The anatomy of Chinese Superlative Modifiers

The case of Q-adjectives

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This paper studies the morpho-semantics of a particular class of scalar focus adverbs called Superlative Modifiers (SMs). One key feature of these scalar focus adverbs is that they bear degree morphology, along with gradable adjectives involved. Most analyses of SMs in the market do not take into consideration the semantic contributions of their morphology. However, the cross-linguistic facts strongly suggest that the morphological makeup of SMs cannot simply be a linguistic coincidence. Thus, SMs have posed a long-standing and intriguing morpho-semantic puzzle: Why do SMs morphologically involve a quantity adjective (Q-adjective) and the superlative morpheme? What is the role of Q-adjectives and the superlative morpheme inside SMs? How are these morphological pieces of SMs connected with their semantics? This paper is dedicated to these questions by focusing on two expressions of Mandarin SMs, *zui-duo* and *zui-shao* (which morphologically consist of only the superlative morpheme *zui* and a quantity adjective *duo* 'many/much' or *shao* 'few/little'), and presents a decompositional analysis of both expressions as modified superlatives.

If the proposed analysis is on the right track, it shows that insights and tools developed in studies on gradability (Kennedy 1999) can be applied to those on scalarity. Recently, Greenberg (2016; 2017) has argued for a gradability-based semantics of English *even*. This paper contributes to this growing research agenda, through a detailed case study of SMs, a class of scalar focus adverbs but bearing degree morphology and gradable adjectives. Moreover, this paper also deepens our understanding of the semantics of Q-adjectives. By studying SMs, this paper shows that the measured domain of Q-adjectives need not be structured by the part-of relation, but rather the natural ordering on the relevant domain. Crucially, this updated view on Wellwood's (2014; 2015) semantics of Q-adjectives leads us to their differential uses and ultimately a unified account of Q-adjectives.

Keywords: Superlative Modifiers, scalarity, focus, alternative semantics, superlatives, degree semantics

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1. Introduction

This paper studies the morpho-semantics of a particular class of scalar focus adverbs in Mandarin Chinese called Superlative Modifiers (SMs), such as *zui-duo* 'at most' and *zui-shao* 'at least'. One key feature of these scalar focus adverbs is that their morphological makeup consists of only a quantity adjective (Q-adjective) and the superlative morpheme *zui*, as shown in (1).

(1) *Liubei* ***zui-duo/ zui-shao*** *shii* $[fu]_F$*-jiaoshou.* (Superlative Modifier)
Liubei SUP-much SUP-little be associate-professor
'Liubei is at most/at least an associate professor.'

Crucially and puzzlingly, exactly the same expressions are also used in Quantity Superlatives (QSs). More specifically, the two expressions of SMs and QSs are twins in Mandarin Chinese: the same expressions are ambiguous between a meaning of QSs and that of SMs.[1]

(2) a. *Liubei mai-le* ***zui-duo/ zui-shao*** *ke pinguo.* (Quantity Superlative)
Liubei buy-ASP SUP-much SUP-little CL apple
'Liubei bought more/fewer apples than anyone else did.'
b. *Liubei mai de* ***pinguo zui-duo/ zui-shao.***
Liubei buy DE apple SUP-much SUP-little
'The apples that Liubei bought are more/fewer than anyone else's.'

It is worth emphasizing that being a "scalar" focus adverb does not guarantee the involvement of degree morphology or gradable adjectives.[2] (3) demonstrates examples of some Mandarin scalar focus adverbs. Crucially, none of them involve degree morphology or gradable adjectives; even though arguably these focus adverbs make reference to certain type of "scales" in their semantics.

(3) a. *Liubei* ***shenzhi*** *xihuan* $[Feifei]_F$.
Liubei even like Feifei
'Liubei even likes Feifei.'
b. *Liubei* ***hai*** *xihuan* $[Feifei]_F$.
Liubei still like Feifei
'Liubei still likes Feifei.'

1. In fact, every Mandarin Superlative Modifier has a superlative twin (but crucially not vice versa). This paper focuses on two Mandarin SMs: *zui-duo* and *zui-shao*.

2. SMs such as *at least n/at most n* are often called modified numerals. But, again, being a numeral modifier does not entail the involvement of degree morphology and/or gradable adjectives. Expressions like *minimally* or *maximally* make the point.

c. ***Jiu*** [*Liubei*]$_F$ *xihuan Feifei.*
Jiu Liubei like Feifei
'Only Liubei likes Feifei.'
d. *Liubei* ***zhi*** [*xihuan*]$_F$ *Feifei.*
Liubei only like Feifei
'Liubei only likes Feifei.'

Once we shift our attention to languages beyond Mandarin, we see that the same morphological pattern repeats itself. In English, SMs similarly involve the superlative morpheme and a Q-adjective.

(4) a. John at **least**/**most** bought [three]$_F$ apples. (Superlative Modifier)
b. John drank the **least**/**most** water. (Quantity Superlative)

Cross-linguistically, it is not uncommon to find languages where SMs typically involve a quantity adjective (and the superlative morpheme). In fact, it is surprisingly pervasive across languages. In addition to English and Mandarin, both Japanese and Turkish have their SMs morphologically involved a quantity adjective. Similar facts also hold for Brazilian Portuguese, French, German Hindi, Italian, Korean, Magahi, Russian, Spanish, etc. Among these languages, crucially, Mandarin is not the only language with the same expressions showing the ambiguity between a meaning of SMs and that of QSs. Turkish makes another case. (5) illustrates the data from Japanese and Turkish.

(5) Some cross-linguistic facts about the morpho-semantic puzzle of SMs
a. Japanese
i. *ooku-tomo*
many-even.if
'at most'
ii. *sukunaku-tomo*
few-even.if
'at least'
b. Turkish
i. *en çok / en fazla*
SUP many/much SUP many/much
'at most'
ii. *en az / en az-ın-dan*
SUP little SUP little-3SGPOSS-ablative(from)
'at least'

The facts in Mandarin and Turkish strongly suggest that SMs and QSs should be intrinsically connected in the semantics, beyond the surface morphology. Minimally, it requires explanation.

Seen in this light, three important questions arise immediately: Why do SMs morphologically involve a quantity adjective and the superlative morpheme? What is the role of quantity adjectives and superlative morphemes inside SMs? How are these morphological pieces of SMs connected with their semantics? With an attempt to answer these questions, this paper takes Mandarin *zui-duo* and *zui-shao* as a case study and presents a decompositional analysis that incorporates a superlative SUP in their morpho-syntax and semantics. In a nutshell, the central proposal is two-fold: (a) SMs are scalar focus adverbs, structurally containing a superlative construction SUP instantiating the scalar component; (b) SMs can be decomposed into two major parts: one is an existential operator F-OP and the other is the superlative SUP establishing a comparison relation making the prejacent the upper/lower bound among its focus alternatives, along a contextually-valued dimension.[3]

The rest of this paper proceeds as follows. §2 presents the main data of Mandarin SMs that this paper is concerned with. §3 introduces some core assumptions endorsed in this paper. §4 spells out the core ingredients of my proposal and presents a decompositional analysis of Mandarin *zui-duo* and *zui-shao*. §5 discusses some significant implications of the current analysis of SMs by addressing three issues: (a) the semantic parallel of SMs with disjunction and epistemic indefinites; (b) the possibility for a unified account of Q-adjectives; (c) SMs in languages beyond Mandarin and their morpho-semantic mappings. §6 concludes the paper.

2. Basic facts

This section introduces the major data of Mandarin SMs that this paper is concerned with. To anticipate, (6) summarizes the main facts that any semantic analysis of Mandarin SMs must explain.

(6) a. **The morpho-semantic puzzle**: The same expressions *zui-duo* and *zui-shao* are used as SMs and QSs.
b. **Focus-sensitivity**: The semantic contribution of *zui-duo* and *zui-shao* depends on the position of their focus associate.

3. Inspired by Coppock (2016), the idea here is that the ranking between the prejacent and its focus alternatives (the scalarity of a focus operator) is understood as a comparison relation between the alternatives along a certain dimension. In this line, SMs instantiate a structure similar to phrasal comparatives, with the prejacent set up as the comparative standard. See Coppock (2016) for a different implementation of the idea on English SMs.

c. **Varieties of scales**: *Zui-duo* and *zui-shao* are compatible with a variety of scales (based on semantic strength or pragmatic strength).
d. **The bounding property**: Under sentences with SMs, the prejacent is made as the lower bound/the upper bound among the set of focus alternatives.
e. **The non-strict comparison**: The meaning of SMs delivers a non-strict comparison, in contrast to the strict comparison of superlatives.

As demonstrated in the introduction, Mandarin SMs demonstrate a morpho-semantic puzzle where the same expressions are ambiguous between a meaning of SMs and that of QSs; similar patterns are observed across languages. In what follows, I discuss the other four properties of Mandarin SMs.

First, like English *at least/at most* (e.g. Krifka 1999), Mandarin SMs are also focus-sensitive: the semantic contribution of *zui-duo/zui-shao* depends on its focus associate and different positions of the associate leads to truth-conditional differences.[4] Consider the contrast between (7) and (8).

(7) a. **Context A:** A contextual ranking: cherries > apples > bananas
What did *Liubei* buy for our plan tonight?
b. **Context B:** A contextual ranking: make dinner > buy apples > boil water
What did *Liubei* do for our plan tonight?

(8) a. *Liubei* ***zui-duo/ zui-shao*** *mai-le* $[pinguo]_F$.
Liubei SUP-much SUP-little buy-ASP apple
'Liubei at most/at least bought apples.'
b. *Liubei* ***zui-duo/ zui-shao*** $[mai\text{-}le\ pinguo]_F$.
Liubei SUP-much SUP-little buy-ASP apple
'Liubei at most/at least bought apples.'

Due to different positions of the focus associates, (7a) and (7b) are truth-conditionally different. In (7a), a lower bound (in the case of *zui-shao*)/an upper bound (in the case of *zui-duo*) is imposed on "what *Liubei* has bought". In contrast, the relevant bounding property is placed on "what *Liubei* has done" in (7b). Therefore, (7a) is felicitous as a continuation to the question in context A, but (7b) is not. Conversely, (7b) is felicitous as a continuation to the question in context B, but (7a) is not.

4. In English, focused constituents usually bear prosodic prominence. One may wonder whether Mandarin-focused constituents bear similar prosodic realizations as English. Without conducting any phonetic experiment, I do not intend to make any phonetic claim here. Nevertheless, the focus effect in Mandarin can be clearly observed in the question-answer congruence between focused constituents and their discourse questions.

It is worth noting that superlatives are also focus-sensitive (e.g. Heim 1999); in particular, its relative readings crucially rely on focus association (e.g. Tomaszewicz 2015). An explanation of such semantic parallel would be missing if the morphology of SMs is simply taken as a coincidence.

Second, *zui-duo* and *zui-shao* are compatible with various scales, as shown in (9)–(12). Crucially, in contrast, other Mandarin SMs involving quality adjectives do not share this flexibility; instead, the relevant scale is restricted to the dimension of the quality adjective, as shown in (13).

(9) **Numerical scales** (given a contextual ranking: 4 > 3 > 2)
Liubei ***zui-duo/ zui-shao*** *xie-le* [*san*]$_F$*-ben-xiaoshuo.*
Linbei SUP-much SUP-little write-ASP three-CL-novel
'Liubei at most/at least wrote three novels.'

(10) **Plurality scales** (a contextual ranking: adam&bill&chris > adam&bill > adam)
Liubei ***zui-duo/ zui-shao*** *guyong-le* [*Adam he Bill*]$_F$.
Liubei SUP-much SUP-little hire-ASP Adam and Bill
'Liubei at most/at least hired Adam and Bill.'

(11) **Lexical scales** (a contextual ranking: gold > silver > bronze)
Liubei ***zui-duo/ zui-shao*** *na-le* [*yin*]$_F$*-pai.*
Liubei SUP-much SUP-little take-ASP silver-medal
'Liubei at most/at least got a silver medal.'

(12) **Pragmatic scales** (a contextual ranking: cherries > apples > bananas)
Liubei ***zui-duo/ zui-shao*** *mai-le* [*pingguo*]$_F$.
Liubei SUP-much SUP-little buy-ASP apple
'Liubei at most/at least bought apples.'

(13) a. *Liubei* ***zui-zhong*** [*liushi*]$_F$ *gongjin.* (heaviness)
Liubei SUP-heavy sixty kilo
'Liubei is sixty kilos at the heaviest.'
b. *Liubei* ***zui-gao*** [*yi-bai-ba-shi*]$_F$ *gongfen.* (height)
Liubei SUP-tall one-hundred-and eighty centimeters
'Liubei is 180 centimeters at the tallest.'

The semantic contrast above between Mandarin SMs involving Q-adjectives and those involving quality adjectives would be surprising and puzzling if their morphology is simply a coincidence.

Third, under sentences with SMs, the prejacent is made as the lower bound/ the upper bound among the set of focus alternatives. Below, I use English *at least/*

at most to illustrate the point, but the same observation holds of Mandarin SMs *zui-duo* and *zui-shao* as well.[5]

(14) **The lower-bound property of *at least*/*zui-shao***
a. **Numerical scales** (given a contextual ranking: 4 > 3 > 2)
at least [three]$_F$ understood as {3, 4, 5…}

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5. In Mandarin Chinese, when *zui-duo*/*zui-shao* occur with proper names or quantifiers in a prenominal position, the sentences are reported to be degraded for some native speakers.

(i) ?*Liubei guyong-le zui-duo/ zui-shao* [*Adam he Bill*]$_F$.
Liubei hire-ASP SUP-much SUP-little Adam and Bill
Intended: 'Liubei hired at most/at least Adam and Bill.'

(ii) ??*Liubei yaoqing-le zui-duo/ zui-shao* [*yi-xie-xueshen*]$_F$.
Liubei invite-ASP SUP-much SUP-little one-CL-student
Intended: 'Liubei invited at most/at least some students.'

However, the sentences become perfect when *zuiduo*/*zuishao* occurs in a preverbal position.

(iii) *Liubei zui-duo/ zui-shao guyong-le* [*Adam he Bill*]$_F$.
Liubei SUP-much SUP-little hire-ASP Adam and Bill
'Liubei at most/at least hired Adam and Bill.'

(iv) *Liubei zui-duo/ zui-shao yaoqing-le* [*yi-xie-xueshen*]$_F$.
Liubei SUP-much SUP-little invite-ASP one-CL-student
'Liubei at most/at least invited some students.'

Note that in addition to quantifiers and proper names, prenominal SMs in Mandarin Chinese are also incompatible with bare nouns. Again, the sentence becomes perfect when *zuiduo*/*zuishao* occurs in a preverbal position. I am very grateful to an anonymous reviewer for pointing out the case of bare nouns.

(v) ??*Liubei mai-le zui-duo/ zui-shao* [*pingguo*]$_F$.
Liubei buy-ASP SUP-much SUP-little apples
Intended: 'John bought at most/at least apples'.

(vi) *Liubei zui-duo/ zui-shao mai-le* [*pingguo*]$_F$.
Liubei SUP-much SUP-little buy-ASP apples
'John at most/at least bought apples'.

However, it is worth pointing out that prenominal *at most*/*at least* in English does not show such incompatibility.

(vii) a. John invited at most/at least [Adam and Bill]$_F$.
b. John bought at most/at least [apples]$_F$.

At this moment, I have nothing interesting to say about the observed contrasts, other than suggesting the possibility that the contrast may result from the fact that prenominal *zui-duo*/*zui-shao* in Mandarin Chinese must be syntactically adjoined to a numeral phrase (NumP), thus incompatible with proper names/quantifiers (DP) and bare nouns (NP). In contrast, their English counterparts are syntactically compatible with various types of nominal phrases (DP/NumP/NP). I leave this line of research for another occasion.

b. **Plurality scales** (given a contextual ranking: a ⊕ b ⊕ c > a ⊕ b > a)
at least [Adam and Bill]$_F$ understood as {a ⊕ b, a ⊕ b ⊕ c}
c. **Lexical scales** (given a contextual ranking: gold > silver > bronze)
at least a [silver]$_F$ medal understood as {a silver medal, a gold medal}
d. **Pragmatic scales** (given a contextual ranking: cherries > apples > bananas)
at least [apples]$_F$ understood as {apples, cherries}

(15) **The upper-bound property of *at most*/*zui-duo***
a. **Numerical scales** (given a contextual ranking: 4 > 3 > 2)
at most [three]$_F$ understood as {3, 2, 1…}
b. **Plurality scales** (given a contextual ranking: a ⊕ b ⊕ c > a ⊕ b >a)
at most [Adam and Bill]$_F$ understood as {a ⊕ b, a, b}
c. **Lexical scales** (given a contextual ranking: gold > silver > bronze)
at most a [silver]$_F$ medal understood as {a silver medal, a bronze medal}
d. **Pragmatic scales** (given a contextual ranking: cherries > apples > bananas)
at most [apples]$_F$ understood as {apples, bananas}

Crucially, both superlatives and Superlative Modifiers convey a similar bounding property. Again, the point is illustrated by English in (16) and (17); but it holds of Mandarin as well.

(16) a. John drank the least coffee. (superlative)
b. John ate at least [three]$_F$ apples. (Superlative Modifier)

(17) a. John drank the most coffee. (superlative)
b. John ate at most [three]$_F$ apples. (Superlative Modifier)

In (16), sentence (a) conveys that the amount of coffee that John drank is the *lowest*, and sentence (b) delivers that the *lowest* quantity of apples that John ate is three. Similarly, in (17), sentence (a) conveys that the amount of coffee that John drank is the *greatest*, and sentence (b) delivers that the *greatest* quantity of apples that John ate is three.

This semantic parallel on the bounding property of QSs and SMs, again, would be unexpected and puzzling if the morphological makeup of SMs is simply a coincidence.

Fourth, somewhat surprisingly, while SMs conveys a non-strict comparison, canonical superlatives deliver a strict comparison. Take (17b) for example, the sentence is true if and only if John ate exactly three or less than three apples (i.e. the number of apples John ate was **equal to or less than three**). In a sharp contrast, for a superlative like (17a) to be true, the quantity of coffee that John drank must be **greater than** the amount of coffee that everyone else did, as shown below.

(18) ⟦ (17a) ⟧ = 1 iff ∀*y*[*y*∈*C* ∧ *y* ≠ John → max(λ*d*. John drank *d*-much coffee) > max(λ*d*. *y* drank *d*-much coffee)]

For any semantic analysis of SMs trying to incorporate the contribution of their morphology, the task then is how to account for this semantic contrast between the non-strict vs. strict comparison.

To sum up, we have seen that there is good evidence that the morphology of SMs should be taken into consideration for their semantics. It is worth noting that many properties discussed above are not specific to Chinese, but general to the class of SMs. Thus, they constitute challenges to any analysis of SMs without incorporating the semantic contribution of their morphology. The next section introduces some core assumptions, paving a way for the analysis to be spelled out in § 4.

3. Theoretical assumptions

This section proceeds as follows. § 3.1 introduces the semantics of focus in Rooth (1992). § 3.2 discusses Wellwood's (2014; 2015) approach to the semantics of Q-adjectives; then, I shall propose a revised version of Wellwood's semantics of Q-adjectives in order to accommodate the empirical facts of SMs. § 3.3 reviews two approaches to superlatives: the scope approach (Heim 1999) vs. the in-situ approach (Sharvit & Stateva 2002). I assume with Tomaszewicz (2015) that both approaches are allowed in grammar, but for concreteness, I shall adopt the scope approach for my illustrations. § 3.4 briefly introduces Bobaljik's (2012) Containment Hypothesis; I shall assume Dunbar & Wellwood's (2016) further development and characterization of the hypothesis.

3.1 The representation of focus

In this paper, I assume Rooth's (1992) focus semantics. Briefly put, every expression φ has an ordinary semantic value and a focus semantic value. For an unfocused constituent, its focus semantic value is a singleton set containing the ordinary value of that expression. For a focused constituent, its focus semantic value is a set of alternatives: a set of objects that have the same semantic type as the focused constituent. The set of alternatives induced by focus is computed recursively (essentially as in Rooth 1992). Furthermore, the semantic contribution of a focus-sensitive operator depends on the focus semantic value of its sister. The set of focus alternatives projects until they meet the focus operator where they are interpreted by a squiggle operator ~ and restricted by a contextual variable C.

The definition of ~ in (19) is drawn from Rooth (1996: (20)). The composition of association with focus is illustrated by English *only* in (20). Below, **only** abbreviates the contribution of *only*.

(19) Where φ is a syntactic phrase and C is a syntactically covert semantic variable, $\varphi \sim C$ introduces the presupposition that C is a subset of $[\![\varphi]\!]^f$ containing $[\![\varphi]\!]^o$ and at least one other element.

(20) a. $[_{IP}$ John $[_{VP2}$ **only** (C) $[[_{VP1}$ won a $[\text{silver}]_F$ medal$]$ $\sim C]]]$

b. $[\![$ VP1 $]\!]^o = \lambda x \lambda w.\ x$ won$_w$ a silver medal

c. $[\![$ VP1 $]\!]^f = \{\lambda x \lambda w.\ x$ won$_w$ a gold medal,
$\lambda x \lambda w.\ x$ won$_w$ a silver medal,
$\lambda x \lambda w.\ x$ won$_w$ a bronze medal$\}$

d. $[\![$*only* VP1 $]\!] = \lambda x \lambda w$: $[\![$ VP1 $]\!]^o(x)(w)$.
$\forall P \in C\ [P_w(x) \rightarrow [\![$ VP1 $]\!]^o(x) \subseteq P(x)]$

e. $[\![$ VP2 $]\!] = \lambda x \lambda w.$**only**(won$_w$ (x, a silver medal))

f. $[\![$ IP $]\!] = \lambda w.$**only**(won$_w$ (John, a silver medal))

In (20), C is contextually restricted and is presupposed to be a subset of the focus semantic value of VP1, the sister node of the focus-sensitive operator *only*. Furthermore, C provides the quantificational domain for *only*.

Next, building on Roberts' (2012[1996]) work, I assume with Beaver & Clark (2008) that discourse evolves by interlocutors' continually raising and answering questions. According to Beaver & Clark, a question that is proffered (in the sense of Roberts 2012[1996]) and mutually accepted by the interlocutors as the most immediate goal of the discourse becomes the Current Question (CQ). More specifically, we assume with Beaver & Clark (2008) the following principles:

(21) **Current Question rule**: The Current Question (CQ) must contain at least one true alternative and contain multiple alternatives which are not resolved as true or false in the common ground.[6]

(22) **Discourse principle**: Utterances should be maximally relevant to the CQ.[7]

(23) **Focus principle**: Some part of a declarative utterance should evoke a set of alternatives containing all the Rooth-Hamblin alternatives of the CQ.

Finally, to establish the connection between Beaver & Clark's QUD-based discourse model and Rooth's representation of focus, I follow Rooth's idea that the

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6. This principle determines whether the CQ remains open in a discourse.

7. The notion of relevance between questions and answers is defined in Beaver & Clark (2008) as follows: "For a discourse move to be relevant it must address the CQ, which Roberts (2012[1996]) takes to mean either the move introduces a partial or total answer to the CQ, or that it is part of a strategy to answer the CQ".

variable *C* is contextually restricted and assume that *C* is constrained by the choice of CQ in the discourse. Given the above assumptions, the relation between the quantificational domain of a focus operator, the denotation of a question, and the focus value of an answer to the question can be understood as follows.[8]

(24) a. $[\![\text{Q}]\!]^{o} \subseteq [\![\text{Ans}]\!]^{f}$ (the question-answer congruence)
b. $C \subseteq [\![\text{Q}]\!]^{o}$ (the domain restrictor *C* is anaphoric)

What (24) means is that **(a)** the discourse congruence requires the denotation of a question to be a subset of the focus value of the answer; **(b)** the quantificational domain of a focus operator is contextually restricted by the question in the discourse.[9] Taken together, the contribution of focus particles like English *only* can be understood as imposing further restrictions on the answer space. The dialogue in (25) and its relevant representations in (26) illustrates the point.

(25) Context. There are three individuals in the discourse: Adam, Bill, Chris
A: Who left?
B: Only Adam left.

(26) a. $C = [\![\text{Q}]\!]^{o} = \{\text{Adam, Bill, Chris}\}$
b. LF: $[[_{\text{DP}}\ \text{Only}(C)\ [_{\text{DP}}\ [_{\text{DP}}\ \text{Adam}]_{\text{F}}\ \sim C]]\ \lambda x\ [x\ \text{left}]]$

The use of *only* narrows down the answer space because it excludes the other two individuals (*Bill* and *Chris*) from being in the answer, assuming for simplicity that only singular individuals are relevant in the discourse.

As we shall shortly see, the role of SMs as a focus adverb, resembling English *only*, is also to narrow down the answer space. Furthermore, by factoring in the contribution of the morphology, the semantics of Q-adjectives requires a measured domain and the set of elements induced by focus delivers exactly the domain required. This is part of the reason why Rooth's (1992) focus semantics is adopted here: it is relatively transparent about how these focus elements arise and what they are.

In the next section, I use a pre-theoretical term *quantity words* (instead of Q-adjectives) in the discussion, to avoid some confusion about the syntactic category. Moreover, I shall justify why Wellwood's (2014; 2015; 2019) approach to quantity words should be adopted for the study of SMs. The review will also serve

8. I am assuming with Jacobson (2016), Xiang (2016) and her recent subsequent work that the semantics of a constituent question can denote a set of short answers (i.e. not always denoting a set of propositions).

9. An alternative way of capturing the relation between the quantificational domain of a focus particle and the question in a discourse is to assume an identity relation, rather than a subset relation: $C = [\![\text{Q}]\!]^{o}$.

as a brief background for our discussion on a potentially unified semantics of Q-adjectives in § 5.

3.2 The semantics of Q-adjectives

There are three major approaches to the semantics of quantity words. The first approach is the theory of generalized quantifiers (Barwise & Cooper 1981; Hackl 2001), analyzing quantity words as determiners denoting relations between two sets of individuals, in a parallel with *some* and *every*.[10] However, given what we have seen that SMs behave like adverbs, rather than determiners, in terms of their syntactic distribution, I shan't thus consider this approach for purposes of this paper.

The second approach focuses on the differential use of quantity words such as the sentence *Adam is much taller than Bill*, and suggests that the semantics of quantity words should be defined in terms of intervals (i.e. sets of degrees). For example, Rett (2008; 2014) proposes that quantity words are degree modifiers (of type <<*d, t*>, <*d, t*>>), denoting relations between a set of degrees *D* (i.e. an interval) and its size *d*, as in (27).

(27) $[\![much]\!] = \lambda D_{<d,\,t>}\, \lambda d_d.[d \text{ is the size of } D]$

Because quantity words are now analyzed as a relation between a set of degrees and its size (of type <<*d, t*>, <*d, t*>>), we need some element that enables nouns to be optionally associated with degree-denoting expressions. The association is done via a null operator or a corresponding type-shifting mechanism (Schwarzschild 2005, 2006; Nakanishi 2007), as shown in (28), where μ_c represents the relevant dimension of measurement, valued contextually.

(28) $[\![\text{M-OP}]\!]^c = \lambda P_{<e,\,t>}\, \lambda d_d\, \lambda x_e.[P(x) \wedge \mu_c(x) \geq d]$

M-OP relates individuals *x* in the extension of some predicate *P* to their degrees along some contextually valued dimension.

Solt (2009; 2015) proposes another interval-based analysis of quantity words. In a series of papers, Solt suggests that quantity words should be analyzed as predicates of intervals (of type <*d*, <<*d, t*>, *t*>>), as shown in (29). Similar to Rett's (2014) M-OP, a null operator Meas is required.

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10. Along the idea of generalized quantifiers, Hackl (2001) proposes a "parameterized determiner" analysis: Quantity words are analyzed as determiners while parameterized with an additional degree argument, as shown in (i).

(i) a. $[\![many]\!]^c = \lambda d_d\, \lambda P_{<e,\,t>}\, \lambda Q_{<e,\,t>}.\ \exists x[P(x) \wedge Q(x) \wedge |x| \geq d]$
b. $[\![few]\!]^c = \lambda d_d\, \lambda P_{<e,\,t>}\, \lambda Q_{<e,\,t>}.\ \exists x[P(x) \wedge Q(x) \wedge |x| < d]$

(29) a. $[\![\textit{many/much}]\!] = \lambda d_d \lambda I_{<d, t>}.I(d)$
b. $[\![\textit{few/little}]\!] = \lambda d_d \lambda I_{<d, t>}. \neg I(d)$

(30) $[\![\text{ Meas }]\!]^c = \lambda x_e \lambda d_d.\mu_c(x) \geq d$

Below, (31) briefly illustrates how an interval-based approach works for the use of quantity words in a sentence like *many students left*. Note that POS stands for the *pos*-morpheme which requires the relevant degree property *P* to exceed a certain contextual threshold d_c.

(31) a. Many students left.
b. LF: [**POS** [λ2 [d_2-**much** [λ1 [d_1-[**M-OP**-students] left]]]]]
c. $[\![\text{ POS }]\!]^c = \lambda P_{<d, t>}. \exists d'[P(d') \wedge d' > d_c]$
d. $[\![$ (31a) $]\!]^c = 1$ iff $\exists d'$ [d' is the size of {d: d-many students left} $\wedge$ $d' > d_c$]

As shown above, a null operator (M-OP) relates the denotation of a noun to its degrees along some dimension; the quantity word *much* measures the size of that degree property and POS in turn requires the degree obtained by the measurement of the size to exceed a certain contextual threshold.

In short, an interval-based analysis of quantity words is a two-head analysis in spirit: quantity words mediate between a degree and an interval (the mediation is via either measurement or set-inclusion) and the actual job of measurement is done by a null operator (Rett's M-OP/Solt's Meas).

As discussed in the introduction, in many languages, SMs typically involve quantity words (along with the superlative morpheme) in their morphological makeup. The same morphological pattern holds for a bunch of genetically-unrelated languages. These cross-linguistic facts would be surprising if the semantics of quantity words involved in SMs were simply bleached as in Rett (2014) and Solt (2015), where the relevant dimension of measurement is actually done by a null operator such as Rett's M-OP or Solt's Meas. Put differently, it would be puzzling why cross-linguistically natural languages insist on the presence of these semantically-bleached quantity words in the morphology of SMs. Thus, for purposes of this paper, I shall not consider this approach either.

The third approach is taken by Wellwood et al. (2012) and Wellwood (2014; 2015; 2019), which I shall adopt in this paper. Following Bresnan (1973), Wellwood (2014; 2015) entertains the hypothesis that all comparative sentences – nominal, verbal, and adjectival – contain instances of a single morpheme that introduces measurement. In particular, this morpheme in English is sometimes pronounced *much* and semantically contributes a structure-preserving mapping from entities, events or states to their measures along some contextually-valued dimensions. Consider (32) and (33).

(32) Nominal Comparatives
a. Adam drank more coffee than Bill did. (√volume, √weight, *temperature)
b. Adam drank as much as coffee as Bill did.
(√volume, √weight, *temperature)

(33) Verbal Comparatives
a. Adam ran more than Bill did. (√duration, √distance, *speed)
b. Adam ran as much as Bill did. (√duration, √distance, *speed)

In (33), the dimension of measurement cannot be temperature. In (33), the dimension of measurement cannot be speed. Crucially, volume and weight are monotonic with respect to measurement while temperature is not (e.g. Schwarzschild 2006). A similar contrast holds between duration/distance and speed (e.g. Krifka 1989). Based on these facts, Wellwood (2014; 2015) proposes an index-based entry of English *much*, of type <η, d>. In (34), α ranges over (at least) events and individuals, thus η could be of type v (eventualities) or e (individuals); μ is a variable over the relevant measure function, contextually valued by the assignment function A.

(34) $[\![much_{\mu}]\!]^{A} = \lambda\alpha.A(\mu)(\alpha)$ <η, d>

To capture the above restrictions on nominal and verbal comparatives, Wellwood proposes three definedness conditions to which $A(\mu)$, in any context and for any assignment A, is restricted: (**a**) the measured must be **structured**; (**b**) the mapping to degrees must be **homomorphic**; (**c**) the mapping must be **monotonic**.

First, requiring that the measured domain be structured amounts to the requirement that α is in the domain with an ordering, $D_{\geq}$. This ensures that singular count nouns and telic verb phrases are not measurable (by *much*), because the domain of these expressions is an unstructured atomic subset of D_{η}. Second, requiring that the mapping be homomorphic ensures that the mapping to degrees preserves the structure of the measured domain. Third, requiring that the mapping be monotonic is a restatement of Schwarzschild's (2006) monotonicity condition: $A(\mu)$ not only preserves the structure, but also preserves the part-whole structure non-trivially.

(35) Monotonicity
For all $\alpha, \beta \in D_{\geq Part}$, if $\alpha <^{Part} \beta$, then $\mu(\alpha) <^{Deg} \mu(\beta)$.

Against the above background, how do we extend Wellwood's proposal to the case of SMs involving Q-adjectives? As we have seen in §2, *zui-duo*/*zui-shao* and *at most*/*at least* are compatible with a variety of scales. Crucially, in contrast, it seems that examples in Wellwood's work are those cases where the measured domain D is structured by a part-of relation ($\geq_{part}$): $D_{\geq part}$. When a measured domain is

structured in this particular way, it typically has the formal property of cumulative reference, as in (36).

(36) Cumulative Reference
$\text{CUM}(P) =_{\text{def}} \forall x \forall y[P(x) \wedge P(y) \rightarrow P(x \oplus y)]$
A predicate P is cumulative if and only if whatever it holds of two things, it also holds of their sum.

Specifically, the fact that the dimension such as *temperature* and *speed* are unavailable in (32) and (33), is precisely because the measured domain is $D_{\geq part}$ while the mapping may not be monotonic. Crucially, notice that the monotonicity requirement is conditional: **if** the measured domain is structured by a part-of relation, **then** the mapping must be monotonic ($\forall \alpha, \beta \in D_{\geq Part}$, if $\alpha <^{Part} \beta$, then $\mu(\alpha) <^{Deg} \mu(\beta)$). So, what if the measured domain is **not** structured by the part-of relation? Wellwood (2019: 54) explicitly mentions that the monotonicity constraint cannot be vacuously satisfied, based on the fact that singular count nouns cannot be the measured domain of Q-adjectives in comparatives. This ensures that the measured domain of Q-adjectives **must** have a part-whole structure, which correctly captures the empirical facts about nominal and verbal comparatives.

However, recall that in § 2 we have seen four types of scales that SMs are compatible with: **numerical scale** (an ordering like *four* > *three* > *two*), **plurality scale** (an ordering like *Adam* ⊕ *Bill* ⊕ *Chris* > *Adam* ⊕ *Bill* > *Adam*), **lexical scale** (an ordering like *a full professor* > *an associate professor* > *an assistant professor*), and **pragmatic scale** (an ordering like *ate bananas* > *washed apples* > *bought cherries*).

In the case of SMs, except for plurality scales, other scale types such as lexical scales and pragmatic scales do **not** involve a part-whole structure. For example, neither an associate professor is **part of** a full professor, and vice versa; nor an assistant professor is **part of** an associate professor, and vice versa. Similarly, neither washing apples is **part of** eating bananas, and vice versa; nor buying cherries is **part of** washing apples, and vice versa. But Q-adjectives are morphologically involved in SMs! Therefore, SMs present a serious challenge to our semantic theory of Q-adjectives; if we strictly follow Wellwood's (2019) view of Q-adjectives, then we are forced to claim that Q-adjective *duo* has **no** semantic contribution in SMs and its presence in SMs is merely a morphological coincidence; or even worse, we wrongly predict that all examples where SMs involve a lexical scale or a pragmatic scale (where **no** part-whole structure is involved) should be ill-formed and must be ruled out by the monotonicity constraint, contrary to the facts.

Seen in this light, in order to reconcile the conflict between the case of SMs and Wellwood's view, I suggest that the key aspect of extending Wellwood's proposal to SMs without losing her insights about nominal and verbal comparatives requires a shift of our perspective on how the measured domain is structured.

In particular, I propose that the ordering relation of a measured domain *D* of Q-adjectives need **not** be a part-of relation; but rather the natural ordering on *D*.[11] More specifically, what is required in the measured domain of Q-adjectives is some ordering structure; but, crucially, the measured domain cannot be unstructured (i.e. a set of atomic semantic objects with no ordering structure). Put differently, on the current view, singular count nouns are ill-formed with Q-adjectives because the former fails to satisfy an ordering structure of the measured domain required by the latter, not because of the monotonicity constraint (cf. Wellwood 2019).

A part-whole relation is simply a subcase of natural orderings. Specifically; when the measured domain concerns pluralities (e.g. individuals, events or states in Wellwood's work), the natural ordering is the part-of relation and the mapping must be monotonic.[12]

Furthermore, as indicated by the case of lexical scales or pragmatic scales, the natural ordering in a given domain may result from our world knowledge (e.g. *master degree* > *college degree* > *high school diploma*) or contextually-conditioned conversations (e.g. *ate bananas* > *washed apples* > *bought cherries*). In these cases, the measured domain is crucially **not** structured by a part-of relation; the monotonicity constraint is irrelevant or vacuously satisfied (by its conditional nature).[13] Crucially, it is worth emphasizing that it is definitely false to claim that the use of SMs bleeds the monotonicity constraint. Given the existence of plurality scales, it is obvious that the monotonicity constraint still has its impact on the use of SMs in natural language.

Given the above discussion and the idea of natural orderings, the notion of "measure" concerning Q-adjectives can be understood and formally presented in (37).

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11. I am greatly indebted to Alexis Wellwood (p.c.) for suggesting the idea of natural orderings to substitute for the part-of relation on the measured domain of Q-adjectives.

12. Whether the numerical scale (e.g. natural numbers) involves a part-of relation is a non-trivial question. It raises at least two important issues: (a) whether natural numbers are degree terms; (b) whether degrees involve the notion of pluralities. See Hackl (2001) and Balcerak Jackson & Penka (2017) for discussion on the first issue. See Dotlačil & Nouwen (2016) for an analysis of individual quantifiers in comparatives based on the notion of degree pluralities.

13. The natural ordering in a given measured domain may be a total order (a binary relation that is reflexive, transitive, anti-symmetric and connected), a partial order (a binary relation that is reflexive, transitive and anti-symmetric but crucially not connected), or maybe even a preorder (i.e. quasi-order; a binary relation that is transitive and reflexive). Crucially, however, the measured domain of Q-adjectives cannot be unstructured, as proposed in a series of Wellwood's work.

(37) μ is measure function, making a structure-preserving mapping from a structure $<P, \geq_{no}>$ (where P is the measured domain and $\geq_{no}$ is the natural ordering on the domain P) to a scale S, where S is a structure $<D_{deg}, \geq_{deg}>$ such that D_{deg} is set of degrees (i.e. entities of type d) and $\geq_{deg}$ is a total order on D_{deg}.[14]

This understanding of measurement is familiar form measurement theory (Krantz et al. 1971), where measurement is defined as a structure-preserving mapping from an empirical relation structure (i.e. a set of objects and an observable ordering relation between them) to a numerical structure (i.e. a set of numerical values and an ordering relation between them; here understood as degree orderings).[15]

Finally, to cover examples of both SMs and superlatives, I assume a relation version of Wellwood (2015)'s semantics of English *much*, for the Mandarin Q-adjective *duo* 'much/many'.[16, 17]

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14. A total order is a binary relation that is reflexive, transitive, anti-symmetric, and connected. The notions of reflexivity, transitivity, anti-symmetry, and connectedness are defined below.

(i) A relation R is reflexive iff
$\forall x \in D_R, <x, x> \in R$.

(ii) A relation R is transitive iff
$\forall x, y, z \in D_R$, if $<x, y> \in R$ and $<y, z> \in R$, then $<x, z> \in R$.

(iii) A relation R is anti-symmetric iff
$\forall x, y \in D_R$, if $<x, y> \in R$ and $<y, x> \in R$, then $x = y$.

(iv) A relation R is connected iff
$\forall x, y \in D_R$, either $<x, y> \in R$ or $<y, x> \in R$.

15. See Krantz et al. (1971) and Roberts (1985) for an introduction to measurement theory; see also Sassoon (2010) for the relevant application of measurement theory in linguistics.

16. I assume that this relational entry can be derived by either combing with the absolute morpheme ABS in Kennedy (1999) or a corresponding type-shifting rule; alternatively, it may simply exist in the lexicon in a given language. In the literature on degree semantics, it has been widely-held that gradable adjectives denote either a measure function mapping an individual to degrees (Kennedy 1999) or a relation between an individual and degrees (von Stechow 1984; Heim 2000, among others). Thus, I consider the relational entry of Q-adjectives to be unproblematic in this respect. However, it is worth noting that although both camps (the measure function approach and the relational approach) have their own proponents, they usually come with different assumptions on the syntax and semantics. See Wellwood (2014) for an overview and discussion.

17. For purposes of this paper, α is intended to range over individuals, properties, and situations. I shall come back to this issue in § 4, where the decompositional analysis is spelled out in detail.

(38) $[\![duo_{\mu}]\!]^{A} = \lambda d.\lambda\alpha.\ A(\mu)(\alpha) \geq d$ $\quad <d, <\eta, t>>$

The next section briefly reviews two approaches to superlatives: an in-situ approach vs. the movement approach. This is done to provide a background for my illustration of how Mandarin Quantity Superlatives are computed in § 4. For purposes of this paper, I shall adopt the movement approach, though nothing crucial in my analysis of Mandarin SMs hinges on this choice.

3.3 The theory of superlatives

A sentence containing a superlative expression, such as *the highest mountain* in (39), can receive different interpretations depending on how the comparison class is specified with respect to different constituents of the sentence (Heim 1985; 1999). When the comparison class is determined with respect to the superlative DP itself, the absolute reading arises. In contrast, the relative reading arises when the comparison class is established with respect to one of the constituents in the sentence.

(39) Adam climbed the highest mountain.
Absolute reading: Adam climbed the mountain that is higher than any other (relevant) mountain.
Relative reading: Adam climbed a mountain that is higher than any other (relevant) individual did.

Heim (1999) propose that the absolute-relative ambiguity of a superlative sentence is derived by allowing the superlative morpheme *-est*, with the semantics in (40), to take different scope within the clause. Under this movement approach, the ambiguity of a superlative sentence is actually a case of structural ambiguity. The computation of the relevant pieces is illustrated in (41) and (42).

(40) a. $[\![\text{-}est]\!] = \lambda C_{<e, t>}\ \lambda G_{<d, <e, t>>}\ \lambda x_{<e>}.\ \forall y[y \in C \wedge y \neq x \rightarrow \max(\lambda d.G(x, d)) > \max(\lambda d.G(y,d))]$
b. Presuppositions: $x \in C,\ \forall y[y \in C \wedge y \neq x \rightarrow \exists d[G(y, d)]]$

(41) Absolute reading
a. $[_{DP}$ the $[_{NP}$ [-***est*** $(C)][_{NP}$ d-high mountain]]]
b. $[\![d\text{-high mountain}]\!] = \lambda d.\lambda x.\text{mountain}(x) \wedge \text{high}(x) \geq d$
c. $C = \{x\colon \exists d.\text{mountain}(x) \wedge \text{high}(x) \geq d\}$
d. $[\![\text{ DP }]\!] = \acute{\imath}x \forall y[y \in C \wedge y \neq x \rightarrow \max(\lambda d.\text{mountain}(x) \wedge \text{high}(x) \geq d) > \max(\lambda d.\ \text{mountain}(y) \wedge \text{high}(y) \geq d)]$

(42) Relative reading
a. $[_{IP}$ Adam [-***est*** $(C)]$ $\lambda d.\ \lambda x.\ [_{vP}\ x$ climbed a d-high mountain]]
b. $C = \{x\colon \exists d \exists z[\text{mountain}(z) \wedge \text{high}(z) \geq d \wedge x \text{ climbed } z]\ \}$
c. $[\![\ \text{IP}\ ]\!] = 1$ iff
$\forall y[y \in C \wedge y \neq \text{adam} \rightarrow$
$\max(\lambda d.\exists z[\text{mountain}(z) \wedge \text{high}(z) \geq d \wedge \text{Adam climbed } z])$
$> \max(\lambda d.\exists z[\text{mountain}(z) \wedge \text{high}(z) \geq d \wedge y \text{ climbed } z])$

Under the absolute reading in (41), the superlative morpheme takes scope within the DP and the comparison class C is a set of relevant mountains. In contrast, under the relative reading shown in (42), the superlative morpheme takes scope outside the DP (specifically, *-est* scopes over the VP) and the comparison C is a set of relevant mountain-climbers.

Alternatively, some researchers purse an in-situ approach (e.g. Farkas & Kiss 2000; Sharvit & Stateva 2002), where the superlative morpheme never moves out of the DP, and the relative reading is derived from domain restriction. Consider (43), where the bolded part indicates the additional contextual restriction on the value of C.

(43) Relative reading (an in-situ approach)
a. $[_{DP}$ the $[_{NP}$ [-***est*** $(C)][_{NP}\ d$-high mountain]]]
b. $[\![d\text{-high mountain}\ ]\!] = \lambda d.\lambda x.\text{mountain}(x) \wedge \text{high}(x) \geq d$
c. $C = \{x\colon \exists d \exists z.\text{mountain}(x) \wedge \text{high}(x) \geq d \wedge z \textbf{ climbed } x\}$
d. $[\![\ \text{DP}\ ]\!] = \acute{\imath}x \forall y[y \in C \wedge y \neq x \rightarrow \max(\lambda d.\text{mountain}(x) \wedge \text{high}(x) \geq d)$
$> \max(\lambda d.\ \text{mountain}(y) \wedge \text{high}(y) \geq d)]$

The choice between the movement approach and the in-situ approach is an ongoing debate in the literature on superlatives. However, it may well be the case that both approaches are needed (see Tomaszewicz 2015 for a comparative perspective on the correlation between definiteness marking and different types of relative readings). However, for concreteness, I adopt the scope approach for my illustrations. Nothing crucial in my analysis of Mandarin SMs/QSs hinges on this choice.[18, 19]

18. In explicating the role of focus, the three-place superlative operator requires the movement of the focus-marked constituent to serve as its third argument. Heim (1999) discusses this point and explicitly expresses her doubt that multiple LFs actually go with the *relative prominence* on focus-marked constituents at PFs. Readers are referred to Heim (1999) and Sharvit & Stateva (2002) for discussion on the role of focus in superlatives.

19. See Chen (2019) for an analysis of Mandarin SMs formed with quality adjectives implemented in the in-situ approach.

3.4 The Containment Hypothesis

In this paper, I assume Bobaljik's (2012: 4) Containment Hypothesis in (44).

(44) Containment Hypothesis (Bobaljik 2012: 4)
The representation of the superlative properly contains that of the comparative.

Bobaljik (2012) motivates the hypothesis through the study of morphological patterns concerning the positive form of adjectives, the comparative form and the superlative form in over three hundred languages. Dunbar & Wellwood (2016) further explores and develops the Containment Hypothesis, and offers a formal characterization, as shown in (45).

(45) No Containment Condition (NCC; Dunbar & Wellwood 2016: (21))
No (functional) head's semantic representation can contain another's.

NCC is proposed as a constraint on grammars, such that if an expression in the language can be decomposed, it must be decomposed. Note that Containment Hypothesis only commands on *what* to decompose, but not *how* to decompose it. In principle, the decomposition can be (46a) or (46b).

(46) Decomposition and the case of superlatives
a. [SUP [CMPR [MUCH]]]
b. [[SUP-CMPR] [MUCH]]

(46a) is a nested structure where the superlative takes the comparative as its complement and the embedded comparative in turn contains the Q-adjective. (46b) is a structure where the superlative contains the comparative and the resulting expression combines with the Q-adjective. In this paper, I assume with Dunbar & Wellwood (2016) that (46b) is the way how superlatives are decomposed. Readers are referred to Dunbar & Wellwood (2016: § 3) for more detailed discussion.

4. The proposal

In this section, I spell out my decompositional analysis of *zui-duo* and *zui-shao*. Recall that one very intriguing puzzle is the fact that Mandarin SMs are exclusively composed of a quantity adjective and the superlative morpheme in their morphology. To recapitulate, the key facts that this paper is intended to capture are repeated in (47).

(47) a. **The morpho-semantic puzzle**: The same expressions *zui-duo* and *zui-shao* are used as SMs and QSs.
b. **Focus-sensitivity**: The semantic contribution of *zui-duo* and *zui-shao* depends on the position of their focus associate.
c. **Varieties of scales**: *Zui-duo* and *zui-shao* are compatible with a variety of scales (based on semantic strength or pragmatic strength).
d. **The bounding property**: Under sentences with SMs, the prejacent is made as the lower bound/the upper bound among the set of focus alternatives.
e. **The non-strict comparison**: The meaning of SMs delivers a non-strict comparison, in contrast to the strict comparison of superlatives.

The rest of this section is structured as follows. § 4.1 spells out the core ingredients of my decompositional analysis of Mandarin SMs. § 4.1.1 demonstrates a detailed computation of Mandarin data. In particular, I illustrate how the proposed analysis works for different syntactic positions of *zui-duo*: cases of propositional modification and those of non-propositional modification. § 4.1.2 offers the computation of Mandarin QSs under the movement approach, for the completeness of my decompositional analysis of *zui-duo*. § 4.2 extends the proposed analysis to *zui-shao*, by showing how sentences of SMs/QSs with *zui-shao* are compositionally computed.

4.1 The anatomy of *zui-duo*

My decompositional proposal of the focus adverb *zui-duo* has three pieces: **(a)** the internal compositionality of the superlative construction SUP, and the role of the superlative morpheme *zui* and the quantity adjective *duo* 'much' inside Mandarin SM *zui-duo*; **(b)** the role of the SUP as a whole inside Mandarin SMs; **(c)** a covert existential operator F-OP, which structurally contains SUP and introduces the quantificational force. Let us see the first piece of my proposal. Assuming Bobaljik's (2012) Containment Hypothesis, I propose that in Mandarin SMs, the superlative structurally embeds a comparative, as illustrated in (48).[20] Note that Comp$^+$P represents the projection of the embedded covert comparative.

(48) $[[_{\text{SupP}}\ \textit{zui}\ [_{\text{Comp+P}}\ \text{Comp}^+]]\ [\textit{duo}]]$

Regarding the semantic details, let us start in a bottom-up fashion. For the quantity adjective *duo*, as discussed in § 3.2, I propose that it encodes a measure function making a structure-preserving mapping from the elements induced by focus to their corresponding positions along a contextually given dimension, as illus-

20. The domain variable *C* is ignored for clarity at this point.

trated in (49). Note that the focus alternatives α can be of propositional (type <*s, t*>) or non-propositional (e.g. type *e* and <*e, t*>).[21]

(49) $[\![duo_{\mu}]\!]^{A} = \lambda d.\lambda\alpha.A(\mu)(\alpha) \geq d$ <*d*, <η, *t*>>

The key idea here is that the set of focus elements with a natural ordering serves as the measured domain (i.e. a domain structured by the natural ordering) of the Q-adjective.

Next, the covert comparative morpheme Comp^{+} takes a gradable adjective *g* as its first argument and returns a comparison relation between the alternatives (along the dimension of *g*).

(50) $[\![\ \text{Comp}^{+}]\!]^{A} = \lambda g.\lambda\alpha\lambda\beta.\max(\lambda d\ .g(d)(\alpha)) > \max(\lambda d.g(d)(\beta))$
<<*d*, <η, *t*>>, <η, <η, *t*>>>

Here, I assume with Liu (2011; 2018) that Mandarin does have covert comparative morphemes.[22, 23] Crucially, notice that the entry of the covert comparative

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21. Lin (2014) focuses on the differential use of the quantity adjective *duo* 'much' in Chinese differential comparatives. He follows Solt (2009; 2015) and assigns *duo* 'much' an interval-based meaning. As discussed in §3.2, the reason why I pursue Wellwood's approach (rather than an interval-based approach) is because Wellwood's view that quantity adjectives encode a domain-general measure function seems to be a better fit with the relevant facts observed for SMs across languages.

22. One famous Chinese comparative is the *bi* comparative, as shown in (i). Unlike English, Mandarin Chinese does not have overt comparative morphemes (though there are degree adverbs conveying a comparative meaning). It is this lack of overt comparative morpheme that leads many researchers (e.g. Erlewine 2007; Lin 2009, among others) to analyze the marker of comparative standard *bi* as a degree word delivering a meaning similar to that of the overt English comparative morpheme *more*/*-er*.

(i) *Liubei bi Caocao gao*.
Liubei than Caocao tall
'Liubei is taller than Caocao.'

However, Liu (2011; 2012) explicitly argues against the view that the marker *bi* is a degree word. Readers are referred to his paper for more detail.

23. Liu (2018) proposes that in Mandarin, both comparative morpheme and *pos*-morpheme have two allomorphs: an overt form and a covert counterpart. He argues that the covert form of the comparative morpheme (and the *pos*-morpheme) is licensed only in a focus-sensitive domain (in his terminology, a domain where the bare gradable adjective is focus-anchored). My decompositional analysis of Mandarin SMs *zui-duo*/*zui-shao* (where a covert comparative construction is structurally embedded under the SUP, couched in Bobaljik's Containment Hypothesis) may be compatible with a broad definition of a focus-sensitive domain, given that the covert comparative construction is inside the body of focus particles *zui-duo*/*zui-shao*. But it is less clear in the case of canonical superlatives with *zui-duo*/*zui-shao*. I leave the compatibility between my decompositional analysis and Liu (2018) for future research.

morpheme Comp^{+} is simply a reminiscent of the mode of individual comparison, when α and β ranges over individuals (η is of type e). The mode of individual comparison has been argued to hold for comparatives in Mandarin-type languages since Kennedy (2009), in contrast to the mode of degree comparison in English.

Finally, the semantics of the superlative morpheme *zui* involved in SMs is offered in (51), which is essentially like the traditional entry assigned to English *-est* (see § 3.3), except for (a) type-flexibility, (b) the additional component M for the meaning of Comp^{+} (due to the decomposition and Containment Hypothesis), and (c) the switch of the order of the domain C and gradable predicate g. The semantics of the superlative is provided in (52).

(51) $[\![zui]\!]^{A} = \lambda M_{<<d,<\eta,t>>,<\eta,<\eta,t>>>}\lambda g_{<d,<\eta,t>>}\lambda C_{<\eta,t>}\lambda\alpha_{<\eta>}\forall\beta_{<\eta>}[\beta\in C \wedge \beta \neq \alpha \rightarrow M(g)(\alpha)(\beta)]$

(52) $[\![\ (48)\ ]\!]^{A} = \lambda C_{<\eta,t>}\lambda\alpha_{<\eta>}.\forall\beta_{<\eta>}[\beta\in C \wedge \beta \neq \alpha \rightarrow \max(\lambda d.A(\mu)(\alpha)\geq d) > \max(\lambda d.A(\mu)(\beta)\geq d)]$

So far, we have established the first piece. The second piece of my proposal concerns the role of the superlative SUP as a whole inside Mandarin SMs. I propose that the superlative construction serves as a domain restrictor on the set of alternatives induced by information focus and introduces the scalarity of focus adverbs (i.e. SMs). For example, in the case of *zui-duo*, the superlative construction SUP requires that the alternatives that are non-identical to the prejacent α in the domain C, be ranked **below** the prejacent along a contextually given dimension. This amounts to excluding the higher alternatives in the computation of the sentences with *zui-duo*.

The third piece of my proposal is that the superlative construction SUP as a whole is embedded under a covert existential operator F-OP (i.e. a focus operator introducing the quantificational force of focus adverbs). In (53), the semantics of F-OP is defined with a propositional version. Note that S represents the meaning of the superlative SUP in SMs.[24, 25]

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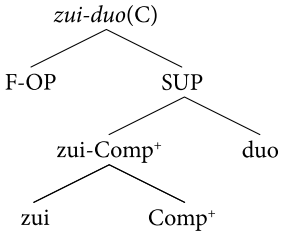
24. For simplicity, I use an extensional representation of the non-propositional entry for the illustrations.

25. An anonymous reviewer raises the question of whether there is any clear rule why F-OP is involved in the case of SM but not in the case of QS. The answer to this question boils down to the core semantic distinction between a focus adverb and a comparative construction. The fundamental semantic core of a focus adverb is that it is a quantifier over alternatives induced by information focus. On the current analysis, this is the job of F-OP, which asserts that there is one element in the non-singleton domain (i.e. $S(\alpha)$) such that the element is true. Thus, F-OP is considered as part of the lexical semantics of SMs (i.e. focus adverbs). In this line, we do not

(53) $[\![\text{F-OP}]\!]^{s,A} = \lambda S_{<<st,\,t>,\,<st,\,t>>} \lambda C'_{<st,\,t>}\, \lambda \alpha_{<st>}.\exists \gamma[\gamma \in C' \wedge \gamma_s \wedge S(C', \alpha)]$

F-OP takes SUP as its domain restrictor and asserts that there is one element in the domain *C* further restricted by SUP (i.e. $S(\alpha)$) such that the element is true. A complete picture concerning the morpho-semantics of Mandarin SM *zui-duo* is presented below, with the internal structure in (54) and the semantics in (55).[26]

(54) The internal structure of Mandarin SM *zui-duo* at LF



(55) $[\![zui\text{-}duo(C)]\!]^{s,A}$
$= \lambda \alpha_{<s,\,t>}.\exists \gamma[\gamma \in C \wedge \gamma_s \wedge \forall \beta[\beta \in C \wedge \beta \neq \alpha \rightarrow \max(\lambda d.A(\mu)(\alpha) \geq d) > \max(\lambda d.A(\mu)(\beta) \geq d)]]$

Given that the set of focus alternatives does not have to be propositional and that SMs may be adjoined to constituents of non-propositional meanings, I assume a non-propositional entry of Mandarin SM *zui-duo* in (56), which can be obtained by the Geach rule (see Jacobson 1999; Coppock & Brochhagen 2013: §2.2; Coppock & Beaver 2014: 397).

(56) A non-propositional version of Mandarin SM *zui-duo*
$[\![zui\text{-}duo(C)]\!]^{s,A} = \lambda \alpha_{<\eta,\,t>}\, \lambda P_{<\eta>}.\exists \gamma[\gamma \in C \wedge \gamma(P) \wedge \forall \beta[\beta \in C \wedge \beta \neq \alpha \rightarrow \max(\lambda d.A(\mu)(\alpha) \geq d) \wedge \max(\lambda d.A(\mu)(\beta) \geq d)]$

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expect F-OP to freely show up in any comparative construction; however, as far as expressions of SMs are concerned, it is expected that F-OP can be overtly realized in some languages, but covert in others.

26. In this paper, I assume that the truth of a proposition is evaluated relative to a situation *s*, rather than a world *w*. A situation *s* is a piece of a world. Worlds are maximal situations, i.e. situations that are not a proper part of any other situation. One important logical property of situations is that they are persistent: for all situations *s* and *s'*, if *s* is part of *s'* and a proposition *p* is true in *s*, then the proposition *p* is also true in *s'* (formally, $\forall s, s'$, if $s \leq s'$ and $s \in p$, then $s' \in p$). See Kratzer (1989) for more detail. The main reason to adopt situation semantics here lies in the idea that in the case of SMs as a propositional modifier where we evaluate the truth of the prejacent versus the truth of the higher/lower alternatives, we only compare those minimal situations where only the prejacent is true and those minimal situations where only the alternative(s) is true. See von Fintel (2002) and Kratzer (2014) for discussion and the definition of minimal situations.

Before moving to the computation of Mandarin data, it is worth noting that with the stage set up, when SMs serve as a propositional modifier, what is actually compared are two sets of situations: one is a set of situations where the prejacent holds true and the other is a set of situations where the alternatives (the higher/the lower ones) hold true. When SMs serve as a non-propositional modifier, what is compared are the focus associate and its alternatives along a contextually-given dimension.

4.1.1 Compositions: Superlative Modifiers (*zui-duo*)

Let us first consider the case of propositional modification. The relevant sentence is presented in (57), with its LF in (58). The computation is illustrated in (59).

(57) ***Zui-duo*** *Liubei shi yi-wei* $[fu]_F$*-jiaoshou.*
SUP-much Liubei be one-CL associate-professor
'At most, Liubei is an associate professor.'

(58) LF: $[_{IP}$ **zui-duo**(C) $[_{IP}$ $[_{IP}$ Liubei is an $[\text{associate}]_F$ professor$]$ $\sim C]]$

(59) a. $[\![zui\text{-}duo(C)]\!]^{s,A}$
$= \lambda\alpha_{<s,t>}.\exists\gamma[\gamma \in C \wedge \gamma_s \wedge \forall\beta[\beta \in C \wedge \beta \neq \alpha \rightarrow \max(\lambda d.A(\mu)(\alpha) \geq d) > \max(\lambda d.A(\mu)(\beta) \geq d)]]$

b. $\alpha \sim C$ is defined iff $[\![\alpha]\!]^o \in C \wedge \exists\alpha'[\alpha' \neq \alpha \wedge [\![\alpha']\!]^o \in C] \wedge C \subseteq [\![\alpha]\!]^f$

c. $C = \{\lambda s.$Liubei is a full professor in s, $\lambda s.$Liubei is an associate professor in s, $\lambda s.$Liubei is an assistant professor in $s\}$

d. $[\![(57)]\!]^{s,A} = 1$ iff $\exists\gamma[\gamma \in C \wedge \gamma_s \wedge \forall\beta[\beta \in C \wedge \beta \neq \lambda s.$Liubei is an associate professor in $s \rightarrow \max(\lambda d.A(\mu)(\lambda s.$Liubei is an associate professor in $s) \geq d) > \max(\lambda d.A(\mu)(\beta) \geq d)]]$

Because of the presuppositions introduced by the ~ squiggle operator (Rooth 1992), the prejacent is one element in the domain *C*. Note that the domain *C* of *zui-duo* is anaphoric to the CQ (suppose it is *what type of professor is Liubei?*). Furthermore, because of the restrictions imposed by the superlative SUP, the elements non-identical to the prejacent are ranked below the prejacent; this amounts to excluding the higher alternatives. Taken together; the domain *C* further restricted by SUP is now a set consisting of only the pejacent and its lower alternatives. The assertion with *zui-duo* requires that there is one element in this restricted domain such that the element is true. According to (59), (57) is judged true if and only if there is one element in the domain (i.e. a set exclusively consisting of the prejacent and its lower alternatives) such that the element is true. This seems intuitively correct. Consider an academic ranking like *full professor* > *associate professor* > *assistant professor*, the sentence (57) is true only if *Liubei* is an associate professor or an assistant professor. Given the measured domain along

with the natural ordering, the relevant dimension may be Liubei's academic success or Liubei's suitability to be a dean (assuming the academic ranking is related to the suitability), etc.

The same analysis can be extended to the preverbal *zui-duo*, assuming the well-known VP-Internal Subject Hypothesis (Sportiche 1988). To simplify the computation, the subject is assumed to reconstruct to its base-generated position Spec, vP for interpretation.[27] The relevant sentence is presented in (60) and its LF in (61).

(60) *Liubei **zui-duo** shi yi-wei [fu]$_F$-jiaoshou.*
Liubei SUP-much be one-CL associate-professor
'Liubei is at most an associate professor.'

(61) LF: [$_{vP}$ **zui-duo**(*C*) [$_{vP}$ [$_{vP}$ Liubei is an [associate]$_F$ professor] ~*C*]]

Next, let us consider the case of non-propositional modification (i.e. the prenominal case).[28] The idea here is that the syntactic position where a focus particle is merged determines its quantificational domain. Thus, when a focus particle is merged in the prenominal position, its quantificational domain is then non-propositional (e.g. a set of individuals or generalized quantifiers). Now, consider the relevant sentence in (62) and its LF in (63). The computation is illustrated in (64).[29]

(62) *Liubei mai-le **zui-duo** [san]$_F$-ke pinguo.*
Liubei buy-ASP SUP-many three-CL apple
'Liubei bought at most three apples.'

(63) LF: [[$_{FP}$ **zui-duo**(*C*) [$_{NumP}$ [$_{NumP}$ [three]$_F$ apples] ~*C*]]$_1$ λ1 [Liubei bought t$_1$]][30]

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27. The reconstruction of the subject for interpretation is simply to avoid unnecessary complications such as calculating the lambda-abstract created by the movement of the subject from Spec, vP to Spec, IP. Nothing crucial hinges on the assumption of the reconstruction.

28. If one considers the preverbal case to be non-propositional, the non-propositional entry of *zui-duo* discussed in § 4.1 is readily to be applied in the pre-verbal case as well.

29. For readability, I abstract away from the issue of aspect, classifiers, and bare nouns. See Chen (2019) for an analysis of Mandarin SMs, incorporating the contributions of Mandarin classifiers and bare nouns.

30. For purposes of this paper, I gloss over the exact position of prenominal *zui-duo*/*zui-shao*, assuming that they are hosted by some functional projection above NumP within the nominal. A viable alternative possibility is that prenominal *zui-duo*/*zui-shao* is adjoined to numerals (in this sense, they are bona fide "modified numerals") and then the whole constituent with numerals undergoes quantifier-raising. See Kennedy (2015) for a similar analysis of English modified numerals. Crucially, the semantics of prenominal *zui-duo*/*zui-shao* proposed in this paper is compatible with both analytical possibilities.

(64) a. $[\![zui\text{-}duo(C)]\!]^{s,A}$
$= \lambda\alpha_{<\eta,\, t>}\, \lambda P_{<\eta>}.\exists\gamma[\gamma \in C \wedge \gamma(P) \wedge \forall\beta[\beta \in C \wedge \beta \neq \alpha \rightarrow \max(\lambda d.A(\mu)(\alpha) \geq d) \wedge \max(\lambda d.A(\mu)(\beta) \geq d)]]$

b. $\alpha \sim C$ is defined iff $[\![\alpha]\!]^{o} \in C \wedge \exists\alpha'[\alpha' \neq \alpha \wedge [\![\alpha']\!]^{o} \in C] \wedge C \subseteq [\![\alpha]\!]^{f}$

c. $[\![\text{three apples}]\!]^{f} = \left\{ \begin{array}{l} \ldots \\ \lambda Q\, \exists z[\text{apple}(z) \wedge \mu_{\text{card}}(z) \geq 4 \wedge Q(z)] \\ \lambda Q\, \exists z[\text{apple}(z) \wedge \mu_{\text{card}}(z) \geq 3 \wedge Q(z)] \\ \lambda Q\, \exists z[\text{apple}(z) \wedge \mu_{\text{card}}(z) \geq 2 \wedge Q(z)] \\ \ldots \end{array} \right\}$

d. $[\![(62)]\!]^{s,A} = 1$
iff $\exists\gamma[\gamma \in C \wedge \gamma(\lambda x.\text{Liubei bought } x) \wedge$
$\forall\beta[\beta \in C \wedge \beta \neq [\![\text{three apples}]\!]^{s,A} \rightarrow$
$\max(\lambda d.A(\mu)([\![\text{three apples}]\!]^{s,A}) \geq d) > \max(\lambda d.A(\mu)(\beta) \geq d)]]$

As before, the prejacent *three apples* is an element in the domain C because of the presuppositions imposed by the ~ squiggle operator. The superlative SUP excludes the higher alternatives such as four apples, five apples and so on. The domain C combined with the contribution of SUP is now a set consisting of only the prejacent and its lower alternatives. The assertion with *zui-duo* requires that there is one element in this restricted domain such that the element is true. According to (64), the sentence (62) is predicted to be true if and only if there is one element in the domain such that the proposition denoted by that element composed with the relevant verbal information is true.

Before leaving this section, I should like to address an issue concerning the monotonicity of *zui-duo*. In principle, sentences like (62) with *zui-duo* can still be true even if Liubei did not buy any apples (the same hold true for English *at most*). That is, sentences with *zui-duo*/*at most* lack an existential entailment. Note that the issue concerning the lack of existential entailment is not unique to SMs like *zui-duo*/*at most*; in fact, it is a general feature of negative quantifiers such as English *less than three*, as shown below, where the sentence is still judged true when no student left.

(65) Less than three students left.

There are at least two ways to approach this issue. One approach (a semantic approach) to this issue is that people may attempt to define a notion of *null individual* and incorporates the null individual into the ontology (see Buccola & Spector 2016: § 8.3 for some tentative proposals). This semantic approach is fairly legitimate, though it requires some revolutionary revision of our current theories of plurality. Similar issues concerning the null individual is also raised in recent studies on the semantics of the word *zero* (see Bylinina & Nouwen 2018).

Alternatively, one may pursue a pragmatic approach. Given that *at most* is a scalar focus operator across different scales (i.e. not unique to numerical scales) and its quantificational domain is anaphoric to the denotation of Question-Under-Discussion (QUDs) in the discourse, we may try to address the issue by looking into the question-answer congruence in the discourse. More specifically, given that the semantics of *zui-duo* only concerns the prejacent and its lower alternatives, the issue concerning existential entailment boils down to whether negative quantifiers such as *no NP* or the numeral *zero* are included in the domain *C* as one of the lower alternatives.[31] It follows that depending on the content of the answerhood operator, the *zero* element may (not) be included.

A nuanced perspective on the second approach is to say that negative responses like *no one* are not part of the semantics of a constituent question, but only allowed under certain discourse conditions (typically in a cross-speaker conversation). It has been argued that a constituent question semantically imposes an existential presupposition (e.g. Dayal 2016: Chapter 2, among others). Roughly speaking, when the speaker asks a question like *who left?*, the speaker imposes a soft presupposition that *someone left* in asking the question. An important observation from Dayal (2016: § 2.3.4) is that those negative responses are mostly allowed in a cross-speaker conversation (see 66a), while questions with a cleft typically do not brook those negative responses (see 66b). The conclusion suggested in Dayal (2016) is that the ordinary constituent question has a soft presupposition while the question with a cleft has a hard presupposition (that comes from the cleft). (67) taken from Dayal (2016: 52) illustrates her point.

(66) a. Q: Who left? Ans.: No one/No one left.
b. Q: Who was it that left? Ans.: #No one/#No one left.

(67) a. Who left?
Presupposes: $\mathbf{I}_{\text{SPEAKER}}$ assume that someone left.
b. Who was it that left?
Presupposes: $\mathbf{We}_{\text{SPEAKER+HEARER}}$ believe that someone left.

In short, the proposed analysis of *zui-duo* is compatible with the three positions discussed above. Crucially, as long as the relevant higher alternatives are systematically excluded by the semantics of *zui-duo* (i.e. excluded from being a true answer to the discourse question), they will be a downward-entailing quantifier, leaving open the exact nature of those negative responses.

31. See also Mihoc (2019) for the similar idea that the relevant higher alternatives are systematically excluded in the case of English *at most*, thus making it a downward-entailing quantifier.

Finally, an anonymous reviewer wonders whether the proposed semantics of *zui-duo* is too weak, given the infelicity in (68): an assertion with *zui-duo* is completely unacceptable with a situation where the higher alternative (e.g. *Xiaoming's eating five candies*) is true.

(68) *Xiaoming **zui-duo** chi-le si-ke tangguo, #ye keneng shi wu-ke.*
Xiaoming SUP-much eat-ASP four-CL candy also possible be five-CL
'Xiaoming ate at most four candies; #it is also possible to be five.'

First, it is well-observed in the literature that an assertion with SMs typically leads to a speaker ignorance inference, as illustrated below. In (69), Speaker B's assertion with *zui-duo* conveys her ignorance about whether *Xiaoming* has eaten exactly four candies or fewer than four candies.

(69) A: *Xiaoming jiujing chi-le duo-shao tangguo?* (The Current Question (CQ))
Xiaoming exactly eat-ASP how-many candy
'Exactly how many candies did Xiaoming eat?'
B: *Xiaoming **zui-duo** chi-le si-ke tangguo.*
Xiaoming SUP-much eat-ASP four-CL candy
'Xiaoming has eaten at most four candies.'

Crucially, the above conversation shows that when the maxim of quantity is active (given the CQ), by making an assertion with SMs, the speaker is drawing a line between **what she is certain about** and **what she is not**. The prejacent (i.e. *Xiaoming ate four candies*) chosen among the set of alternatives is precisely the line explicitly drawn by the speaker.

Second, under the assertion with *zui-duo*, given the proposed semantics, the speaker is not silent about whether the higher alternatives are true or false. By choosing a particular lower scalar value as the prejacent (i.e. *Xiaoming ate four candies*) under her assertion with *zui-duo*, the speaker consciously and explicitly excludes any more informative alternatives ranked above the prejacent (e.g. *Xiaoming ate five candies*...etc.). Note that such exclusion of the higher alternatives made by the speaker cannot be attributed to their irrelevance, given the CQ. Thus, under the assertion with *zui-duo*, the speaker is not uncertain about whether higher alternatives are true or false.

Taken together, given her explicitly choosing a lower scalar value as the prejacent p under the assertion with *zui-duo*, the speaker is not silent about the status of its higher alternatives q—they are crucially excluded by the speaker because they are believed to be false in the discourse.

Seen in this light, I suggest that the infelicity of (68) results from a self-contradiction of the speaker's beliefs/knowledge under her assertion. Assuming

that the speaker sincerely believes what she asserts, by making an assertion with *zui-duo* that *Xiaoming has eaten at most four apples*, the speaker explicitly excludes the higher alternatives (e.g. *Xiaoming has eaten five apples*) because they are (believed to be) false; but then the same speaker continues to assert that the higher alternatives are also possibly true, which crucially contradicts what she believes under her previous assertion. It is precisely this **self-contradiction** that leads to the infelicity of (68). Below, I provide more examples to support this intrinsic connection between the speaker's beliefs/knowledge and the exclusion of higher alternatives under her assertion with *zui-duo*.[32]

Assuming that the conversation in a given discourse is governed by Cooperative Principle (Grice 1975), (70) presents the maxim of quality and the maxim of quantity.

(70) a. **The maxim of quality**
Do not say what you believe to be false
Do not say for which you lack adequate evidence
b. **The maxim of quantity**
Make your contribution as informative as required
Do not make your contribution more informative as required

Assuming that the speaker is obeying both the maxim of quality and the maxim of quantity, let us consider the speaker's assertion addressing the CQ in (71), where the asserted sentence remains the same but the speaker's beliefs are crucially different.

(71) CQ: What medal did Adam win?

(72) Context: Speaker B believes that Adam has won a gold medal.
B's assertion: #*Yadang* ***zui-duo*** *na* $[yin]_F$*-pai.*
Adam SUP-much take silver-medal
'Adam won at most a silver medal.'

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32. The suggested connection between the semantics of *zui-duo* and the speaker's beliefs/knowledge also correctly captures the infelicity in (i), assuming the same CQ as in (71): *Exactly how many candies did Xiaoming eat?*

(i) Context: Speaker B believes that Adam has eaten five apples.
B's assertion: #*Xiaoming* ***zui-duo*** *chi-le si-ke tangguo.*
Xiaoming SUP-much eat-ASP four-CL candy
'Xiaoming has eaten at most four candies.'

Speaker B's assertion is infelicitous according to her beliefs: it violates the maxim of quality because she wrongly excludes Adam's eating five apples, not only contradicting what she believes but also saying things that are believed to be false by the speaker herself, and she also mistakenly signals her ignorance about whether *Xiaoming* has eaten exactly four apples or fewer than four apples.

Speaker B's assertion is **infelicitous** according to her beliefs: it violates the maxim of quality because she wrongly excludes Adam's winning a gold medal, not only contradicting what she believes but also saying things that are believed to be false by the speaker herself, and she also mistakenly signals her ignorance about whether Adam has won a silver medal or a bronze medal.

(73) Context: Speaker B believes that Adam has won a silver medal.
B's assertion: #*Yadang* ***zui-duo*** *na* [*yin*]$_F$*-pai.*
Adam SUP-much take silver-medal
'Adam won at most a silver medal.'

Speaker B's assertion is **infelicitous** according to her beliefs: it violates the maxim of quality because she mistakenly signals her ignorance about whether Adam has won a silver medal or a bronze medal, and it also violates the maxim of quantity because she could have asserted that Adam has won a silver medal.

(74) Context: Speaker B believes that Adam has won a bronze medal.
B's assertion: #*Yadang* ***zui-duo*** *na* [*yin*]$_F$*-pai.*
Adam SUP-much take silver-medal
'Adam won at most a silver medal.'

Speaker B's assertion is **infelicitous** according to her beliefs: it violates the maxim of quality because she mistakenly signals her ignorance about whether Adam has won a silver medal or a bronze medal, and it also violates the maxim of quantity because she could have asserted that Adam has won a bronze medal.

(75) Context: Speaker B believes that Adam has won a silver medal or a bronze medal.
B's assertion: *Yadang* ***zui-duo*** *na* [*yin*]$_F$*-pai.*
Adam SUP-much take silver-medal
'Adam won at most a silver medal.'

No infelicity arises because the speaker is truly committed to her ignorance about whether Adam has won a silver medal or a bronze medal, which is consistent with her assertion with *zui-duo*.

4.1.2 Compositions: Quantity Superlatives (*zui-duo*)

For comparison and completeness, this section illustrates the computation of QSs with *zui-duo* in the nominal domain and verbal domain. Let us first consider QSs in the nominal domain. Recall that we have assumed the movement approach where the relative reading of QSs results from an LF where the degree operator moves to take scope (see § 3.3). Given that we have decomposed the superlative

into two parts: the Q-adjective *duo* and the constituent where *zui* contains the covert comparative morpheme COMP$^+$, on the current analysis, this means that the degree operator that takes scope would be the syntactic chunk [**zui**-COMP$^+$]. The relevant sentence is presented in (76), with its LF in (77). The semantics of the superlative morpheme *zui* involved in canonical Quantity Superlatives is shown in (78). A detailed compositional computation is presented in (79).

(76) QSs in Nominal Domain
Liubei mai-le ***zui-duo*** *ke pinguo.*
Liubei buy-ASP SUP-many CL apple
'Liubei bought more apples than anyone else did.'

(77) $[[\text{Liubei}]_2\ [[\textbf{zui}\text{-COMP}^+]\text{-}C\ [\lambda 1\ [\lambda 2\ [x_2\ \text{bought}\ [d_1\text{-}\ \textbf{duo}\ \text{apples}]]]]]]$

(78) $[\![zui]\!]^A = \lambda M_{<<d,<\eta,t>>,<\eta,<\eta,t>>>} \lambda C_{<\eta,t>} \lambda g_{<d,<\eta,t>>} \lambda \alpha_{<\eta>}. \forall \beta_{<\eta>} [\beta \in C \wedge \beta \neq \alpha \rightarrow M(g)(\alpha)(\beta)]$

(79) a. $[\![duo_\mu]\!]^A = \lambda d.\lambda \alpha.A(\mu)(\alpha) \geq d$

b. $[\![\ [d_1\text{-}\ \textbf{duo}\ \text{apples}]\ ]\!]^A = \lambda x.\text{apples}(x) \wedge A(\mu)(x) \geq d_1$

c. $[\![\ [x_2\ \text{bought}\ [d_1\text{-}\ \textbf{duo}\ \text{apples}]]\ ]\!]^A = \exists x.\ \text{bought}\ (x_2, x) \wedge \text{apples}(x) \wedge A(\mu)(x) \geq d_1$

d. $[\![\ [\lambda 1[\lambda 2[x_2\ \text{bought}\ [d_1\text{-}\ \textbf{duo}\ \text{apples}]]]]\ ]\!]^A$
$= \lambda d\, \lambda y\ \exists x.\ \text{bought}\ (y, x) \wedge \text{apples}(x) \wedge A(\mu)(x) \geq d$

e. $[\![\ [\textbf{zui}\text{-COMP}^+]\text{-}C\ ]\!]^A$
$= \lambda g_{<d,<e,t>>} \lambda z_e. \forall z'[z' \in C \wedge z' \neq z \rightarrow \max(\lambda d.g(z) \geq d) > \max(\lambda d.g(z') \geq d)]$

f. $C = \{x\text{: } \exists d.\ x\ \text{bought}\ d\text{-many apples}\}$

g. $[\![\ [[\textbf{zui}\text{-COMP}^+]\text{-}C[\lambda 1[\lambda 2\ [\ x_2\ \text{bought}\ [d_1\text{-}\ \textbf{duo}\ \text{apples}]]]]]\ ]\!]^A$
$= \lambda z_e.\ \forall z'[z' \in C \wedge z' \neq z \rightarrow \max(\lambda d.\ z\ \text{bought}\ d\text{-many apples}) > \max(\lambda d.\ z'\ \text{bought}\ d\text{-many apples})]$

h. $[\![\ (76)\ ]\!]^A = 1$ iff $\forall z'[z' \in C \wedge z' \neq \text{Liubei} \rightarrow \max(\lambda d.\ \text{Liubei bought}\ d\text{-many apples}) > \max(\lambda d.\ z'\ \text{bought}\ d\text{-many apples})]$

i. In words: For all relevant *z'* mentioned in *C*, the number of apples *Liubei* bought exceeds the number of apples *z'* bought.

(79a) is given by the semantics of the Q-adjective *duo*. (79b) is derived by Predicate Modification, by composing the noun *pingguo* 'apples' with the Q-adjective (whose degree argument is saturated by the trace left by the movement of the chunk [**zui**-COMP$^+$]-*C*). (79c) is obtained by composing (79b) with the verb and the subject, assuming an existential closure over the individual variable *x*. (79d) is obtained by the lambda-abstraction, resulting from the movement of the subject and the chunk [**zui**-COMP$^+$]-*C*. (79e) is given by composing *zui* with COMP$^+$. (79f) provides the contextual value of the domain *C*. (79g) is obtained by Func-

tional Application, applying (79e) to (79d). Finally, according to (79h), the sentence (76) is true if and only if the number of apples that *Liubei* bought is more than the number of apples that any other individual bought. This seems intuitively correct.

Now, let us consider QSs in the verbal domain. Again, the degree operator [**zui**-COMP$^+$] will move to take scope under the movement approach. The relevant sentence is shown in (80), with its LF in (81). A detailed compositional computation is presented in (82).

(80) QSs in Verbal Domain
*(Paobu) Liubei pao **zui-duo**.*
Running Liubei run SUP-much
'(As for running,) Liubei ran more than anyone else did.'

(81) $[[\text{Liubei}]_2\ [[\textbf{zui}\text{-Comp}^+]\ \text{-}C\ [\lambda 1\ [\lambda 2\ [\exists\ [x_2\ [\text{ran}\ d_1\text{-}\textbf{duo}]]]]]]]$

(82) a. $[\![duo_\mu]\!]^A = \lambda d.\lambda \alpha.A(\mu)(\alpha) \geq d$

b. $[\![\ [\text{ran}\ d_1\text{-}\ \textbf{duo}]\ ]\!]^A = \lambda e.\text{ran}(e) \wedge A(\mu)(e) \geq d_1$

c. $[\![\ [x_2\ [\text{ran}\ d_1\text{-}\ \textbf{duo}]]\ ]\!]^A = \lambda e.\ \text{Agent}(e) = x_2 \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d_1$

d. $[\![\ [\exists\ [x_2\ [\text{ran}\ d_1\text{-}\ \textbf{duo}]]]\ ]\!]^A = \exists e.\text{Agent}(e) = x_2 \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d_1$

e. $[\![\ [\lambda 1\ [\lambda 2\ [\exists\ [x_2\ [\text{ran}\ d_1\text{-}\ \textbf{duo}]]]]]\ ]\!]^A = \lambda d\ \lambda y\ \exists e.\ \text{Agent}(e) = y \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d$

f. $[\![\ [\textbf{zui}\text{-COMP}^+]\text{-}C\ ]\!]^A$
$= \lambda g_{<d,<e,t>>}\ \lambda z_{<e>}.\ \forall z'[z' \in C \wedge z' \neq z \rightarrow \max(\lambda d.g(z) \geq d) > \max(\lambda d.g(z') \geq d)]$

g. $C = \{x\colon \exists d.x\ \text{ran}\ d\text{-much}\}$

h. $[\![\ [[\textbf{zui}\text{-Comp}^+]\text{-}C\ [\lambda 1\ [\lambda 2\ [\exists\ [x_2\ [\text{ran}\ d_1\text{-}\textbf{duo}]]]]]]\ ]\!]^A$
$= \lambda z_{<e>}.\ \forall z'[z' \in C \wedge z' \neq z \rightarrow \max(\lambda d\ \exists e.\ \text{Agent}(e) = z \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d) > \max(\lambda d\ \exists e.\ \text{Agent}(e) = z' \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d)$

i. $[\![\ (80)\ ]\!]^A = 1$
iff $\forall z'[z' \in C \wedge z' \neq \text{Liubei} \rightarrow \max(\lambda d\ \exists e.\ \text{Agent}(e) = \text{Liubei} \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d) > \max(\lambda d\ \exists e.\ \text{Agent}(e) = z' \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d)$

j. In words: For all relevant *z'* mentioned in *C*, the quantity that *Liubei* ran exceeds the quantity that *z'* ran, along a contextually-given dimension (e.g. duration or distance).

(82a) is given by the semantics of the Q-adjective *duo*. (82b) is derived by Predicate Modification, by composing the verb *pao* 'run' (assuming a neo-Davidsonian semantics of verbs denoting a predicate of events) with the Q-adjective (whose degree argument is saturated by the trace left by the movement of the chunk [**zui**-COMP$^+$]-*C*). (82c) is obtained by composing (82b) with the subject. (82d) is obtained by assuming an existential closure over the event variable *e*. (82e) is obtained by the lambda-abstraction, resulting from the movement of the subject and the chunk [**zui**-COMP$^+$]-*C*. (82f) is given by composing *zui* with COMP$^+$. (82g) provides the contextual value of the domain *C*. (82h) is obtained by Functional Application, applying (82f) to (82e). Finally, according to (82i), the sentence (80) is true if and only if the quantity of events that *Liubei* ran exceeds the quantity of events that anyone else ran (e.g. in terms of duration/distance). This seems intuitively correct.

4.2 The anatomy of *zui-shao*

In this section, I first spell out my decompositional analysis of *zui-shao*; then I illustrate how the proposed analysis works for different syntactic positions of *zui-shao*: cases of propositional modification and those of non-propositional modification. Finally, I present a detailed compositional computation of QSs with *zui-shao* in the nominal domain and verbal domain.

One important issue centers on how to capture the antonymous relation indicated in the morphology: *zui-duo* 'SUP-much' and *zui-shao* 'SUP-little'. This issue of antonyms boils down to how to properly represent the morpho-semantics of *shao* 'little' and its relation to *duo* 'much'. Following the decompositional analysis of English *little* and *less* along the line in Heim (2006a; 2006b) and Büring (2007; 2009), I propose that the quantity adjective *shao* 'little' contributes to two semantic components at LF: a negative feature NEG and a covert *duo* 'much' (see also Solt 2009; 2015, and § 3.2). As in the case of SM *zui-duo*, I propose that in Mandarin SM *zui-shao*, the superlative construction structurally embeds a comparative construction (assume Bobaljik's 2012 Containment Hypothesis). The covert comparative morpheme Comp$^+$ combined with the negative feature NEG is reanalyzed as a covert comparative morpheme Comp$^-$ (with the opposite comparison relation). The connection between Comp$^+$ and Comp$^-$ is reminiscent of Heim's and Büring's analyses of English *less* as a reanalyzed result from the combination of a negation contributed by adjectives with negative polarity (glossed as little in their analyses) and the comparative morpheme *-er*.

The superlative construction SUP involved in Mandarin SM *zui-shao* is schematized in (83). The semantics of Comp$^-$ (cf. English *less*) is defined in (85);

it takes the Q-adjective *duo* as its first argument and returns a comparison relation between the prejacent and its alternatives along a contextually-valued dimension.

(83) $[[_{\text{SupP}}\ zui\ [_{\text{Comp}^-\text{P}}\ \text{Comp}^-]]\ [duo]]$

(84) NEG-Comp$^+$ is reanalyzed as Comp$^-$ (Heim 2006a, b; Büring 2007, 2009)

(85) $[\![\ \text{Comp}^-]\!]^A = \lambda g.\lambda\alpha\lambda\beta.\max(\lambda d\ .g(\alpha)\geq d) < \max(\lambda d.g(\beta)\geq d)$
$<<d, <\eta, t>>, <\eta, <\eta, t>>>$

Composing (85) with the same semantics of *duo* and *zui* (see §4.1) delivers the semantics of the superlative, as in (86). On the current analysis, the crucial difference between the SUP in *zui-duo* and that in *zui-shao* lies in the opposite comparison relation between the prejacent (i.e. the comparative standard) and its alternatives: the greater-than vs. less-than relation.[33]

(86) $[\![\ (83)\ ]\!]^A = \lambda C_{<\eta, t>}\lambda\alpha_{<\eta>}.\forall\beta[\beta\in C \wedge \beta \neq \alpha \rightarrow$
$\max(\lambda d.A(\mu)(\alpha)\geq d) < \max(\lambda d.A(\mu)(\beta)\geq d)]$

Next, as in the case of Mandarin SM *zui-duo*, the superlative construction serves as a domain restrictor on the set of alternatives induced by focus. For example, in the case of *zui-shao*, the superlative construction SUP requires that all the alternatives that are non-identical to the prejacent α in the domain C, be ranked **above** the prejacent along a contextually-given dimension. This amounts to excluding the lower alternatives in the computation of the sentences with *zui-shao*.

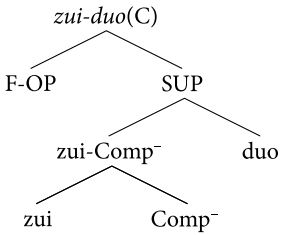
Finally, as in the case of Mandarin SM *zui-duo*, the superlative construction SUP as a whole is structurally embedded under a covert existential operator F-OP. The propositional version of the F-OP is repeated as (87). Note that S represents the meaning of the superlative SUP in SMs.

(87) $[\![\text{F-OP}]\!]^{s, A} = \lambda S_{<<st, t>, <st, t>>}\lambda C'_{<st, t>}\ \lambda\alpha_{<st>}.\exists\gamma[\gamma\in C' \wedge \gamma_s \wedge S(C', \alpha)]$

The morpho-semantics of Mandarin SM *zui-shao* is presented below, with the internal structure in (88) and the semantics in (89).

33. See Stateva (2003) for a similar idea that superlatives should be decomposed in a way the two opposite ordering relations in question are encoded in the semantics of comparative heads, and for empirical evidence from Slavic languages where superlatives are formed by overt comparative heads (as envisioned here) coupling with a superlative particle.

(88) The internal structure of Mandarin SM *zui-shao* at LF



(89) $[\![zui\text{-}shao(C)]\!]^{s,A} = \lambda\alpha_{<s,t>}.\exists\gamma[\gamma\in C \wedge \gamma_s \wedge \forall\beta[\beta\in C \wedge \beta \neq \alpha \rightarrow \max(\lambda d.A(\mu)(\alpha)\geq d) < \max(\lambda d.A(\mu)(\beta)\geq d)]]$

Given that the set of focus alternatives does not have to be propositional and that SMs may be adjoined to constituents of non-propositional meanings, a non-propositional entry of Mandarin SM *zui-shao* can be obtained in (91), via the Geach rule.

(90) A non-propositional version of Mandarin SM *zui-shao*
$[\![zui\text{-}shao(C)]\!]^{s,A} = \lambda\alpha_{<\eta,t>}\lambda P_{<\eta>}.\exists\gamma[\gamma\in C \wedge \gamma(P) \wedge \forall\beta[\beta\in C \wedge \beta \neq \alpha \rightarrow \max(\lambda d.A(\mu)(\alpha)\geq d) < \max(\lambda d.A(\mu)(\beta)\geq d)]]$

In short, if the superlative is further decomposed, the locus of variation in ordering relations then lies in the comparative, where we do see overt morphological evidence in natural language.

4.2.1 Compositions: Superlative Modifiers (*zui-shao*)

Let us first consider the case of propositional modification. The relevant sentence is presented in (91), with its LF in (92). The computation is illustrated in (93).

(91) ***Zui-shao*** *Liubei shi yi-wei* $[fu]_F$*-jiaoshou.*
SUP-little Liubei be one-CL associate-professor
'At least, Liubei is an associate professor.'

(92) LF: $[_{IP}$ **zui-shao**(C) $[_{IP}$ $[_{IP}$ Liubei is an $[\text{associate}]_F$ professor$]$ $\sim C]]$

(93) a. $[\![zui\text{-}shao(C)]\!]^{s,A} = \lambda\alpha_{<s,t>}.\exists\gamma[\gamma\in C \wedge \gamma_s \wedge \forall\beta[\beta\in C \wedge \beta \neq \alpha \rightarrow \max(\lambda d.A(\mu)(\alpha)\geq d) < \max(\lambda d.A(\mu)(\beta)\geq d)]]$

b. $\alpha \sim C$ is defined iff $[\![\alpha]\!]^o \in C \wedge \exists\alpha'[\alpha'\neq\alpha \wedge [\![\alpha']\!]^o \in C] \wedge C \subseteq [\![\alpha]\!]^f$

c. C = {λs.Liubei is a full professor in s, λs.Liubei is an associate professor in s, λs.Liubei is an assistant professor in s}

d. $[\![(91)]\!]^{s,A} = 1$
iff $\exists\gamma[\gamma\in C \wedge \gamma_s \wedge \forall\beta[\beta\in C \wedge \beta \neq \lambda s$.Liubei is an associate professor in $s \rightarrow \max(\lambda d.A(\mu)(\lambda s$.Liubei is an associate professor in $s)\geq d)$ $< \max(\lambda d.A(\mu)(\beta)\geq d)]]$

Given the presuppositions introduced by the ~ squiggle operator, the prejacent is one element in the domain *C*. Furthermore, because of the restrictions imposed by the superlative SUP, the elements non-identical to the prejacent are ranked above the prejacent; this amounts to excluding the lower alternatives. Taken together; the domain *C* further restricted by SUP is now a set consisting of only the pejacent (i.e. *Liubei is an associate professor*) and its higher alternative (e.g. *Liubei is a full professor*). The assertion with *zui-shao* requires that there is one element in this restricted domain such that the element is true. According to (93), (91) is judged true if and only if there is one element in the domain (i.e. a set exclusively consisting of the prejacent and its higher alternatives) such that the element is true. This seems intuitively correct.[34] Given an academic ranking like *full professor* > *associate professor* > *assistant professor*, the sentence (91) is true only if *Liubei* is an associate professor or a full professor. Given the measured domain along with the natural ordering, the relevant dimension may be Liubei's academic success or Liubei's suitability to be a dean (assuming the academic ranking is related to the suitability), etc.

The same analysis can be extended to the preverbal *zui-shao*. To simplify the computation, the subject is assumed to reconstruct to its base-generated position Spec, vP for interpretation. The relevant sentence is presented in (94) and its LF in (95).

(94) *Liubei* ***zui-shao*** *shi yi-wei* $[fu]_F$*-jiaoshou.*
Liubei SUP-little be one-CL associate-professor
'Liubei is at least an associate professor.'

(95) LF: $[_{vP}$ **zui-shao**(C) $[_{vP}$ $[_{vP}$ Liubei is an $[\text{associate}]_F$ professor$]$ ~$C]]$

Next, consider the case of non-propositional modification (i.e. the prenominal case). The relevant sentence is presented in (96) and its LF in (97). The computation is illustrated in (98).

(96) *Liubei mai-le* ***zui-shao*** $[san]_F$*-ke pinguo.*
Liubei buy-ASP SUP-few three-CL apple
'Liubei bought at least three apples.'

(97) LF: $[[_{FP}$ **zui-shao**(C) $[_{NumP}$ $[_{NumP}$ $[\text{three}]_F$ apples$]$ ~$C]]_1$ λ1 [Liubei bought t_1]]

34. Sentences with sentence-initial *zui-shao* have only a concessive reading, while those with preverbal *zui-shao* are ambiguous between a concessive and an ignorance reading. See Chen (2018) for a semantics-pragmatics unified account.

(98) a. $[\![\textit{zui-shao}(C)]\!]^{s,A} = \lambda\alpha_{<\eta,t>}\,\lambda P_{<\eta>}.\exists\gamma[\gamma \in C \wedge \gamma(P) \wedge \forall\beta[\beta \in C \wedge \beta \neq \alpha \rightarrow \max(\lambda d.A(\mu)(\alpha) \geq d) < \max(\lambda d.A(\mu)(\beta) \geq d)]]$

b. $\alpha \sim C$ is defined iff $[\![\alpha]\!]^o \in C \wedge \exists\alpha'[\alpha' \neq \alpha \wedge [\![\alpha']\!]^o \in C] \wedge C \subseteq [\![\alpha]\!]^f$

c. $[\![\text{three apples}]\!]^f = \left\{ \begin{array}{l} \ldots \\ \lambda Q\,\exists z[\text{apple}(z) \wedge \mu_{\text{card}}(z) \geq 4 \wedge Q(z)] \\ \lambda Q\,\exists z[\text{apple}(z) \wedge \mu_{\text{card}}(z) \geq 3 \wedge Q(z)] \\ \lambda Q\,\exists z[\text{apple}(z) \wedge \mu_{\text{card}}(z) \geq 2 \wedge Q(z)] \\ \ldots \end{array} \right\}$

d. $[\![(96)]\!]^{s,A} = 1$
iff $\exists\gamma[\gamma \in C \wedge \gamma(\lambda x.\text{Liubei bought } x) \wedge \forall\beta[\beta \in C \wedge \beta \neq [\![\text{three apples}]\!]^{s,A} \rightarrow \max(\lambda d.A(\mu)([\![\text{three apples}]\!]^{s,A}) \geq d) < \max(\lambda d.A(\mu)(\beta) \geq d)]]$

As before, the prejacent *three apples* is an element in the domain C because of the presuppositions imposed by the ~ squiggle operator. The superlative SUP excludes the lower alternatives such as two apples, one apple, and so on. The domain C combined with the contribution of SUP is now a set consisting of only the prejacent and its higher alternatives. The assertion with *zui-shao* requires that there is one element in the restricted domain such that the element is true. According to (98), the sentence (96) is predicted to be true if and only if there is one element in the domain such that the proposition denoted by that element composed with the relevant verbal information is true.

4.2.2 Compositions: Quantity Superlatives (*zui-shao*)

This section illustrates the computation of QSs with *zui-shao* in the nominal domain and verbal domain. Let us first consider QSs in the nominal domain. Recall that the movement approach where the relative reading of QSs results from an LF where the degree operator moves to take scope is adopted. Given that we have decomposed the superlative into two parts: the Q-adjective *duo* and the constituent where *zui* contains the covert comparative morpheme Comp$^-$, this means that it is the degree operator [**zui**-Comp$^-$] that undergoes movement and scope-taking. The relevant sentence is presented in (99), with its LF in (100). A detailed compositional computation is presented in (101).

(99) QSs in Nominal Domain
Liubei mai-le ***zui-shao*** *ke pinguo.*[35]
Liubei buy-ASP SUP-few CL apple
'Liubei bought fewer apples than anyone else did.'

(100) [[Liubei]$_2$ [[**zui**-Comp$^-$]-C [λ1 [λ2 [x_2 bought [d_1- **duo** apples]]]]]]

(101) a. $[\![duo_{\mu}]\!]^A = \lambda d.\lambda \alpha.A(\mu)(\alpha) \geq d$

b. $[\![\ [d_1\text{- }\mathbf{duo}\text{ apples}]\ ]\!]^A = \lambda x.\text{apples}(x) \wedge A(\mu)(x) \geq d_1$

c. $[\![\ [x_2\text{ bought }[d_1\text{- }\mathbf{duo}\text{ apples}]]\ ]\!]^A = \exists x.\text{ bought }(x_2, x) \wedge \text{apples}(x) \wedge A(\mu)(x) \geq d_1$

d. $[\![\ [\lambda 1[\lambda 2[x_2\text{ bought }[d_1\text{- }\mathbf{duo}\text{ apples}]]]]\ ]\!]^A$
$= \lambda d\, \lambda y\ \exists x.\text{ bought }(y, x) \wedge \text{apples}(x) \wedge A(\mu)(x) \geq d$

e. $[\![\ [\mathbf{zui}\text{-Comp}^-]\text{-}C\ ]\!]^A$
$= \lambda g_{<d,<e,t>>}\, \lambda z_e.\forall z'[z' \in C \wedge z' \neq z \rightarrow \max(\lambda d.g(z) \geq d) < \max(\lambda d.g(z') \geq d)]$

f. $C = \{x\text{: }\exists d.\ x\text{ bought }d\text{-many apples}\}$

g. $[\![\ [[\mathbf{zui}\text{-Comp}^-]\text{-}C\ [\lambda 1\ [\lambda 2\ [x_2\text{ bought }[d_1\text{- }\mathbf{duo}\text{ apples}]]]]]\ ]\!]^A$
$= \lambda z_e.\forall z'[z' \in C \wedge z' \neq z \rightarrow \max(\lambda d.\ z\text{ bought }d\text{-many apples}) < \max(\lambda d.\ z'\text{ bought }d\text{-many apples})]$

h. $[\![\ (99)\ ]\!]^A = 1$ iff $\forall z'$
$[z' \in C \wedge z' \neq \text{Liubei} \rightarrow \max(\lambda d.\ \text{Liubei bought }d\text{-many apples}) < \max(\lambda d.\ z'\text{ bought }d\text{-many apples})]$

i. In words: For all relevant z' mentioned in C, the amount of apples *Liubei* bought is less than the amount of apples z' bought.

(101a) is given by the semantics of the Q-adjective *duo*. (101b) is derived by Predicate Modification, by composing the noun *pingguo* 'apples' with the Q-adjective (whose degree argument is saturated by the trace left by the movement of the chunk [**zui**-Comp$^-$]-*C*). (101c) is obtained by composing (101b) with the verb and the subject, assuming an existential closure over the individual variable *x*. (101d) is obtained by the lambda-abstraction, resulting from the movement of the subject and the chunk [**zui**-Comp$^-$]-*C*. (101e) is given by composing *zui* with Comp$^-$. (101f) provides the contextual value of the domain *C*. (101g) is obtained by Functional Application, applying (101e) to (101d). Finally, according to (101h), the sentence (99) is true if and only if the amount of apples that *Liubei* bought is less than the amount of apples that any other individual bought. This seems intuitively correct.

Now, let us consider QSs in the verbal domain. Again, under the movement approach, the relative reading results from the scope-taking of the degree operator

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35. Some native speakers prefer QSs with *zui-shao* in a predicate position (such as (i)), rather than in an attributive position. The proposed analysis in this paper extends to predicative superlatives as well.

(i) *Liubei de pingguo zui-shao.*
Liubei DE apple SUP-little
'The amount of Liubei's apples is less than that of everyone else's.'

[**zui**-Comp^{-}]. The relevant sentence is shown in (102), with its LF in (103). A detailed composition is presented in (104).

(102) QSs in Verbal Domain
*(Paobu) Liubei pao **zui-shao**.*
Running Liubei run SUP-little
'(As for running,) Liubei ran less than anyone else did.'

(103) [[Liubei]$_2$ [[**zui**-Comp^{-}]-*C* [λ1 [λ2 [∃ [x_2 [ran d_1- **duo**]]]]]]]

(104) a. $[\![duo_{\mu}]\!]^A = \lambda d.\lambda\alpha.A(\mu)(\alpha) \geq d$

b. $[\![$ [ran d_1- **duo**] $]\!]^A = \lambda e.\text{ran}(e) \wedge A(\mu)(e) \geq d_1$

c. $[\![$ [x_2 [ran d_1- **duo**]] $]\!]^A = \lambda e.\text{Agent}(e) = x_2 \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d_1$

d. $[\![$ [∃ [x_2 [ran d_1- **duo**]]] $]\!]^A = \exists e.\text{Agent}(e) = x_2 \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d_1$

e. $[\![$ [λ1 [λ2 [∃ [x_2 [ran d_1- **duo**]]]]] $]\!]^A$
$= \lambda d\, \lambda y\, \exists e.\text{Agent}(e) = y \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d$

f. $[\![$ [**zui**-Comp^{-}]-*C* $]\!]^A$
$= \lambda g_{<d,<e,t>>}\, \lambda z_{<e>}.\ \forall z'[z' \in C \wedge z' \neq z \rightarrow \max(\lambda d.g(z) \geq d) < \max(\lambda d.g(z') \geq d)]$

g. $C = \{x\colon \exists d.\ x \text{ ran } d\text{-much}\}$

h. $[\![$ [[**zui**-Comp^{-}]-*C* [λ1 [λ2 [∃ [x_2 [ran d_1- **duo**]]]]]] $]\!]^A$
$= \lambda z_{<e>}.\ \forall z'[z' \in C \wedge z' \neq z \rightarrow \max(\lambda d\ \exists e.\text{Agent}(e) = z \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d) < \max(\lambda d\ \exists e.\text{Agent}(e) = z' \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d)$

i. $[\![$ (102) $]\!]^A = 1$
iff $\forall z'[z' \in C \wedge z' \neq \text{Liubei} \rightarrow \max(\lambda d\ \exists e.\text{Agent}(e) = \text{Liubei} \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d) < \max(\lambda d\ \exists e.\text{Agent}(e) = z' \wedge \text{ran}(e) \wedge A(\mu)(e) \geq d)$

j. In words: For all relevant *z'* mentioned in *C*, the quantity that *Liubei* ran is less than the quantity that *z'* ran, along a contextually-given dimension (e.g. duration or distance).

(104a) is given by the semantics of the Q-adjective *duo*. (104b) is derived by Predicate Modification, by composing the verb *pao* 'run' (assuming a neo-Davidsonian entry of verbs denoting a predicate of events) with the Q-adjective (whose degree argument is saturated by the trace left by the movement of the chunk [**zui**-Comp^{-}]-*C*). (104c) is obtained by composing (104b) with the subject. (104d) is obtained by assuming an existential closure over the event variable *e*. (104e) is obtained by the lambda-abstraction, resulting from the movement of the subject and the chunk [**zui**-Comp^{-}]-*C*. (104f) is given by composing *zui* with Comp^{-}.

(104g) provides the contextual value of the domain *C*. (104h) is obtained by Functional Application, applying (104f) to (104e). Finally, according to (104i), the sentence (102) is true if and only if the quantity of events that *Liubei* ran is less than the quantity of events that anyone else ran (e.g. in terms of duration/distance). This seems correct.

5. Implications

This section discusses some important implications of the current analysis of SMs by addressing three issues: (**a**) the semantic parallel of SMs with disjunction and epistemic indefinites; (**b**) the possibility for a unified account of Q-adjectives; (**c**) SMs in languages beyond Mandarin Chinese.

5.1 Two types of semantic parallels

To begin with, it is worth noting that the current analysis additionally captures two types of semantic parallels that have been identified in the literature on SMs: **(a)** the parallel to disjunction (Büring 2008); **(b)** the parallel to epistemic indefinites (Nouwen 2015). Let us first consider the semantic parallel between SMs and disjunction. According to the current analysis, the semantics of SMs is an existential claim over a non-single domain consisting of the prejacent and its lower/higher alternatives. Notice that an existential claim over a set amounts to the disjunction of each element in the set. This is informally schematized in (105).

(105) The parallel with disjunction
$\exists\gamma\,[\gamma\in\{\alpha,\beta\}\wedge\gamma \text{ is true}]\Leftrightarrow\alpha \text{ is true}\vee\beta \text{ is true}$

Suppose that α, β and γ are propositions; α is the prejacent and β is the lower/higher alternative. The claim that there is a proposition γ in the set $\{\alpha, \beta\}$ such that γ is true is equivalent to the disjunctive claim that the prejacent α is true or the proposition β is true. Seen in this light, under the current analysis, SMs are not only parallel with disjunction with respect to ignorance inferences (as argued in Büring 2008 and others), but also parallel with disjunction from the view of their semantics.[36]

36. For purposes of this paper, I do not discuss how the ignorance inference associated with SMs arises. Given the proposed semantics of *zui-duo* and *zui-shao*, the current analysis is compatible with the pragmatic camp where the ignorance inference of SMs arises from certain mechanism of implicature calculation (see e.g. Cummis & Katos 2010; Kennedy 2015; Mendia 2016a, b; and Schwarz 2016a, b, for proposals and discussion).

Next, let us consider the parallel between *at least* and Epistemic Indefinites (EIs). Both SMs such as *at least* and EIs such as Spanish *algún* lead to ignorance inferences (e.g. see Büring 2008 on SMs and Alonso-Ovalle & Menéndez-Benito 2010 on Spanish *algún*). (106) shows the relevant Spanish example and (107) the semantics of *algún* proposed in Alonso-Ovalle & Menéndez-Benito (2010).

(106) Epistemic Indefinites: Spanish *algún*
María se caso´ con ***algún*** *estudiante del departamento de lingüística.*
María se married with algún student of the department of linguistics
'María married a linguistics student.'

(107) $[\![algún]\!]$
$= \lambda f_{<<e,t>,<e,t>>}$: anti-singleton $(f).\ \lambda P_{<e,t>}.\lambda Q_{<e,t>}.\exists x_{<e>}[f(P)(r) \wedge Q(r)]$

According to Alonso-Ovalle & Menéndez-Benito, by using *algún* in (106), the speaker is ignorant about the linguistics student who Maria married. An important aspect in their analysis of *algún* is that it imposes an anti-singleton presupposition on the domain. In this respect, under the current analysis, the domain of SMs will always be non-singleton, consisting of the prejacent (obtained by focus presuppositions) and the lower/higher alternatives (obtained by the component SUP). That is, SMs and EIs like *algún* both require a non-singleton domain. This seems to be one common core of those expressions leading to ignorance inferences. For comparison, the semantics of *zui-shao* and *zui-duo* (propositional version) are repeated below, $S(\alpha)$ represents the contributions of the superlative construction SUP inside SMs.

(108) $[\![zui\text{-}shao(C)]\!]^{s,c}$
$= \lambda\alpha_{<st>}.\exists\gamma[\gamma \in C \wedge \gamma_s \wedge \underline{\forall\beta[\beta \in C \wedge \beta \neq \alpha \rightarrow \mu_{\underline{c}}(\alpha) < \mu_{\underline{c}}(\beta)]}]$

(109) $[\![zui\text{-}duo(C)]\!]^{s,c}$
$= \lambda\alpha_{<st>}.\exists\gamma[\gamma \in C \wedge \gamma_s \wedge \underline{\forall\beta[\beta \in C \wedge \beta \neq \alpha \rightarrow \mu_{\underline{c}}(\alpha) > \mu_{\underline{c}}(\beta)]}]$

Note that the ignorance inference induced by *algún* is obligatory; in contrast, the ignorance inference associated with SMs is unfeasible (e.g. Mendia 2016b, among others), thus not obligatory. Seen in this light, there is a crucial semantic difference between *algún* and SMs on the non-singleton requirement: In contrast to *algún* where the anti-singleton requirement is a presupposition, the non-singleton domain of SMs is part of the truth-conditions. This semantics of SMs together with the pragmatics of focus result in the sensitivity of their ignorance inferences to different discourse questions (i.e. Questions-Under-Discussions in the sense of Roberts 2012[1996]).

Finally, if the current analysis is on the right track, it implies that the non-strict comparison of SMs is not a semantic primitive. As discussed in §3.3, the

semantics of superlatives, like that of comparatives, encode a strict comparison relation, regardless of which approach is adopted. However, in a sharp contrast to the strict comparison relation encoded in the semantics of superlatives, a non-strict comparison relation has usually been assigned to the semantics of SMs such as *at least* in the previous studies.[37]

(110) The degree-based approach (e.g. Kennedy 2015)
$[\![at\ least]\!] = \lambda m_d \lambda P_{<d,t>}.\ max\{n \mid P(n)\} \geq m$

(111) The discourse-based approach (e.g. Coppock & Brochhagen 2013)
$[\![at\ least\ (C)]\!]^{w,g} = \lambda p_{<s,t>}.\exists q\ [q \in C \wedge q(w) \wedge q \geq_i p]$

Although the non-strict comparison correctly characterizes the truth-conditions of sentences with SMs, it raises a non-trivial question in connecting with the semantics of superlatives: Where does the additional "equal-to" relation (i.e. =) come from? The semantics of superlatives encode a strict comparison, but not a non-strict one. Under the current analysis, the non-strict comparison of SMs is not a semantic primitive; it is obtained via the joint work of the focus presuppositions and the contribution of the superlative SUP. Put differently; how to decompose SMs in a way incorporating the semantics of superlatives amounts to how to break the apparent non-strict comparison of SMs.[38]

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37. Although there have been various proposals for the semantics of at least, they can be generally classified into two approaches, depending on what kind of scales SMs are thought to make reference to: a degree-based approach and a discourse-based approach. The degree-based approach considers SMs as degree operators and invokes a scale of degrees (Nouwen 2010; Kennedy 2015). In contrast, the discourse-based approach invokes scales of pragmatic strength, which are not restricted to numerals and may not even respect entailment (e.g. Krifka 1999; Geurts & Nouwen 2007; Büring 2008; Coppock & Brochhagen 2013).

38. An issue not addressed in this paper concerns the distinction between free association with focus and conventional association with focus. Beaver & Clark (2008) argues for a three-way distinction of focus-sensitive expressions. In particular, according to them, although both *always* and *only* in English are focus-sensitive, the latter but not the former is conventionally associated with focus. Put differently, the association with focus is obligatory for *only*, while it is optional for *always*. Similar distinction can be said between SMs and QSs; that is, SMs pattern with *only* in being conventionally associated with focus, while QSs pattern with *always* in being freely associated with focus. At this point, it is unclear to me how to maintain the distinction between different types of focus-sensitive expressions within the Roothian system of focus; to my understanding, different types of focus-sensitive expressions within the Roothian focus semantics all boil down to how focus resolves the contextual value of the domain restriction (see also von Fintel 1994).

5.2 Toward a "unified" semantics of Q-adjectives

A common criticism on Wellwood's approach to the semantics of Q-adjectives lies in its failure to explain their differential uses, on which Rett's/Solt's approach is empirically based, as in (112).

(112) a. Adam is much taller than Bill.
b. Adam bought much more apples than Bill.
c. Adam ran much more than Bill.

It is true that Wellwood's (2014) version where the measured domain is structured by a part-of relation may not be easy to extend to the differential use of *much*. However, an updated view here is that the measured domain of Q-adjectives need not be structured by a part-of relation, but rather the natural ordering on the relevant domain (based on the facts of SMs).

(113) μ is measure function, making a structure-preserving mapping from a structure $<P, \geq_{no}>$ (where P is the measured domain and $\geq_{no}$ is the natural ordering on the domain P) to a scale S, where S is a structure $<D_{deg}, \geq_{deg}>$ such that D_{deg} is set of degrees (i.e. entities of type d) and $\geq_{deg}$ is a total order on D_{deg}.

On this updated view, the criticism on Wellwood's approach to differential *much* is no longer justified. Specifically, under this updated view, nothing prevents Wellwood's *much* to impose measurement on a degree interval (i.e. a set of degrees), as long as the measured domain is structured with the natural ordering (which is true in the domain of degrees: the degree ordering).

Against the background above, Solt's and Rett's semantics of Q-adjectives (repeated in (114)) can be considered as a relational variant of Wellwood's, as shown in (115): what is measured is a degree interval, with its size/length as the dimension. Note that α is an interval, of type $<d, t>$.[39, 40]

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39. Under this unified view of Q-adjectives, one remaining issue concerns the status of the covert measurement operator: Rett's (2014) M-OP/Solt's (2015) Meas. It seems to me that these covert operators may not be dispensable if numerals are considered as degree terms, particularly in the construction of bare numerals where no overt *much* shows up.

40. Note that a unified semantic account of Q-adjectives can be neutral as to the question whether gradable adjectives lexically encode a measure function (in contrast to other lexical categories such as nouns and verbs), which is a fundamental division between Rett's/Solt's approach vs. Wellwood's (2014; 2015; 2019) approach. This paper remains agnostic as to an answer. Furthermore, even though Rett's/Solt's semantics of Q-adjectives can be considered as a relation variant of Wellwood's proposal, the long-standing debate between the measure function view vs. the relational view of gradable adjectives remains open.

(114) a. $[\![much]\!] = \lambda D_{<d, t>}\, \lambda d_d.[d \text{ is the size of } D]$ Rett's *much* $_{<<d, t>, <d, t>>}$
b. $[\![many/much]\!] = \lambda d_d \lambda I_{<d, t>}.I(d)$ Solt's *much* $_{<d, <<d, t>, t>>}$

(115) a. $[\![much_\mu]\!]^A = \lambda\alpha.\lambda d.A(\mu)(\alpha) \geq d$ $<<d, t>, <d, t>>$
b. $[\![much_\mu]\!]^A = \lambda d.\lambda\alpha.A(\mu)(\alpha) \geq d$ $<d, <<d, t>, t>>$

One reviewer asks whether the morpheme *duo* in Mandarin may have multiple lexical entries by raising some examples such as (116) and (117).[41]

(116) *Xiaoming* ***duo****-pao-le.*
Xiaoming much-run-ASP
'Xiaoming has run more than expected/someone else did.'

(117) *Xiaoming pao-****duo****-le.*
Xiaoming run-much-ASP
'Xiaoming has run a lot/(too) much.'

To some extent, both examples of *duo* involve some sense of comparison. (117) is a case where *duo* seems to plays the role of differentials while (116) seems to be a case of Differential Verbal Comparatives (DVCs) where *duo* may be a comparative morpheme (see Li 2009 for discussion of Mandarin DVCs). As far as I can tell, (117) but not (116) may be amenable to the current analysis of the quantity adjective *duo*, assuming that there is a covert degree morpheme (e.g. *POS* or a comparative morpheme) combining with *duo*, which together plays the role of differentials. Seen in this light, I tentatively conclude that the current analysis is able to provide a unified semantics of *duo* in cases where it serves as a Q-adjective. For any other uses of *duo* where it is not a Q-adjective such as the one in DVCs, a different lexical entry of *duo* may be required.

5.3 SMs in languages beyond Mandarin Chinese

On the proposed analysis, SMs are analyzed as modified superlatives where a superlative construction is structurally contained under a covert existential operator F-OP. This leads to the apparent ambiguity of Mandarin SMs. One may wonder whether there are languages where F-OP is overtly realized. If we look at English, one plausible candidate is the morpheme ***at*** in examples like *at least*/*at most*. However, the situation in English is further complicated by the fact that the determiner *the* may **optionally** show up: *at (the) least* and *at (the) most*. At this point, it is worth noting that at least two other candidates are observed: the morpheme ***al*** in Italian SMs (*al massimo* 'at most' and *al meno* 'at least') and the

41. I am grateful to the reviewer for drawing my attention to these examples of Mandarin *duo*.

morpheme ***au*** in French SMs (*au plus* 'at most' and *au moins* 'at least'). Further studies on the morpho-semantics of SMs are needed to verify whether the realization of the F-OP is limited to the Indo-European language family.

Note that Mandarin is not the only language where F-OP is covert in the expression of SMs; a similar situation is also attested in Indonesian, Turkish, and Vietnamese, as illustrated below. The bolded part indicates the Q-adjectives and the underlined part indicates superlative morphology.

(118) a. Indonesian
  i. *paling-**banyak***
  SUP-much
  'at most'
  ii. *paling-**sedikit***
  SUP-little
  'at least'
 b. Turkish
  i. *en* ***çok*** / *en* ***fazla***
  SUP many/much SUP many/much
  'at most'
  ii. *en* ***az*** / *en* ***az-ın-dan***
  SUP little SUP little-3SGPOSS-ablative(from)
  'at least'
 c. Vietnamese
  i. ***nhiều-****nhất*
  much-SUP
  'at most'
  ii. ***ít-****nhất*
  little-SUP
  'at least'

As illustrated above, a similar morphological makeup repeats itself in a bunch of genetically unrelated languages. These cross-linguistic facts again reinforce the point advocated by this paper: the morphology of SMs cannot be simply ignored or regarded as a linguistic coincidence in natural language; the contributions of their morphology must be factored into our linguistic theory of SMs.

Finally, it is worth emphasizing that the present analysis cannot be the whole story of SMs. There is more than one possible morpho-semantic mapping attested in natural language. The bolded part below indicates the Q-adjectives in Japanese and Korean.

(119) Q-adjectives plus even-if (e.g. Japanese and Korean, among others)
  a. Japanese
    i. ***ooku**-tomo*
      many-even.if
      'at most'
    ii. ***sukunaku**-tomo*
      few-even.if
      'at least'
  b. Korean
    i. ***manh**-ato*
      many-even.if
      'at most'
    ii. ***cek**-eto*
      few-even if
      'at least'

(120) Q-adjectives plus comparatives (e.g. Magahi, Hindi, Russian, among others)
Magahi
  i. *jaadaa se aadaa*
    more than more
    'at most'
  ii. *kam se kam*
    less than less
    'at least'

I have shown that the morphology of SMs is intrinsically connected with their semantics. In particular, the scalar component of a focus adverb can be instantiated by a degree construction. This implicates that the scalarity of SMs concerning the role of SUP may be instantiated by some scalar operators in natural languages. Japanese and Korean make an interesting case at hand. Note that it is also possible that the concessive conditional operator *even-if* plays both roles: F-OP and the superlative component in the current analysis.

6. Concluding remarks

Most analyses of SMs on the market do not incorporate the semantic contributions of their morphology. However, the cross-linguistic facts strongly suggest that the morphological makeup of SMs cannot be a linguistic coincidence in natural language. In this respect, Kennedy (2015: 39) explicitly raises a question as to whether it is possible to move from a degree-based semantics and pragmatics for

comparatives and superlatives to an alternatives-based semantics and pragmatics. This paper offers an affirmative answer based on Mandarin *zui-duo*/*zui-shao* and presents a decompositional analysis of SMs as a modified superlative. Thus, any semantic theory of SMs must take into account the morphology of SMs. Along this line, this paper has shown that insights and tools developed in studies on gradability (Kennedy 1999) can be applied to those on scalarity. Recently, Greenberg (2016; 2017) has argued for a gradability-based semantics of English *even*. This paper contributes an important part to this growing research agenda, by including SMs, a class of scalar focus adverbs but bearing overt degree morphology and gradable adjectives. Finally, this paper also advances our understanding of the semantics of Q-adjectives. By studying SMs, it has been shown that the measured domain of Q-adjectives need not be structured by the part-of relation, but by the natural ordering on a given domain. The notion of natural orderings put forth in this paper is a minimal extension of Wellwood's (2014; 2015; 2019) insights that what is measured does matter, to the domain of focus adverbs (i.e. SMs). In particular, when the set of elements in the measured domain is structured by a part-of relation, the measurement must be monotonic (i.e. tracking the part-whole structure); conversely, when the set of elements in the measured domain is not structured by a part-of relation; the monotonicity constraint can be irrelevant or vacuously satisfied by its conditional nature. Crucially, this updated view leads us to the differential use of Q-adjectives and thus one step further toward a unified account of Q-adjectives in our semantic theory.

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Abbreviations

CQ	Current Question	NCC	No Containment Condition
DVC(s)	Differential Verbal Comparative(s)	QUD(s)	Question-Under-Discussion(s)
EI(s)	Epistemic Indefinites(s)	SM(s)	Superlative Modifier(s)

References

Alonso-Ovalle, Luis & Menéndez-Benito, Paula. 2010. Modal indefinites. *Natural Language Semantics* 18(1). 1–31. https://doi.org/10.1007/s11050-009-9048-4

Balcerak Jackson, Brendan & Penka, Doris. 2017. Number word constructions, degree semantics and the metaphysics of degrees. *Linguistics and Philosophy* 40(4). 347–372. https://doi.org/10.1007/s10988-017-9213-z

Barwise, Jon & Cooper, Robin. 1981. Generalized quantifiers and natural language. *Linguistics and Philosophy* 4(2). 159–219. https://doi.org/10.1007/BF00350139

Beaver, David I. & Clark, Brady Z. 2008. *Sense and sensitivity: How focus determines meaning*. Malden: Wiley-Blackwell. https://doi.org/10.1002/9781444304176

Bobaljik, Jonathan David. 2012. *Universals in comparative morphology: Suppletion, superlatives, and the structure of words*. Cambridge: The MIT Press. https://doi.org/10.7551/mitpress/9069.001.0001

Bresnan, Joan W. 1973. Syntax of the comparative clause construction in English. *Linguistic Inquiry* 4(3). 275–343.

Buccola, Brian & Spector, Benjamin. 2016. Modified numerals and maximality. *Linguistics and Philosophy* 39(3). 151–199. https://doi.org/10.1007/s10988-016-9187-2

Büring, Daniel. 2007. Cross-polar nomalies. In Friedman, Tova & Gibson, Masayuki (eds.), *Proceedings from Semantics and Linguistic Theory (SALT) 17*, 37–52. Storrs: University of Connecticut. https://doi.org/10.3765/salt.v17i0.2957

Büring, Daniel. 2008. The least *at least* can do. In Chang, Charles B. & Haynie, Hannah J. (eds.), *WCCFL 26: Proceedings of the 26th West Coast Conference on Formal Linguistics*, 114–120. Somerville: Cascadilla Proceedings Project.

Büring, Daniel. 2009. More or less. In Elliott, Malcolm & Kirby, James & Sawada, Osamu & Staraki, Eleni & Yoon, Suwon (eds.), *CLS 43-2: Proceedings from the panels of the Forty-third Annual Meeting of the Chicago Linguistic Society*, 3–17. Chicago: Chicago Linguistic Society.

Bylinina, Lisa & Nouwen, Rick. 2018. On "zero" and semantic plurality. *Glossa: A Journal of General Linguistics* 3(1). 1–23. (Article no. 98.) https://doi.org/10.5334/gjgl.441

Chen, Yi-Hsun. 2018. *Superlative modifiers: Ignorance and concession*. New Brunswick: Rutgers University. (Doctoral dissertation.)

Coppock, Elizabeth. 2016. Superlative modifiers as modified superlatives. In Moroney, Mary & Little, Carol-Rose & Collard, Jacob & Burgdorf, Dan (eds.), *Proceedings from Semantics and Linguistic Theory (SALT) 26*, 471–488. Austin: University of Texas at Austin. https://doi.org/10.3765/salt.v26i0.3822

Coppock, Elizabeth & Beaver, David I. 2014. Principles of the exclusive muddle. *Journal of Semantics* 31(3). 371–432. https://doi.org/10.1093/jos/fft007

Coppock, Elizabeth & Brochhagen, Thomas. 2013. Raising and resolving issues with scalar modifiers. *Semantics and Pragmatics* 6. 1–57. (Article no. 3.) https://doi.org/10.3765/sp.6.3

Dayal, Veneeta. 2016. *Questions*. Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199281268.001.0001

Dotlačil, Jakub & Nouwen, Rick. 2016. The comparative and degree pluralities. *Natural Language Semantics* 24(1). 45–78. https://doi.org/10.1007/s11050-015-9119-7

Dunbar, Ewan & Wellwood, Alexis. 2016. Addressing the 'two interface' problem: Comparatives and superlatives. *Glossa: A Journal of General Linguistics* 1(1). 1–29. (Article no. 5.) https://doi.org/10.5334/gjgl.9

Erlewine, Micheal Yoshitaka. 2007. *A new syntax-semantics for the Mandarin* bi *comparative*. Chicago: University of Chicago. (Master's thesis.)

Farkas, Donka F. & Kiss, Katalin É. 2000. On the comparative and absolute readings of superlatives. *Natural Language and Linguistic Theory* 18(3). 417–455. https://doi.org/10.1023/A:1006431429816

Geurts, Bart, & Nouwen, Rick. 2007. *At least* et al.: The semantics of scalar modifiers. *Language* 83(3). 533–559. https://doi.org/10.1353/lan.2007.0115

Greenberg, Yael. 2016. A novel problem for the likelihood-based semantics of *even*. *Semantics and Pragmatics* 9. 1–28. (Article no. 2.) https://doi.org/10.3765/sp.9.2

Greenberg, Yael. 2017. A revised, gradability-based semantics for *even*. *Natural Language Semantics* 26(1). 51–83. https://doi.org/10.1007/s11050-017-9140-0

Grice, H. Paul. 1975. Logic and conversation. In Cole, Peter & Morgan, Jerry L. (eds.), *Syntax and semantics, volume 3: Speech acts*, 41–58. New York: Academic Press. https://doi.org/10.1163/9789004368811_003

Hackl, Martin. 2001. *Comparative quantifiers*. Cambridge: MIT. (Doctoral dissertation.)

Heim, Irene. 1985. Notes on comparatives and related matters. Austin: University of Texas at Austin. (Manuscript.)

Heim, Irene. 1999. Notes on superlatives. Cambridge: MIT. (Manuscript.)

Heim, Irene. 2000. Degree operators and scope. In Jackson, Brendan & Matthews, Tanya (eds.), *Proceedings of Semantics and Linguistic Theory (SALT)* 10, 40–64. Ithaca: Cornell University. https://doi.org/10.3765/salt.v10i0.3102

Heim, Irene. 2006a. *Little*. In Gibson, Masayuki & Howell, Jonathan (eds.), *Proceedings from Semantics and Linguistic Theory (SALT) 16*, 35–58. Tokyo: University of Tokyo.

Heim, Irene. 2006b. Remarks on comparative clauses as generalized quantifiers. Cambridge: MIT. (Manuscript.)

Jacobson, Pauline. 1999. Toward a variable-free semantics. *Linguistics and Philosophy* 22(2). 117–185. https://doi.org/10.1023/A:1005464228727

Jacobson, Pauline. 2016. The short answer: Implications for direct compositionality (and vice versa). *Language* 92(2). 331–375. https://doi.org/10.1353/lan.2016.0038

Kennedy, Christopher. 1999. *Projecting the adjectives: The syntax and semantics of gradability and comparison*. New York: Routledge. (First published by Garland Publishing Inc.)

Kennedy, Christopher. 2009. Modes of comparison. In Elliot, Malcolm & Kirby, James & Sawada, Osamu & Staraki, Eleni & Yoon, Suwon (eds.), *CLS 43-1: Proceedings from the Main Session of the Forty-third Annual Meeting of the Chicago Linguistic Society*, 139–163. Chicago: Chicago Linguistic Society.

Kennedy, Christopher. 2015. A "de-Fregean" semantics (and neo-Gricean pragmatics) for modified and unmodified numerals. *Semantics and Pragmatics* 8. 1–44. (Article no. 10.) https://doi.org/10.3765/sp.8.10

Krantz, David H. & Luce, R. Duncan & Suppes, Patrick & Tversky, Amos. 1971. *Foundations of measurement, volume 1: Additive and polynomial representations*. New York: Academic Press.

Kratzer, Angelika. 1989. An investigation of the lumps of thought. *Linguistics and Philosophy* 12(5). 607–653. https://doi.org/10.1007/BF00627775

Kratzer, Angelika. 2014. Situations in natural language semantics. In Zalta, Edward N. (ed.), *The Stanford encyclopedia of philosophy*. Summer 2014 edn. Stanford: The Metaphysics Research Lab, Philosophy Department, Stanford University. (https://plato.stanford.edu/archives/win2021/entries/situations-semantics/) (Accessed 2022-10-19.)

Krifka, Manfred. 1989. Nominal reference, temporal constitution and quantification in event semantics. In Bartsch, Renate & van Benthem, Johan & van Emde Boas, Peter (eds.), *Semantics and contextual expression*, 75–115. Dordrecht: Foris Publications. https://doi.org/10.1515/9783110877335-005

Krifka, Manfred. 1999. At least some determiners aren't determiners. In Turner, Kenneth P. (ed.), *The semantics/pragmatics interface from different points of view* (Current Research in the Semantics/Pragmatics Interface 1), 257–291. Amsterdam: Elsevier Science B.V.

Li, Xiao. 2009. *Degreeless comparatives*. New Brunswick: Rutgers University. (Doctoral dissertation.)

Lin, Jo-wang. 2009. Chinese comparatives and their implicational parameters. *Natural Language Semantics* 17(1). 1–27. https://doi.org/10.1007/s11050-008-9033-3

Lin, Jo-wang. 2014. The adjective of quantity *duo* 'many/much' and differential comparatives in Mandarin Chinese. *International Journal of Chinese Linguistics* 1(2). 163–191. https://doi.org/10.1075/ijchl.1.2.01lin

Liu, Chen-Sheng Luther. 2011. The Chinese *bi* comparative. *Lingua* 121(12). 1767–1795. https://doi.org/10.1016/j.lingua.2011.07.002

Liu, Chen-Sheng Luther. 2012. Two notes on Chinese *bi* comparatives. *Concentric: Studies in Linguistics* 38(1). 69–91.

Liu, Chen-Sheng Luther. 2018. Projecting adjectives in Chinese. *Journal of East Asian Linguistics* 27(1). 67–109. https://doi.org/10.1007/s10831-018-9166-4

Mendia, Jon Ander. 2016a. Focusing on scales. In Hammerly, Christopher & Prickett, Brandon (eds.), *NELS 46: Proceedings of the Forty-Sixth Annual Meeting of the North East Linguistic Society*, vol. 3, 11–24. Amherst: Graduate Linguistics Student Association (GLSA), Department of Linguistics, University of Massachusetts.

Mendia, Jon Ander. 2016b. Known unknowns: Epistemic inferences of superlative modifiers. Amherst: University of Massachusetts at Amherst. (Manuscript.)

Mihoc, Teodora. 2019. *Decomposing logic: Modified numerals, polarity and exhaustification*. Cambridge: Harvard University. (Doctoral dissertation.)

Nakanishi, Kimiko. 2007. Measurement in the nominal and verbal domains. *Linguistics and Philosophy* 30(2). 235–276. https://doi.org/10.1007/s10988-007-9016-8

Nouwen, Rick. 2010. Two kinds of modified numerals. *Semantics and Pragmatics* 3. 1–41. (Article no. 3.) https://doi.org/10.3765/sp.3.3

Nouwen, Rick. 2015. Modified numerals: The epistemic effect. In Alonso-Ovalle, Luis & Menéndez-Benito, Paula (eds.), *Epistemic indefinites: Exploring modality beyond the verbal domain*, 244–266. Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199665297.003.0011

Rett, Jessica. 2008. *Degree modification in natural language*. New Brunswick: Rutgers University. (Doctoral dissertation.)

Rett, Jessica. 2014. The polysemy of measurement. *Lingua* 143. 242–266. https://doi.org/10.1016/j.lingua.2014.02.001

Roberts, Fred S. 1985. *Measurement theory: With applications to decisionmaking, utility, and the social sciences*. New York: Cambridge University Press.

Roberts, Craige. 2012[1996]. Information structure in discourse: Towards an integrated formal theory of pragmatics. *Semantics and Pragmatics* 5. 1–69. (Article no. 6.) (Originally published in 1996.) https://doi.org/10.3765/sp.5.6

Rooth, Mats. 1992. A theory of focus interpretation. *Natural Language Semantics* 1(1). 75–116. https://doi.org/10.1007/BF02342617

Rooth, Mats. 1996. Focus. In Lappin, Shalom & Fox, Chris (eds.), *The handbook of contemporary semantic theory*, 271–297. Oxford: Blackwell.

Sassoon, Galit Weidman. 2010. Measurement theory in linguistics. *Synthese* 174(1). 151–180. https://doi.org/10.1007/s11229-009-9687-5

Schwarz, Bernhard. 2016a. Consistency preservation in quantity implicature: The case of *at least*. *Semantics and Pragmatics* 9. 1–47. (Article no. 1.) https://doi.org/10.3765/sp.9.1

Schwarz, Bernhard. 2016b. *At least* and ignorance: A reply to Coppock & Brochhagen 2013. *Semantics and Pragmatics* 9. 1–17. (Article no. 10.) https://doi.org/10.3765/sp.9.10

Schwarzschild, Roger. 2005. Measure phrases as modifiers of adjectives. *Recherches Linguistiques de Vincennes* 34. 207–228. https://doi.org/10.4000/rlv.1401

Schwarzschild, Roger. 2006. The role of dimensions in the syntax of noun phrases. *Syntax* 9(1). 67–110. https://doi.org/10.1111/j.1467-9612.2006.00083.x

Sharvit, Yael & Stateva, Penka. 2002. Superlative expressions, context, and focus. *Linguistics and Philosophy* 25(4). 453–504. https://doi.org/10.1023/A:1020875809794

Solt, Stephanie. 2009. *The semantics of adjectives of quantity*. New York: The City University of New York. (Doctoral dissertation.)

Solt, Stephanie. 2015. Q-adjectives and the semantics of quantity. *Journal of Semantics* 32(2). 221–273. https://doi.org/10.1093/jos/fft018

Sportiche, Dominique. 1988. A theory of floating quantifiers and its corollaries for constituent structure. *Linguistic Inquiry* 19(3). 425–449.

Stateva, Penka. 2003. Superlative *more*. In Young, Robert B. & Zhou, Yuping (eds.), *Proceedings from Semantics and Linguistic Theory (SALT) 13*, 276–291. Seattle: University of Washington. https://doi.org/10.3765/salt.v13i0.2893

Tomaszewicz, Barbara Maria. 2015. *Superlative ambiguities: A comparative perspective*. Los Angeles: University of Southern California. (Doctoral dissertation.)

von Fintel, Kai. 1994. *Restrictions on quantifier domains*. Amherst: University of Massachusetts at Amherst. (Doctoral dissertation.)

von Fintel, Kai. 2002. A minimal theory of adverbial quantification. In Kamp, Hans & Partee, Barbara (eds.), *Context-dependence in the analysis of linguistic meaning*, 137–175. Elsevier. Oxford.

von Stechow, Arnim. 1984. Comparing semantic theories of comparison. *Journal of Semantics* 3(1-2). 1–77. https://doi.org/10.1093/jos/3.1-2.1

Wellwood, Alexis. 2014. *Measuring predicates*. College Park: University of Maryland, College Park. (Doctoral dissertation.)

Wellwood, Alexis. 2015. On the semantics of comparison across categories. *Linguistics and Philosophy* 38(1). 67–101. https://doi.org/10.1007/s10988-015-9165-0

Wellwood, Alexis. 2019. *The meaning of more*. Oxford: Oxford University Press. https://doi.org/10.1093/oso/9780198804659.001.0001

Wellwood, Alexis & Hacquard, Valentine & Pancheva, Roumyana. 2012. Measuring and comparing individuals and events. *Journal of Semantics* 29(2). 207–228. https://doi.org/10.1093/jos/ffr006

Xiang, Yimei. 2016. *Interpreting questions with non-exhaustive answers*. Cambridge: Harvard University. (Doctoral dissertation.)

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