one can get the right properties by taking out the presupposition, as we proposed in (2b).

The proof presented above applies Strawson entailments to the function F from equivalence classes to amounts, i.e. a rather abstract function. The question arises as to the degree of abstraction at which the monotonicity properties must be verified. We note that it feels difficult to come up with linguistic examples of functions F_1 and F_2 as defined in (1a) that are in a Strawson entailment relation $F_1 \Rightarrow F_2$. Technically speaking, this is because this relation involves equivalence classes, and whenever the accessibility function Acc or the predicate Q are altered for the purpose of monotonicity checking, the content of the equivalence class associated with a given amount q is affected. However, an entailment relation can still be verified at the level of the world-individual pairs (w', x') which themselves remain directly accessible using the function F, rather than at the level of the equivalence classes c' that contain them. The world-individual pairs (w', x') that we need to consider are the elements of the equivalence classes in the first argument of F, and the amounts associated to these world-individual pairs are the amounts associated to the equivalence classes by the function F. There is no loss of information and no need to make a copy of any content of the sentence to retrieve this information, as per ACD. The entailment can be expressed as follows: if (w', x') belongs to class c_1 associated with amount q via function F_1, then (w', x') belongs to some class c_2 associated with amount q via function F_2. However, it is not required that all pairs (w'', x'') in c_2 belongs to c_1. At the more abstract level of equivalence classes, this entailment relation can be expressed as follows: if $F_1(c_1)(q)$, then there exists c_2 s.t. $c_1 \subseteq c_2$ and $F_2(c_2)(q)$, noted $F_1 \overset{\bullet}{\Rightarrow} F_2$. We will show that this relation between F_1 and F_2 implies the Strawson relation $\text{SUP}_{mod}(F_2) \Rightarrow \text{SUP}_{mod}(F_1)$. In this sense, SUP_{mod} verifies the SDE property at the level of world-individual pairs, while it verifies a quasi-SDE property only at the more abstract level of equivalence classes.

The discussion can be pursued in at least two directions, as we might want i) to vary the entailments by plugging in tests that take up Zwarts (1998) hierarchy, or ii) to look at empirical facets of the NPIs licensing power. The (modal) superlative operators discussed all have the right monotonicity properties, but they do not seem to license NPIs in all languages (Corblin and Tovena 2003, Hoeksema 2012, Loccioni 2018 i.a.), and evidence of NPIs licensed by modal superlatives is scanty. We conclude by discussing the (rare) example [(35i)] from Bumford and Sharvit, given in (3), where the modal superlative interpretation seems available with *any*, despite *possible* being prenominal and doubts concerning whether *any* is NPI or free choice.

(3) Our goal with this satellite is to capture the best possible image of any asteroid in the Kuiper Belt

In (3), an accessible world in which a carbonaceous asteroid image of quality q is captured is a fortiori an accessible world in which an asteroid image of such quality q is captured. If the best asteroid image is captured, and if this is a carbonaceous asteroid image, then we can say that the best carbonaceous asteroid image is captured. If *any* is actually an NPI, then the SUP_{mod} operator seems to have the SDE property, at the level of world-individual pairs. Note that the modification expressed by *any* in this example concerns the predicate *asteroid*, which is part of the restriction on the type of situation expressed by the predicate Q and constitutes a restriction on the individuals in the accessible worlds (Tovena and Fleury, 2024). The use of an NPI for the modality, although seemingly difficult, should not be completely ruled out. A study of a corpus of modal superlatives will make it possible to determine the interest of quasi-SDE property, and to verify which phenomenon this property could reflect in the language.

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