Mandarin Has Degree Abstraction After All

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May 26, 2021

Abstract

Mandarin, along with Japanese, Yorùbá, Mòoré, and Samoan, has been argued to lack so-called 'degree abstraction', a configuration at LF involving lambda abstraction over a degree variable. These languages are claimed to have a negative setting for a hypothesized 'Degree Abstraction Parameter'. Recent work, however, has argued for degree abstraction in Japanese and Yorùbá, and degree abstraction has been detected in a number of additional languages. Could it in fact be universal? Here, we focus on the case of Mandarin, and argue that Mandarin has degree abstraction too. We rebut prior arguments for the lack of degree abstraction in Mandarin and discover positive evidence for degree abstraction along the way, considering degree questions, direct measure phrases, subcomparatives and 'sub-equatives' (*wh*-correlatives), various types of scope interactions with modals, negative island effects, attributive comparatives, embedding within clausal comparatives, and superlatives. Taken together, these results show that degree abstraction is not a parameter along which Mandarin and English vary, and cast further doubt on the existence of the proposed 'Degree Abstraction Parameter'.

1 Introduction

Despite claims in the literature that have been made to the contrary, we argue that Mandarin does have so-called 'degree abstraction' in this paper. By 'degree abstraction' we mean a configuration like the following:

$$\lambda d \quad \ldots\ d\ \ldots$$
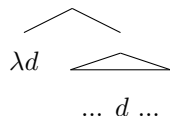
where there is a trace of type d that is bound by a lambda abstraction operator. Mandarin is among a whole class of languages that have been claimed to lack this type of construction, having a negative setting for the so-called 'Degree Abstraction Parameter' (DAP) (Beck et al., 2004, 2010).

The (purported) absence of degree abstraction is particularly interesting in the case of languages that have degree semantics as part of their grammar – those that have a positive setting for the so-called 'Degree Semantics Parameter' (DSP). In [+DSP] languages, gradable predicates express relationships between individuals and degrees, along the lines proposed by Cresswell (1977).[1] Beck et al. (2010) subdivide the [+DSP] languages into those that allow abstraction over degree variables, the [+DAP] languages, and those that do not allow this, the [−DAP] languages. Beck et al. (2010), building on Beck et al. (2004), as well as Oda (2008) and Krasikova (2008), categorize Mandarin, Yorùbá, Mòoré, and Samoan as [+DSP] and [−DAP], in addition to Japanese, using similar diagnostics.

This typology is inspired by Beck et al.'s (2004) work on Japanese, in which they argue that Japanese should be categorized as [−DAP]. They base this on the following evidence: a) Japanese disallows subcomparatives; b) Japanese fails to show scope interactions between comparatives and modals; c) Japanese

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[1]Purported examples of [−DSP] languages include Motu (Beck et al., 2010) and Washo (Bochnak, 2015); in these languages, it is argued that gradable predicates are ordinary predicates of individuals.

comparatives do not display so-called 'negative island effects'; d) Japanese does not have 'genuine' degree questions; and e) Japanese disallows measure phrases directly combining with gradable predicates. To explain these patterns, Beck et al. (2004) suggest that Japanese "probably lacks abstraction over degree variables in the syntax altogether" (p. 289).

Nevertheless, subsequent work has argued *for* the existence of degree abstraction in both Japanese (Kennedy, 2009; Shimoyama, 2012; Sudo, 2015) and Yorùbá (Howell, 2013). These findings raise the question of whether other supposed [−DAP] languages would actually turn out to have degree abstraction upon closer inspection. Here we focus on the case of Mandarin.

Recent work on Mandarin has actually supported the claim that it lacks degree abstraction (Erlewine, 2018). Although Erlewine takes issue with some of the argumentation in Beck et al.'s (2010) paper, he provides two other arguments for the [−DAP] status of Mandarin, one from attributive comparatives and one from comparatives with embedding. Nevertheless, contrary to Krasikova (2008), Beck et al. (2010) and Erlewine (2018), this paper argues that Mandarin in fact allows degree abstraction, adding to the doubt surrounding the Degree Abstraction Parameter in general.

In the next section (§2), we will run through each of the previous arguments that have been made against the existence of degree abstraction in Mandarin, and attempt to convince the reader that all of the evidence is consistent with the existence of degree abstraction. Along the way, we will discover related, positive arguments for the existence of degree abstraction in this language. In §3, we will provide an additional positive argument. By the end, we hope to have convinced the reader that degree abstraction is not a parameter along with Mandarin and English vary, and to have increased the suspicion in the reader's mind as to whether this is a parameter along which any languages vary.

2 Reassessment of the arguments

Let us now review the empirical evidence that has been brought to bear against the existence of degree abstraction in Mandarin. The arguments are based on the following empirical claims:

(1)   Mandarin lacks...

    a.   ...degree questions and direct measure phrases

    b.   ...subcomparatives

    c.   ...scope interactions between comparatives and modals

    d.   ...negative island effects

    e.   ...attributive comparatives

    f.   ...comparatives with matching embedded standard and associate

The first four are diagnostics that Beck et al. (2010) use in their cross-linguistic investigation on degree semantics. The last two are discussed specifically for Mandarin by Erlewine (2018). We now address each of these arguments point by point.

2.1 Degree questions and direct measure phrases

Degree questions and direct measure phrase constructions can be analyzed as involving quantification over degrees (Heim, 2000).

(2)   a.   How tall is John?   (Degree question)

       [Q [λ_1 [John is t_1 tall]]]

    b.   John is exactly six feet tall.   (Direct measure phrase)

       [exactly six feet] [λ_1 [John is t_1 tall]]

A degree question like (2a) involves movement of the *wh*-phrase *how*, which

leaves a trace at the degree slot next to the degree predicate *tall*. Movement of *how* triggers lambda abstraction, giving us a degree abstraction configuration. The same analysis can be extended to direct measure phrases.

It follows from this analysis that if a language lacks degree abstraction, then it should not allow English-style degree questions and direct measure phrase constructions. The absence of such constructions can then be taken as evidence that the language does not have degree abstraction. Japanese, for example, employs degree nouns such as *kurai* 'degree' in constructing degree questions (Beck et al., 2004).

(3) John wa {*ikura, dore-kurai} kasikoi no?
     John TOP how-much, which-degree smart Q
     'How smart is John?'

Beck et al. (2004) suggest that the use of *kurai* 'degree' indicates that Japanese degree questions involve quantification over individuals instead of degrees. However, as argued by Sudo (2015), it is also possible to have an analysis in which *kurai* 'degree' has a degree-based denotation, and does participate in a degree abstraction configuration as in (4).

(4) which degree [λd. John is d-smart].

So while Japanese does lack English-style degree questions, this does not constitute evidence against degree abstraction in Japanese.

According to Beck et al. (2010), Mandarin lacks English-like degree questions, just like Japanese. However, unlike in Japanese, degree questions in Mandarin do not make use of degree nouns. Instead, they are constructed with the degree *wh*-expression *duo* as exemplified in (5), and measure phrases can combine directly with the degree adjective as in (6).

(5)   John duo gao?
        John how tall
        'How tall is John?'

(6)   John 2 mi   gao.
        John 2 meter tall
        'John is 2 meters tall.'

The examples provided by Beck et al. (2010) use the focus marker *shi* as the copula:

(7)   *John shi   duo gao?
        John COP how tall
        'How tall is John?'

(8)   *John shi   2 mi   gao.
        John COP 2 meter tall
        'John is 2 meters tall.'

These examples are reported to be ungrammatical by Beck et al. (2010). We note that they are acceptable in the right context: the first one is acceptable as a clarification/echo-question, and the second with contrastive focus on 'two meters tall'. But regardless of whether the examples with *shi* can be counted as genuine degree questions or direct measure phrase constrictions, examples (5) and (6) above clearly are. So the relevant phenomena do exist in Mandarin.

That said, the significance of these observations is highly analysis-dependent. In fact, as Erlewine (2018) points out, degree questions do not really provide conclusive evidence in Mandarin since it is a *wh*-in-situ language, and its degree questions do not involve movement (Tsai, 1994; Liao, 2013). In other words, degree abstraction is not expected in Mandarin degree questions in the first place because there is no *wh*-movement in questions, overt or covert.

The case of the direct measure phrase construction is different, but the conclusion is the same. Krasikova (2008) points out that Mandarin direct measure

phrase constructions contrast with English ones in that simple positive forms without a measure phrase are unacceptable in Mandarin.

(9) a. John is (2 meters) tall.

b. John *(2 mi) gao.
John 2 meter tall
'John is tall./John is 2 meters tall.'

According to Krasikova (2008), the contrast between (9a) and (9b) shows that Mandarin direct measure phrase constructions are not English-like, and therefore do not count as the kind of measure phrase constructions that would give evidence for degree abstraction in Mandarin. She claims that they do not function as quantifiers that move and trigger degree abstraction, the way measure phrases in English do.

However, this is not the only place where Mandarin requires an overt degree morpheme co-occurring with the gradable predicate. In positive predication, an additional overt degree morpheme such as the "bleached *hen*" (Paul, 2015) is also required, as in (10).[2]

(10) John *(hen) gao.
John very tall
'John is tall.'

The obligatory presence of *hen* in (10) can be explained by a syntax constraint proposed by Grano (2012), called T+[V] constraint:

(11) **T+[V] constraint**

In Mandarin, the direct complement to T(ense) must either be (an extended projection of) a verb or functional morpheme that can in principle combine with a verb.   (Grano, 2012)

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[2]The unstressed *hen* here does not function as an intensifier like *very*.

Since APs cannot be the direct complement of T, a degree morpheme such as a measure phrase or *hen* is required to project a DegP to satisfy T+[V] constraint.[3]

We conclude, therefore, that the difference in measure phrase constructions that Krasikova observes is a consequence of an independent syntactic constraint in Mandarin, unrelated to degree abstraction. Thus, a quantification-over-degree account is still possible for Mandarin direct measure phrase constructions.

In summary, what we have shown in this section is that while degree questions and direct measure phrase constructions in Mandarin differ syntactically from their English counterparts, these differences do not suggest that Mandarin lacks degree abstraction.

2.2 Subcomparatives

We turn now to subcomparatives, another one of Beck et al.'s (2010) diagnostics. Subcomparatives are a particular type of clausal comparative, and clausal comparatives in general are thought to involve degree abstraction; an example is given in (12).

(12)   John is taller than [Bill is ~~tall~~].

The clausal standard in (12) denotes a set of degrees, namely the set of degrees to which Bill is tall (i.e., λd . Bill is d-tall). That set of degrees is thought to be obtained through Quantifier Raising (QR) of a covert operator with a meaning like *what* from a base position beside the gradable predicate to the edge of the *than* clause, where it contributes abstraction over the degree variable (Chomsky, 1977; Bresnan, 1973).

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[3]For this property of Mandarin gradable adjectives, see discussions in Grano (2012).

(13)

-er

than

Op

λd

Bill is d-tall
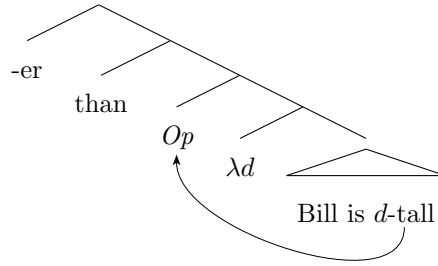
On a standard analysis of clausal comparatives, this set of degrees is compared to the set of degrees to which John is tall (i.e., λd . John is d-tall). The latter is obtained through covert QR of the DegP headed by -*er* from its base position beside the gradable predicate in the matrix clause (the instance of *tall* that is pronounced) to the edge of the clause, where it binds the trace it left behind – another case of degree abstraction. The standard clause is late merged to -*er* at its scope position (Bhatt & Pancheva, 2004).

(14)

-er

than λd Bill is d-tall

λd

John

is d-tall
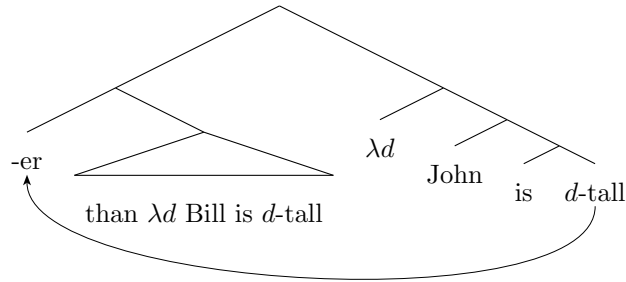
The two-place predicate -*er*, as defined in (15a), takes two complex degree arguments of type $\langle d, t \rangle$ and returns true if the maximal degree of set Q exceeds the maximal degree of set P. The truth conditions for (12) are represented in (15b).

(15)   a.   -*er* $\rightsquigarrow \lambda P_{\langle d,t \rangle} . \lambda Q_{\langle d,t \rangle} . max(Q) > max(P)$

           b. $max(\lambda d . \text{John is } d\text{-tall}) > max(\lambda d . \text{Bill is } d\text{-tall})$

Again, two instances of degree abstraction are thought to be involved in the

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derivation of these truth conditions.

In subcomparatives, two commensurable adjectives are used for comparison, as exemplified in (16).

(16)   a.   The door is wider than the table is long.

        b. $\max(\lambda d \,.\, \text{the door is } d\text{-wide}) > \max(\lambda d \,.\, \text{the table is } d\text{-long})$

Just as in (12), the *than*-phrase here (*than the table is long*) characterizes a degree d by way of a condition that it could meet: 'the table is d long'. This degree-description can be obtained with the help of a silent operator that serves to lambda-bind the degree argument of *long*:

(17)   ... than [Op$_i$ the table is d_i-long]

Assuming the gradable adjective is type $\langle d, et \rangle$ (an assumption that not everyone makes, as we will discuss shortly), degree abstraction would seem to be an essential component of any analysis of this phenomenon. Inability to form subcomparatives might then be taken as an indication that a language lacks degree abstraction.

Subcomparatives are disallowed in Mandarin (Fu, 1978; Xiang, 2005; Krasikova, 2008), as shown in (19). An ordinary comparative is given in (18) for comparison.

(18)   men [bi   zhuozi] kuan.
        door [than table] wide
        'The door is wider than the table.'

(19)   *men kuan [bi   zhuozi chang]
         door wide [than table   long   ]
        'The door is wider than the table is long.'

Beck et al. (2010) and Krasikova (2008) suggest that the lack of subcomparatives

in Mandarin is caused by absence of degree abstraction in the language.

The situation is not so simple, though. For cases like the ones we've been considering, there is actually a way to form the relevant degree-description without degree abstraction. There are two different ways of analyzing gradable predicates. The first is to assume, as is commonly done, that gradable predicates denote relations between individuals and degrees. A gradable adjective like *tall* is considered as an expression of type $\langle d, et \rangle$ with a lexical entry as in (20), in which **tall** is a measure function that takes an entity x and returns the degree d to which x is tall (Kennedy, 2007).
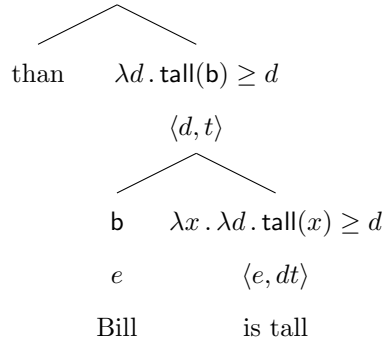
(20) $tall_1 \rightsquigarrow \lambda d.\lambda x.\mathbf{tall}(x) \geq d$

However, Erlewine (2018) analyzes gradable predicates in Mandarin as type $\langle e, dt \rangle$, as exemplified in (21). Following Erlewine, we refer to this as a 'degree-last' analysis.

(21) $tall_2 \rightsquigarrow \lambda x \,.\, \lambda d \,.\, \mathbf{tall}(x) \geq d$

The degree-last analysis makes it possible to construct the needed degree descriptions of type $\langle d, t \rangle$ purely through functional application, without degree abstraction. For example, consider a comparative like *John is taller than Bill is*:

(22)   Deriving type $\langle d, t \rangle$ under a degree-last analysis:

$$\text{than} \qquad \lambda d\,.\,\mathsf{tall}(\mathsf{b}) \geq d$$
$$\langle d, t \rangle$$
$$\mathsf{b} \qquad \lambda x\,.\,\lambda d\,.\,\mathsf{tall}(x) \geq d$$
$$e \qquad \langle e, dt \rangle$$
$$\text{Bill} \qquad \text{is tall}$$

The relevant degree-description is formed here simply by applying the gradable adjective to a type e subject argument. This means that under the degree-last analysis of gradable predicates, degree abstraction is not essential in order for *than*-clauses to denote sets of degrees. Erlewine (2018), who adopts the degree-last analysis, is therefore forced to offer an alternative explanation for the ban on subcomparatives.

Like others who advocate a clausal analysis of *bi*-comparatives such as Liu (1996), Erlewine (2018) stipulates a deletion requirement in comparatives: One of the two gradable predicates must be deleted, as illustrated in (23).[4]

(23)   [[$_{TP}$ men [$_{VP}$ ~~kuan~~]] [bi   [$_{TP}$ zhuozi [$_{VP}$ kuan]]].
        door   wide   than   table   wide
'The door is wider than the table.'

The deletion operation is subject to the following requirement:

(24)   Comparative Deletion Requirement (CDR):

        In a *bi* comparative, elide a local predicate of the target TP under identity with a local predicate of the standard TP. If the target TP has no elidable local predicate, the derivation is illicit. (Erlewine, 2018,

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[4]Analyses vary with respect to the deletion site: Liu (1996) suggests that the predicate in the standard clause is elided, while Erlewine (2018) suggests the predicate in the associate clause.

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A *local predicate* of a given TP is a VP or AP dominated by that TP and not dominated by any intervening TP. It follows from this deletion requirement that any sentence with two gradable predicates that are not identical (e.g. *wide* and *long* in (19), repeated below) will be ruled out in the syntax.

(25)   *[[$_{TP}$ men [$_{VP}$ ~~kuan~~]] [bi   [$_{TP}$ zhuozi [$_{VP}$ chang]]].
          door   wide   than   table   long
       'The door is wider than the table is long.'

If this deletion requirement is in force, then subcomparatives are ruled out independently of whether degree abstraction exists in the language. The lack of subcomparatives therefore does not provide a convincing argument against degree abstraction.

What's more, although Mandarin does not have subcomparatives, it has equative-like constructions as in (26). We refer to such constructions as *subequatives*.

(26)   ni   renwei wo neng pao duo kuai, wo jiu   neng pao duo kuai.
       you think   I   can   run how fast, I   then can   run how fast
       'I can run as fast as you think I can run.'

Sentences like (26) consist of two full clauses, each of which contains a degree *wh*-phrase *duo* 'how'.

There are multiple views on how to analyze cases like (26) in the literature. One view comes from Cheng & Huang (1996), who characterize examples like (26) as 'bare conditionals'. They view such constructions as conditionals with two matching *wh*-pronouns being bound by a covert universal operator.

(27) $\forall d$ [[you think I can run d-fast] $\rightarrow$ [I can run d-fast]]

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On this analysis, a degree variable is bound by an operator, but not a lambda abstraction operator; it is bound directly by a universal quantifier through unselective binding.

One challenge for an analysis like (27), as pointed out by Liu (2018b) and Chen (2020), is that it fails to capture maximality inferences delivered by sentences of this kind. For example, (28a) means I will buy the *biggest* T-shirt that you have, as in (28b). Cheng & Huang's analysis, schematized in (28c), predicts the sentence to mean that I will buy *all* T-shirts that you have.

(28)   a.   ni   you   duo da   de chenshan, we mai duo da   de chenshan.
           you have how big DE T-shirt,   I   buy how big DE T-shirt
           'I will buy as big of a T-shirt as you have.'

      b.   [I buy [max d [you have d-big T-shirt]]-big T-shirt]]

      c. $\forall d$ [[you have d-big T-shirt] $\rightarrow$ [I buy d-big T-shirt]]

Chen (2020) proposes to analyze such constructions as *wh*-correlatives, advocating for a movement-based account. We illustrate the analysis with example (26):

(29)
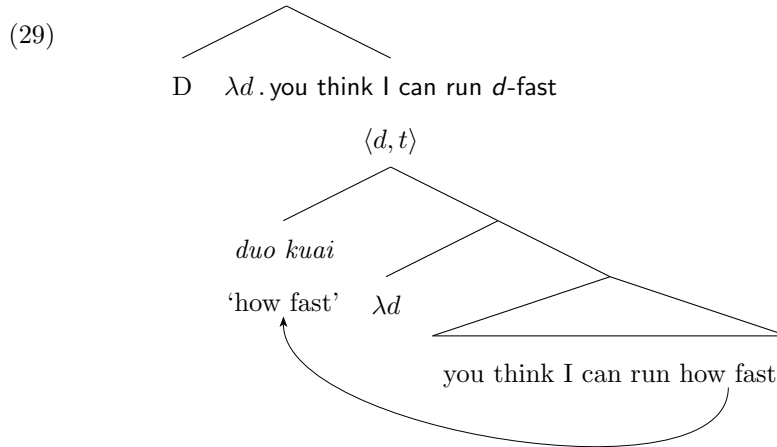
Here, Chen (2020) assumes that the *wh*-pronoun moves to the specifier position of the correlative CP with the lower copy of the *wh*-pronoun not being deleted.

Meanwhile, D hosts a covert type-shifting operation with a function like iota (or max, in the case of degrees), giving us the right type of argument for further predication. We assume that Chen's (2020) is correct, although our conclusions do not rest on this assumption.

As mentioned above, Mandarin is generally thought to lack *wh*-movement in questions, as evidenced by a lack of island sensitivity there (Tsai, 1994; Liao, 2013). *Wh*-correlatives are different; they are subject to island effects, suggesting that they involve *wh*-movement (Chen, 2020). In subequatives, the standard clause is sensitive to, for example, the Coordinate Structure Constraint and the Left Branch Condition (Ross, 1968), as instantiated in (30) and (31) respectively.

(30) *[zhuozi [$_{\text{ConjP}}$ **duo kuan**$_{t_1}$ he   duo chang]]$_2$, men **duo kuan**$_1$ t_2.
      table   how wide   and how long   door how wide
      Lit: 'The table is X wide and Y long, and the door is that wide.'

(31) *[ta you yi   ge [$_{\text{NP}}$ **duo gao**$_{t_1}$ de xiaohai]]$_2$, men **duo gao**$_1$ t_2.
      he have one CL   how tall   DE child   door how tall
      Lit:'He has a X tall child, and the door is that tall.'

These correlative constructions do therefore involve covert *wh*-movement, with corresponding lambda abstraction in the semantics. Degree abstraction is therefore required to derive (29). Even under a degree-last analysis, degree abstraction would be required, due to the embedding involved in the complex degree argument (λd. you think I can run d-fast).

To summarize: On the one hand, the absence of subcomparatives in Mandarin is not evidence of the lack of degree abstraction. On the other hand, the evidence from subequatives provides a strong argument *for* degree abstraction in Mandarin.

2.3 Scope interactions between comparatives and modals

Another place to look for degree abstraction is in scope interactions between degree quantifiers and modals. Heim (2000) investigates the question of whether there are quantifiers over degrees – *-er than 6 feet* being a candidate – which, like quantifiers over individuals, undergo QR, leaving a trace in their original position, and triggering lambda abstraction in their scope. The structural analogy is illustrated in Figure 1.
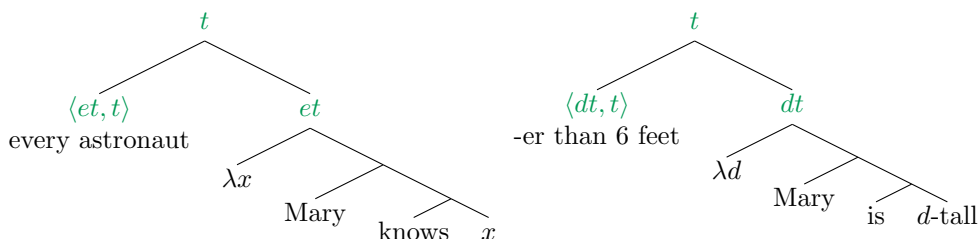

Figure 1: Quantifiers over individuals and degrees undergoing QR

How would we know whether there are such things? Scope ambiguity with other operators would be an indication that there are. Such scope ambiguities are often missing, as Kennedy (1997) pointed out; moreover, often the two scope readings collapse, giving rise to the same truth conditions (Heim, 2000). However, multiple scope readings can be truth-conditionally distinguished in certain cases, and although degree quantifiers do not appear to interact scopally with quantifiers over individuals ('Kennedy's generalization'), they do seem to interact scopally with some modals. Examples claimed to exhibit scopal ambiguity include *less*-comparatives as in (32), *exactly*-comparatives as in (33), and examples involving comparative ellipsis as in (35).

(32)   Mary drives 80mph. John needs to drive less fast than that.

    a.   *need > less*

        [need [[less than that] [λ_1 [John drive t_1 fast]]]]

$$\rightsquigarrow \square[\max(\lambda d \,.\, \mathsf{speed}(\mathsf{j}) \geq d)) < 80\mathsf{mph}]$$

b. *less > need*

[less than that] [λ_1 [need [John drive t_1 fast]]]

$$\rightsquigarrow \max(\lambda d \,.\, \square\mathsf{speed}(\mathsf{j}) \geq d) < 80\mathsf{mph}$$

The two readings of (32) are represented by the LFs in (32a) and (32b). Heim assumes that *less* takes the degree denoted by the pronoun *that* in the standard phrase and says that the maximum degree described by the main clause is smaller than that degree. She assumes further that 'John drives *d*-fast' means that John's driving speed is greater than or equal to d: $\mathsf{speed}(\mathsf{j}) \geq d$. We use $\mathsf{speed}(\mathsf{j})$ as a notational shorthand for 'the (maximal) speed at which John drives'. The maximum degree d to which John drives d fast, then, would be John's actual speed: $\mathsf{speed}(\mathsf{j})$ is equivalent to $\max(\lambda d \,.\, \mathsf{speed}(\mathsf{j}) \geq d)$. Given these assumptions, (32a) says it is disallowed for John to drive faster than 80mph.

A degree d such that John *needs* to drive d fast is a degree such that John's speed reaches or exceeds d in all worlds. Such a degree would be a lower bound on acceptable speeds. The maximum such degree is the greatest lower bound on acceptable speeds. Hence (32b) says the minimum speed required for John is less than 80mph. The first reading is derived with the intensional verb *need* taking scope over the comparative operator, while the second reading is derived when the comparative operator takes scope over *need*. Crucially, the truth conditions differ depending on scope.

Analogous observations hold for (33).

(33)   The draft is 10 pages. The paper is required to be exactly 5 pages longer than that.

   a.   require [exactly 5pp -er than that] [λ_1 [the paper be t_1 long]]

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$$\rightsquigarrow \Box \max(\lambda d \,.\, \text{length}(\text{the-paper}) \geq d) = 10\text{pp} + 5\text{pp}$$

b. [exactly 5pp -er than that] [λ_1 [require the paper be t_1 long]]

$$\rightsquigarrow \max(\lambda d \,.\, \Box\text{length}(\text{the-paper}) \geq d) = 10\text{pp} + 5\text{pp}$$

In order to handle the differential argument of the comparative, *exactly five pages*, Heim assumes that the maximum degree described by the main clause is constrained to be equal to the sum of the degree denoted by the standard and the degree denoted by the differential. (Although *exactly five pages* might be analyzed compositionally as a quantifier, the resulting semantics is the same as if it picked out a particular quantity, 5 pages itself.) The first reading, (33b), says that it is required that the paper be 15 pages long. The second reading says that the greatest lower bound on acceptable lengths is 15 pages (so the paper has to be at least 15 pages long).[5]

Degree abstraction being essential for comparative operators to take wide scope over modals, it follows that in languages without degree abstraction, there should be no scopal ambiguity in such sentences. Indeed, this is one of the diagnostics used by Beck et al. (2004) in order to support the idea that some language lack degree abstraction. However, this argument must always be made carefully, with the specific lexical resources of the language taken into consideration. For instance, Howell (2013) argues that the lack of scope ambiguity in certain Yorùbá sentences is compatible with degree abstraction simply because Yorùbá lacks *less*-comparatives as well as modified numeral measure phrases such as *exactly 5 pages*. A similar point can be made here.

Arguing that Mandarin lacks degree abstraction, Krasikova (2008) and Beck et al. (2010) give the following example (based on a similar one given for Japanese in Beck et al. 2004):

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[5]For what it's worth, the second author, a native speaker of English, does not get a reading where lengths greater than 15pp are allowed. We believe it would be worth carrying out a judgment study on native English speakers before continuing to use this type of example in semantic fieldwork on degree abstraction.

(34) John xuyao [bi   Bill] shao mai yixie lazhu.
      John must [than Bill] little buy some candles
      'John must buy fewer candles than Bill.'

      Not: 'John's minimally required amount is below Bill's.'

They use the absence of the second reading as evidence for the lack of degree abstraction in Mandarin. This example is not perfectly analogous to the ones we've just considered, because the standard is not a given degree ('that'), but rather something like 'than Op_d Bill ~~bought d-many candles~~', with an unpronounced clause. To understand its significance, then, let us first dig into comparative ellipsis a bit.

For the comparative ellipsis sentence in (35), there are two possible scope positions of the comparative.

(35)   Mary needs to drive faster than John.

   a.   *need > -er*:

        need [-er than λd John ~~drive d-fast~~] λd Mary to drive d-fast

        $\Box \max(\lambda d . \mathsf{speed}(\mathsf{j}) \geq d) < \max(\lambda d . \mathsf{speed}(\mathsf{m}) \geq d)$

        'It is required that Mary's speed exceed John's'

   b.   *-er > need*

        [-er than λd ~~need~~ John ~~drive d-fast~~] λd need Mary drive d-fast

        $\max(\lambda d . \Box[\mathsf{speed}(\mathsf{j}) \geq d]) < \max(\lambda d . \Box[\mathsf{speed}(\mathsf{m}) \geq d]$

        'Mary's minimum required speed is above John's minimum required speed'.

The boring scope configuration is the one in (35a), where the modal *need* takes scope over the comparative. The truth conditions for this configuration can be paraphrased, 'It is required that the degree to which Mary drives fast exceeds the degree to which John does,' i.e., 'It is required that Mary drives faster than

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John drives.'

The interesting scope configuration is where the comparative takes scope over *need*, as in (35b). With that configuration, the truth conditions are 'The (greatest) degree to which Mary needs to drive fast exceeds the (greatest) degree to which John needs to drive fast'. The greatest degree to which X needs to drive fast is the greatest lower bound on acceptable speeds for X. Another way of paraphrasing the truth conditions, then, is: 'Mary's minimum required speed is above John's minimum required speed.'[6] Heim designs a context in which this *-er > need* reading is true, and the *need > -er* reading is false:

(36)   **East coast driving scenario**   (Heim, 2000)

        John and Mary both need to get to Boston by eight o'clock; Mary is far away, in New Haven, and John is closer by, in Providence.

In this scenario, *Mary needs to drive faster than John* in order to get to Boston on time, but it is acceptable for John to drive faster than Mary; it's just that Mary's *minimum required* speed is above John's.

With this background on comparative ellipsis covered, let us also give a bit more background on cases involving negative antonyms, because Krasikova's example (34) also involved a negative antonym. With the negative antonyms *less fast* and *slower*, Heim (2006) noticed that there's actually a difference in meaning between (37a) and (37b).

(37)   a.   John needs to drive less fast than Mary.

        b.   John needs to drive slower than Mary.   (Heim, 2006)

Example (37a) is true in Heim's east coast driving scenario, whereas (37b) does

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[6](35) involves ambiguity of antecedent-size: whether the antecedent is the VP [drive *d*-fast], or the one including the modal verb [need to drive *d*-fast]. In the latter case, we get the minimum-required reading when the DegP scopes over the modal verb *need*. (Heim, 2000)

not seem to be. What we would like to point out is that there are actually two readings where the comparative scopes over the modal, depending on whether the negative component of the negative antonym comes with the comparative or not. *Less* expresses both the comparative part and the negative part. If both take scope over *need*, then you get the reading in (38a). This reading is true in the east coast driving scenario. But if only the comparative component scopes over *need*, and the negative component remains underneath it, the reading in (38b) is obtained.

(38)   a.   *less > need*:

        [less than λd ~~needs~~ Mary ~~drive *d*-fast~~] λd needs John drive *d*-fast

        $\max(\lambda d\,.\,\Box[\mathsf{speed}(\mathsf{j}) \geq d]) < \max(\lambda d\,.\,\Box[\mathsf{speed}(\mathsf{m}) \geq d])$

        'John's minimum required speed is below Mary's.'

    b.   *-er > need > slow*:

        [-er than λd ~~needs~~ Mary ~~drive *d*-slow~~] λd needs John drive *d*-slow

        $\min(\lambda d\,.\,\Box[\mathsf{speed}(\mathsf{j}) < d]) < \min(\lambda d\,.\,\Box[\mathsf{speed}(\mathsf{m}) < d])$

        'The degree to which John needs to drive *slowly* exceeds the degree to which Mary needs to drive slowly.'

        hence 'John's maximum allowed speed is below Mary's.'

These two readings are very different, although they both involve high scope for the comparative over the modal. The reading in (38b), although it involves a min operator, is actually a comparison-of-maxima reading, where John's maximum allowed speed is below Mary's maximum allowed speed. More directly, what it says is that John's required slowness exceeds Mary's required slowness. John's required slowness is the set of degrees to which John does *not* drive fast. This is an interval that stretches from right above his speed indefinitely upwards – the sort of thing that serves as a 'negative degree' for Kennedy (2001). The

set of degrees such that in no possible world John drives that fast is the set of impossible speeds for John. Because the interval of impossible speeds stretches down lower from infinity for John than for Mary, its minimum is below the one for Mary. Where the impossible speeds end, the acceptable speeds begin. Hence the greatest *acceptable* speed for John (the speed right below the lower tip of that interval) is lower than the greatest acceptable speed for Mary.

Let us now return to Krasikova's example (34), repeated here:

(39)   John xuyao [bi   Bill] shao mai yixie lazhu.
        John must   [than Bill] little buy some candles
        'John must buy fewer candles than Bill.'

This sentence does have a reading where *must* scopes over *little* + *-er*:

(40)   *must* > *little* + *-er*

        $\Box[\max(\lambda d . \mathsf{candles}(\mathsf{j}) \geq d) < \max(\lambda d . \mathsf{candles}(\mathsf{b}) \geq d]$

        'It is required that John buy fewer candles than Bill'

It does *not* have a reading where *little* + *-er* (the comparative and the negative component together) scope over the modal: 'John's minimally required amount is below Bill's'.

(41)   *little* + *-er* > *must*

        $\max(\lambda d . \Box[\mathsf{candles}(\mathsf{j}) \geq d]) < \max(\lambda d . \Box[\mathsf{candles}(\mathsf{b}) \geq d])$

        'John's minimally required amount is below Bill's.'

However, Krasikova does not discuss the possibility that the comparative element alone scopes over the modal, which in turn scopes over the negative antonym.

(42)   *-er* > *must* > *little*

$$\min(\lambda d \,.\, \Box[\mathsf{candles}(\mathsf{j}) < d]) < \min(\lambda d \,.\, \Box[\mathsf{candles}(\mathsf{b}) < d])$$

'John's maximal amount allowed is below Bill's.'

We have not been able to determine whether this reading is available for this sentence, but we do have that kind of reading – a comparison-of-maxima reading – for other sentences.

Sentence (43) has such a reading. Consider a scenario where the speed limit on I-90 is 60 mph; the speed limit on I-95 is 80 mph. The following sentence would make sense in such a context:

(43)   ni   zai I-90 xuyao [bi   zai I-95] kai   de man.
        you on I-90 need   [than on I-95] drive DE slow
        'You need to drive more slowly on I-90 than on I-95.'

er > need > slow:

$$\min(\lambda d \,.\, \Box\mathsf{speed}(\mathsf{u}) < d) < \min(\lambda d \,.\, \Box\mathsf{speed}(\mathsf{u}) < d)$$

'The max OK speed on I-90 is below the max OK speed on I-95'

If the comparative scopes over *need*, but *slow* remains below *need* (as suggested by the fact that *slow* is a single word here), then the resulting reading is: 'The minimum degree to which you need to drive slow on I-90 is below the minimum degree to which you need to drive slow on I-95'. The minimum degree to which you need to drive slow on I-90 is the minimum degree such that in all possible worlds, you don't drive that fast. In somewhat more normal-human-readable format: 'The maximum acceptable speed on I-90 is below the maximum acceptable speed on I-95.' That would be a comparison-of-maxima reading. This sentence has such a reading; it can be judged true even if driving 50 mph on I-90 but 40 mph on I-95 is OK. In other words, the sentence does not impose any requirements on the relative speeds with which one drives on these two highways. This suggests that comparatives can indeed scope over a modal in

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these kinds of comparative ellipsis constructions.

Moreover, we find that Mandarin displays scope interactions in *exactly*-differential sentences, as illustrated in (44).

(44) ni   zhenghao xuyao [bi   zhiqian] duo xie   2 ye.
      you exactly   need [than before] more write 2 page
      'You need to write exactly 2 more pages than before.'

      Reading 1: It is required that you write exactly 2 pages more than before

      Reading 2: The minimum requirement is exactly two pages greater than before.

Suppose you have written a paper of 10 pages, and you wonder if that is enough for you to publish it. (44) can be judged true in a scenario where the minimal requirement is 12 pages, but you are allowed to write more than that. Hence Reading 2 is available. This (*-er > must*) reading of (44) suggests that comparative operators can take scope over modal verbs in Mandarin.

If Mandarin allows the comparative operator to take scope over modal verbs, then what would account for the unavailability of the (*fewer > must*) reading in (34)? For the fact that Mandarin does not have *less*-comparatives, a natural explanation is that *shao* in Mandarin is a negative antonym like *slow*, in which the negative component can not be singled out and move with *-er* to interact with modal verbs. We adapt the lexical entry for negative antonyms suggested by Heim (2006) and give (45) for *shao*.

(45) $shao \rightsquigarrow \lambda d . \lambda x . \textbf{amount}(x) < d$

If this treatment of *shao* is correct, then a comparison-of-minima reading is already unexpected in (34). The lack of scope ambiguity in this case is not due a limitation imposed by the grammar, because as we have seen, degree

operators can take scope over modal verbs in Mandarin: Example (43) has a comparison-of-maxima reading, and (44) has a comparative-over-modal reading as well.[7]

2.4 Negative island effects

Another key DAP test suggested by Beck et al. (2004) involves so-called 'negative island effects'. Negation in the standard clause results in anomaly in constructions like (48).

(48) a. #Mary bought a more expensive book than no boy did.

b. #Mary bought a more expensive book than John didn't.

An explanation for the anomaly is that the set of degrees denoted by the *than*-clause containing negation does not have a maximal degree (von Stechow, 1984; Rullmann, 1995). For example, the *than*-clause in (48b) has a denotation as follows:

(49) λd . John didn't buy a d-expensive book

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[7]Alrenga et al. (2012) suggest that the semantics of comparison has two sources, one from the comparative predicate and one from the standard marker. In particular, they propose that the standard marker *than* in English encodes comparative semantics as well as comparative predicates and modify the denotation of *-er* and *than* as follows:

(46)   COMP $\rightsquigarrow \lambda G_{\langle d,et \rangle} \lambda x_d \lambda y_e$. $\max(\lambda d . G(d)(y)) > x$
        THAN $\rightsquigarrow \lambda G_{\langle d,et \rangle} \lambda Q_{\langle d,et \rangle}$. $\max(Q) > \max(G)$

If we assume with Alrenga et al. (2012), scope interactions between comparatives and modal verbs will be possible when the language has expressions like the standard-selecting *than*.

Liu (2018a) argues for the predicate-selecting COMP in Mandarin. While it is uncertain yet whether Mandarin also has the standard-selecting *than*, to get the high-scope comparative reading in (43), we must also assume that the predicate-selecting COMP can be QR-ed and thus trigger abstraction over degrees, as sketched below.

(47)   COMP $\rightsquigarrow \lambda G_{\langle d,et \rangle} \lambda x_e \lambda y_e$. $\max(\lambda d . G(y)(d)) > \max(\lambda d . G(x)(d))$
        [on I-90]$_x$ [[bi on I-95] [COMP [λd λx [you need to drive d-slow on x]]]]
        $\rightsquigarrow$ COMP$(\lambda d \lambda x . \Box\mathsf{speed}(\mathsf{x}) < d)(\mathsf{I95})(\mathsf{I90})$

Suppose the price of the most expensive book John has bought is p. So for any price p' that is greater than p, it is always true that John did not buy a p'-expensive book. As p' can increase without bound, there is no maximum, so the maximum operator is undefined.

Beck et al. (2010) suggest that degree abstraction is closely related to negative island effects: only if the *than*-clause denotes a set of degrees will there be a need to define the maximal degree. Hence, according to Beck et al. (2010), if a language does not display such negative island effects, it is likely that *than*-clauses in the language do not denote sets of degrees.

We take issue both with the empirical claim that Mandarin lacks negative island effects and with the logic of the argument. Example (50) is presented by Beck et al. (2010) to show that Mandarin displays no island effects.

(50) $[_{DP}[_{RC}$John mai de shu$]]$ bi $[_{DP}[_{RC}$Bill mei mai de$]]$ gui.
       John buy DE book than   Bill Neg buy DE expensive
'John bought a more expensive book than the one Bill didn't buy.'

Literally: 'The book John bought is more expensive than the book Bill didn't buy.'

Example (50) is quite different from English examples in (48), and not just in that it has an acceptable reading. As one can tell from the added literal translation, (50) makes a comparison between a book which John bought and *the book which Bill didn't buy*. Although Mandarin does not have (in)definite articles equivalent to English *a/the*, the sentence clearly involves reference to a particular book, the book Bill didn't buy. Thus, under a clausal analysis, the denotation of the *than*-clause in (50) should be along the lines of the following:

(51) λd . the book which Bill didn't buy is d-expensive

Because of the fact that the *than*-clause denotes a set of degrees to which a par-

ticular book is expensive, we indeed can define the maximal degree. No anomaly should be expected. Thus, (50) does not show Mandarin lacks negative island effects. In general, if a language allows an interpretation of a string similar to *John bought a more expensive book than Bill didn't* involving definite reference to a particular non-bought book, this does not provide evidence that the language *lacks* degree abstraction; it just shows that the syntax of the language *permits* such a parse.

Now consider example (52) and (53). The negation in the standard clause makes (53) unacceptable.

(52)   John pao de [bi   Bill] pao de kuai.
        John run DE [than Bill] run DE fast
        'John runs faster than Bill.'

(53)   #John pao de [bi   Bill] **mei** pao de kuai.
        John run DE [than Bill] NEG run DE fast
        'John runs faster than Bill doesn't.'

The anomaly of (53) can be explained under the same set of assumptions that explain the anomaly of its English counterpart (54), i.e., there is no maximum of the set of degrees such that Bill doesn't run d-fast.

(54)   #John runs faster than Bill doesn't.

        λd . Bill doesn't run d-fast

Thus Mandarin actually patterns with English, displaying negative island effects. Far from providing an argument *against* degree abstraction, the evidence in this arena is just what is expected if Mandarin comparatives involve sets of degrees, just like their English counterparts.

2.5 Attributive comparatives

We turn now to additional evidence provided by Erlewine (2018). Attributive comparatives are ones in which a comparative attributively modifies a nominal. (55) is an example of attributive quantity comparative, whereas example (56) is an attributive degree comparative.

(55)   J bought more books than B.

max(λd. J bought d-many books) > max(λd. B bought d-many books)

(56)   J wrote a longer paper than B.

max(λd. J wrote a d-long paper) > max(λd. B wrote a d-long paper)

In these cases, two degree descriptions are compared; for instance, in (55), 'λd. J bought d-many books' is compared to 'λd. B bought d-many books'. Forming these degree descriptions requires degree abstraction, even under a degree-last approach: In attributive position, there is no type e expression that a gradable predicate can combine with directly in order to produce an degree-description of type $\langle d, t \rangle$.

Erlewine (2018) argues that attributive comparatives are impossible in Mandarin based on the following example.

(57)   *John bi   Bill xie   le   {duo,   chang} de lunwen.
         John than Bill write ASP {many, long}   DE paper
         'John wrote more papers/a longer paper than Bill.'

We do not dispute the acceptability judgment for (57), but we doubt that this observation can be explained by the lack of degree abstraction. (57) can be rescued by an additional degree adverb *geng* 'more' as in (58).

(58)   John bi   Bill xie   le   **geng** {duo,   chang} de lunwen.
         John than Bill write ASP **more** {many, long}   DE paper

'John wrote more papers/a longer paper than Bill.'

Granted, it is not clear that (57) and (58) are totally equivalent. According to the native speaker intuitions of the first author, (58) has an implication that both John and Bill wrote many papers (or a long paper for the case with *chang* 'long'). However, (58) is undeniably an attributive comparative construction. If attributive constructions like (57) are ruled out by the lack of degree abstraction, we should not have constructions like (58).

In sum, although attributive comparatives are more restricted than non-attributive ones, both degree and quantity attributive comparatives are possible in Mandarin. This provides positive evidence that degree abstraction is present in Mandarin. (See appendix for discussion of why *geng* might be required in attributive comparatives.)

2.6 Comparatives with matching embedded standard and associate

In English, a clausal standard in a comparative construction can itself embed another clause, as exemplified in (59) and (60).

(59)   Mary is taller than Bill thinks she is.

$\max(\lambda d \,.\, \text{Mary is } d\text{-tall}) > \max(\lambda d \,.\, \text{Bill thinks Mary is } d\text{-tall})$

(60)   John thinks Mary is taller than Bill thinks she is.

$\max(\lambda d \,.\, \text{John thinks Mary is } d\text{-tall}) > \max(\lambda d \,.\, \text{Bill thinks Mary is } d\text{-tall})$

Such examples involve a description of a degree that crosses a clause boundary, and it is hard to imagine a process other than degree abstraction that could yield that.

Erlewine (2018) argues on the basis of the absence of similar constructions in Mandarin that Mandarin lacks degree abstraction. His argument is based on the assumption that *bi*-comparatives are clausal, and that the predicate in the associate clause is deleted:

(61)   [$_{TP}$ Mary$_i$ ~~gao~~] bi   [$_{TP}$ John gao].
        Mary tall   than   John tall
        'Mary is taller than John.'

If this analysis is correct, and Mandarin allows the standard clause to contain an embedding predicate as in (59) and (60), we would expect the following structures to be licit, contrary to fact:

(62)   *[$_{TP}$ Mary$_i$ ~~gao~~] bi   [$_{TP}$ John juede [$_{TP}$ ta$_i$ gao]].
        Mary tall   than   John think   she tall
        'Mary is taller than John thinks she is.'

(63)   *[$_{TP1}$ John ~~juede Mary gao~~] bi   [$_{TP2}$ Bill juede Mary gao].
        John think Mary tall than   Bill think Mary tall
        'John thinks Mary is taller than Bill thinks she is.'

The ungrammaticality of (62) can be explained by the comparative deletion requirement directly as suggested by Erlewine (2018): The gradable predicates that are subject to the deletion requirement need to be local. The locality of predicate is defined as follows.

(64) α is a local predicate of β iff

        (a) α is a VP or a predicative AP;

        (b) β dominates α;

        (c) there is no TP that is dominated by β and dominates α.

                                                                (Erlewine, 2018)

In (62), the local predicate of the associate clause (i.e., *tall*) is not identical to

the local predicate of the standard clause (i.e, *think*), therefore, the deletion is illicit.

However, in (63), the deletion requirement is satisfied but the sentence is still ungrammatical. Erlewine (2018) points out that by the proposed definition of local predicate, the local predicate of TP1 in (63) is the VP [think Mary tall], which is identical to the local predicate of TP2. He proposes that the source of the ungrammaticality of (63) is the lack of degree abstraction: In (63), it is impossible to derive the complex degree descriptions without degree abstraction when the standard and associate clause involves embedding.

A ban on degree abstraction would rule out too much, though. Examples with the matrix verb *ling* 'make' are more acceptable than those with *juede* 'think', as shown in (65).

(65)   John bi   Bill ling   Mary kaixin.
           John than Bill make Mary happy
           'John makes Mary happier than Bill does.'

           $\max(\lambda d\,.\,\text{John makes Mary } d\text{-happy}) > \max(\lambda d\,.\,\text{Bill makes Mary } d\text{-happy})$

Note that the same contrast holds in English.

(66)   a. ??John thinks Mary is happier than Bill does.

          b.   John makes Mary happier than Bill does.

One difference between (65) and (63) is that *make* introduces a small clause (SC) whereas *think* introduces a TP. This contrast indicates that the ungrammaticality of (63) is independent of degree abstraction: If there is no degree abstraction, the degree argument will be stuck in the embedded SC as well, making it impossible to interpret (65).

Suppose we were to revise the deletion requirement such that the deletion

site cannot contain a full TP. Then we correctly capture the contrast between (65) and (63):

(67)   a.   John [$_{\text{VP}}$ ~~makes~~ [$_{\text{SC}}$ ~~Mary happy~~]] than Bill makes Mary happy.

        b. *John [$_{\text{VP}}$ ~~thinks~~ [$_{\text{TP}}$ ~~Mary is happy~~]] than Bill thinks Mary is happy.

This revised deletion requirement is no more stipulative than Erlewine's, and it correctly rules out the illicit embedding construction that Erlewine ruled out via a ban on degree abstraction.

3   Additional diagnostics

In the previous section, we provided rebuttals for all arguments that we know to have been made against degree abstraction in Mandarin. In some cases, our rebuttals spoke to the contrary, giving positive evidence in *favor* of it. In this section, we consider two additional diagnostics. Unfortunately, the results are somewhat inconclusive, but we hope that our discussion will be of methodological value to future researchers working on degree abstraction in the languages of the world.

3.1   Scope interaction in *little*-sentences

As discussed by Heim (2006) in a paper entitled *Little*, degree constructions like (68) below involve scope interactions between degree operators and intensional verbs. We refer to such constructions as *little*-sentences.

(68)   The school lets the students write so little!

There are two readings available in (68): a) There is no penalty from the school for the students if they write very little; b) There is penalty if the students

write too much. The ambiguity is analyzed as a scopal ambiguity in Heim (2006). When *let* takes scope over *little*, we have the reading (a), which is true when it is allowed for the students to write very little; whereas when *little* takes scope over *let*, we have reading (b): the students are not allowed to write more than very little.

This interaction between the quantifier and the degree argument provides evidence for degree abstraction in English. More specifically, the wide scope reading (b) requires a degree abstraction operator to take scope over the modal, suggesting that the operator undergoes QR.

Mandarin shows the same scope ambiguity in translations of (68), as instantiated in (69).

(69)   John keyi chi yi-dian-dian.
        John can eat one-dot-dot
        'John can eat very little.'

        ($\diamond >$ little): Eating very little is a possible choice for John.

        (little $> \diamond$): Eating more than very little is not allowed for John.

(69) is judged ambiguous between those two readings by speakers uncontroversially, suggesting that Mandarin allows a degree argument to take scope over modals or the other way around.

Unfortunately, however, the Mandarin sentence is not parallel to the English one; because the meaning of *yi-dian-dian* is more like 'a little' than 'little'. The difference between these two words can be brought out by sentence pairs like (70).

(70)   a.   I'm sad because we can grow {very little/#a little/?a tiny amount of} in our garden.

        b.   I'm happy because we can grow {#very little/a little/a tiny amount

of} in our garden.

(These judgments are based on the assumption that it is always better to be able to grow more in one's garden.) In parallel sentences, Mandarin *yi-dian-dian* behaves like *a little* and unlike *little*. If the meaning is *a little*, then the semantics do not deliver a reading where eating more than very little is disallowed. Such a reading might arise through scalar implicature, but that is possible under both scopings. Hence, unfortunately, we do not get positive evidence for degree abstraction from (69).

3.2   Superlatives

A second additional diagnostic for degree abstraction comes from superlative constructions. It is generally accepted that superlatives are ambiguous between an absolute reading (with a contextual comparison class) and a relative reading (with a focus-driven comparison class), as exemplified in (71).

(71)   John received the most beautiful gift.

Absolute reading: John received a more beautiful gift than all other gifts in the world.

Relative reading: John received a more beautiful gift than all other people.

Under a scope analysis, the absolute reading has the *-est* part being interpreted inside the NP, whereas the relative reading involves LF-movement of the *-est* part: it is moved to a position taking scope over the proposition (Szabolcsi, 1986; Heim, 1985). The representations are roughly as follows.

(72)   a.   John received [-est [λd [d-good present]]]   (absolute)

  b.   John$_\text{F}$ [-est [λd [λx [x received d-good present]]]]   (relative)

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Superlatives in Mandarin are constructed with the degree adverb *zui* 'most' as in (73).

(73)   John shoudao le   zui   piaoliang de liwu.
         John receive   ASP most beautiful DE present
         'John received the most beautiful present.'

Both an absolute reading and a relative reading are available for Mandarin superlatives. If we adopt the scope analysis, in which abstraction is used to derive the relative reading, we expect λ-abstraction over degree variables for the relative reading, i.e., degree abstraction. The derivation of (73) under a relative reading is given in (74).

(74)

```
            John
                  most
                        λd        ⟨e, t⟩
                              λx
                                 x
                                    receive              DP
                                                  d   beautiful   DE
                                                                      present
```
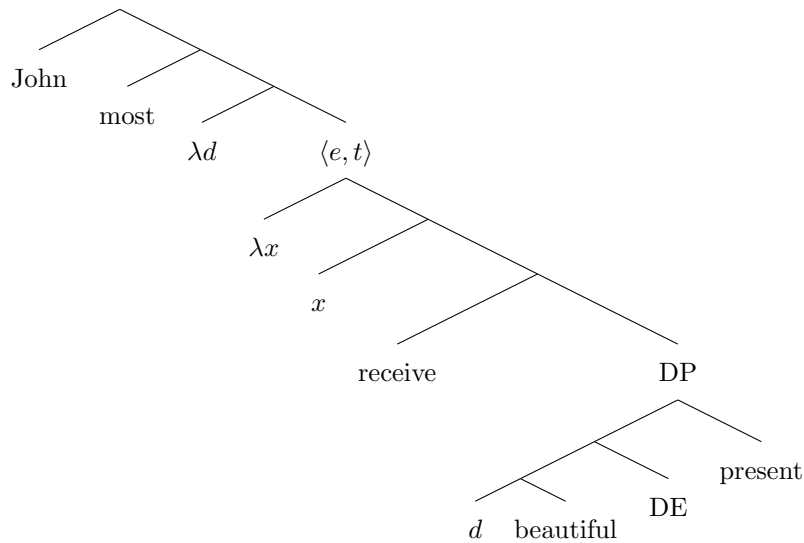
If superlatives undergo covert movement at LF to a position near the focussed consituent, leaving a degree-type trace, then degree abstraction is involved in the generation of relative readings of superlatives. Of course, the force of this argument ultimately depends on what the right analysis of relative readings for superlatives is. The most recent analysis of relative readings of superlatives,

given by Bumford (2017, 2018), does involve scope-taking but it actually does not involve degree abstraction. If that theory is right, then relative readings of superlatives do not provide evidence for degree abstraction.

4 Conclusion

In this paper we have investigated Mandarin degree constructions with respect to the Degree Abstraction Parameter (DAP). We have taken into account the Degree Last assumption and examined the arguments that have been made for the lack of degree abstraction in Mandarin by Krasikova (2008), Beck et al. (2010) and Erlewine (2018).

We have shown that those previous arguments against degree abstraction are not convincing, and we have discovered positive arguments for it along the way:

- We have shown that Mandarin does have degree questions, but that cannot really be used as evidence for degree abstraction because Mandarin is a *wh*-in-situ language.

- Meanwhile, Mandarin direct measure phrase constructions are just like English ones where a quantification-over-degree analysis is quite possible.

- We also showed that although Mandarin lacks subcomparatives, it does have subequatives. This result give positive evidence for degree abstraction.

- We have given new evidence for degree abstraction from scope interactions with modals. In particular, we suggest that in Mandarin the comparative can take scope over modals and gives raise a comparison-of-maxima reading. Such scopal interactions require degree abstraction no matter what analysis is assumed for comparatives in general.

- We showed that negative island effects do exist in Mandarin, but we argue that this test does not provide any evidence with respect to degree abstraction.

- Then we illustrated that Mandarin does have attributive comparatives, contrary to previous claims. This is further evidence for degree abstraction.

- We showed that with certain types of embedding verbs, you can have embedding in a standard clause of a comparative ellipsis construction. This data does not straightforwardly provide positive evidence for degree abstraction, because that conclusion would rely on a number of assumptions, but we do consider ourselves to have provided a rebuttal to the original argument.

Taken together, these results show clearly that degree abstraction is not a parameter along which Mandarin and English vary.

Our conclusion, along with those made for Japanese by Shimoyama (2012); Sudo (2015) and Yorùbá by Howell (2013), casts further doubt on the existence of the Degree Abstraction Parameter. As more and more languages are argued to have degree abstraction in recent studies—including P'urhepecha (Zyman, 2015), Twesap (Clem, 2019), and two Salish languages (Davis & Mellesmoen, 2019)—our findings add to the growing evidence that degree abstraction may in fact be universal among languages with degree predicates.

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A   On the obligatoriness of *geng* in attributive comparatives

Let us take a moment to speculate as to what might account for the unacceptability of (57), repeated here:

(75)　*John bi　　Bill xie　　le　　{duo,　chang} de lunwen.
　　　　　John than Bill write ASP {many, long}　　DE paper
　　　　　'John wrote more papers/a longer paper than Bill.'

and the obligatoriness of the variant with *geng*, illustrated in (58), repeated here:

(76)　John bi　　Bill xie　　le　　**geng** {duo,　chang} de lunwen.
　　　　John than Bill write ASP **more** {many, long}　　DE paper
　　　　'John wrote more papers/a longer paper than Bill.'

We would like to raise the possibility that the obligatoriness of *geng* here is related to the obligatoriness of *hen* 'very' in positive form adjectives. In particular, we suggest that Grano's (2012) T+[V] constraint lies behind both of these phenomena.

　　　There is a debate over how to analyze prenominal modifiers in Mandarin: are they actually relative clauses, or are they just simple attributive modifiers (see discussions in Sproat & Shih (1988) and Paul (2005))? It is also possible that there is widespread ambiguity, and that the answer differs depending on the class of modifier. We cannot resolve this issue here, but if we can assume that comparative modifiers are actually relative clauses, then we can take advantage of Grano's (2012) a T+[V] constraint in order to explain the obligatoriness of *geng* in this construction.

　　　Prenominal comparative modifiers pattern with uncontroversial relative clauses insofar they can appear to the left of the numeral+classifier sequence.

(77)　a.　yi　ge　[RC jiao　yufa　　　de] laoshi
　　　　　　　one CL　　　teach grammar DE teacher
　　　　　　　'a teacher who teaches grammar'
　　　　b.　[RC jiao　yufa　　　de] yi　ge　laoshi
　　　　　　　　　teach grammar DE one CL teacher
　　　　　　　'a teacher who teaches grammar'

(78)　a.　yi　pian [geng chang DE] wenzhang
　　　　　　　one CL　more long　DE　article
　　　　　　　'a longer paper'
　　　　b.　[geng chang de] yi　pian wenzhang
　　　　　　　more long　DE one CL　article
　　　　　　　'a longer paper'

This evidence supports the idea that the prenominal modifier in attributive comparatives is parsed as a relative clause, though we acknowledge that far more would have to be done in order to establish this claim carefully.

　　　The T+[V] constraint is stated as follows:

(79)　In Mandarin, the direct complement to T(ense) must either be (an extended projection of) verb or functional morpheme that can in principle combine with a verb.　　　　　　　　　　(Grano, 2012)

DegP is one such projection while AP is not:

(80)　a.　John [$_{TP}$ [$_{DegP}$ hen [$_{AP}$ gao]]]
　　　　　John　　　　very　　tall
　　　　　'John is tall.'
　　　b.　*John [$_{TP}$ [$_{AP}$ gao]]
　　　　　John　　　　tall
　　　　　'John is tall.'

Following Grano (2012), since relative clauses contain projections of T, if a prenominal modifier is parsed as relative clause, it must project a DegP instead of an AP. A structure for prenominal modifiers as relative clauses is sketched below:
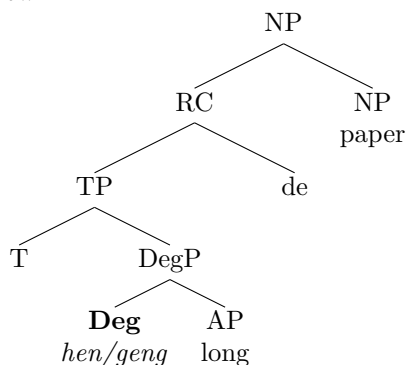
In this configuration, according to Grano, the Deg head needs to be filled by a morpheme such *hen* since it is the direct complement of T. We suggest tentatively that *geng* is the suppletive form of *hen* in comparatives, hence it is required in those attributive comparatives involving a prenominal structure like above.

This analysis relies on the assumption that there is no null comparative operator in Mandarin that could satisfy the T+V constraint (or that any such null comparative operator is not usable in these configurations). A possible objection, then, is that there seems to be good evidence for a null comparative operator in this language. Evidence from Mandarin transitive comparatives (Grano & Kennedy, 2012) and bare comparatives (Grano, 2012) suggests that Mandarin has a null comparative $\emptyset_{COMP}$ in syntax (see also Liu 2018a). If our analysis is on the right track, something must be said with respect to $\emptyset_{COMP}$: Why can't the null operator save those Mandarin attributive comparatives?[8]

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[8]In fact, this objection is not only possible, but actual; it was raised to us via personal communication by [NAME OMITTED].

We suggest that the null comparative operator fails for compositional reasons. Notice that in order to be interpreted in attributive position, it would have to move. We suggest that $\emptyset_{COMP}$ is scopally immobile unless it is given some phonological content, e.g. in the form of *geng*. In other words, *geng* but not $\emptyset_{COMP}$ can be extracted from a NP boundary, giving the right truth conditions for Mandarin attributive comparatives.