Mandarin Transitive Comparatives and the Grammar of Measurement

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Mandarin Chinese has two strategies for forming comparatives of superiority: one in which the standard of comparison is introduced by the morpheme *bi*, and one that resembles a transitive verb construction, in which the standard of comparison directly follows a gradable adjective. The ‘transitive comparative’ exhibits two special restrictions: the predicate must be one that accepts differential measure phrases, and the measure phrase must be overt. We argue that these facts support an analysis of the syntax of the adjectival projection in which gradable adjectives do not project degree arguments, as typically assumed, but do so only in combination with a covert morpheme *µ* (Svenonius and Kennedy 2006). Building on the proposal that argument DPs in Mandarin require Case (Li 2008; Huang, Li, and Li 2009), we hypothesize that there are (at least) two case assigners for standards of comparison in Mandarin: the overt morpheme *bi* and the covert morpheme *µ* found in transitive comparatives.

1 Introduction

The canonical comparative construction in Mandarin Chinese involves the morpheme *bi*, which is followed by a term that provides a standard of comparison, then by a gradable predicate, and finally by an optional differential expression (for recent theoretical literature on the *bi*-comparative, see especially Liu 1996; Xiang 2005; Erlewine 2007; Lin 2009):

(1) a. Zhangsan bi Lisi gao (yi dian).
    Zhangsan SM Lisi tall (one dot)
    ‘Zhangsan is (a little) taller than Lisi.’

b. Zhangsan bi Lisi piaoliang (yi dian).
    Zhangsan SM Lisi pretty one dot
    ‘Zhangsan is (a little) prettier than Lisi.’
It is also possible to express certain kinds of comparisons using a structure which we will refer to as the TRANSITIVE COMPARATIVE, borrowing this term from Erlewine 2007, in which *bi* is absent and the gradable predicate precedes the standard.\(^1\)

(2) a. Zhangsan gao Lisi yi dian / san gongfen.
   Zhangsan tall Lisi one dot / three centimeters
   ‘Zhangsan is a bit/three centimeters taller than Lisi.’

b. Zhangsan zhong Lisi yi dian / san gongjin.
   Zhangsan zhong Lisi one dot / three kilograms
   ‘Zhangsan is a bit/three kilograms heavier than Lisi.’

This structure is not freely available, however, as shown by (3a-b), which are superficially parallel to (2a-b) but are ungrammatical.

(3) a. *Zhangsan piaoliang Lisi yi dian.
   Zhangsan pretty Lisi one dot
   Intended: ‘Zhangsan is a bit prettier than Lisi.’

b. *Zhangsan gaoxing Lisi yi dian.
   Zhangsan happy Lisi one dot
   Intended: ‘Zhangsan is a bit happier than Lisi.’

Xiang (2005) demonstrates that well-formed transitive comparatives must satisfy two conditions. The first condition is that the structure must contain an overt differential term, such as the phrase *yi dian* ‘a bit’ or an appropriate measure phrase, as shown in (2a-b). In the absence of a differential term, transitive comparatives are impossible:

(4) a. *Zhangsan gao Lisi.
   Zhangsan tall Lisi
   Intended: ‘Zhangsan is taller than Lisi.’

b. *Zhangsan zhong Lisi.
   Zhangsan zhong Lisi
   Intended: ‘Zhangsan is heavier than Lisi.’

The second well-formedness condition on transitive comparatives is that the gradable predicate must be one that uses a scale for which a conventional measurement system is defined. Whether this condition is met can be determined by examining the acceptability of measure phrases in regular *bi*-comparatives. Consider, for

\(^1\)The same construction is called the “obligatory measuring comparative” by Mok (1998); the “absent marking construction” by Ansaldo (1999), who explores the construction in Sinitic languages in general; the “bare comparative” by Xiang (2005); and the “X A (Y) D comparative” by Liu (2007).
example, the contrast between (5a) and (5b).

(5)  
a. Zhangsan bi Lisi gao san gongfen / san cun / san ge  
Zhangsan SM Lisi tall three centimeters / three inches / three CL  
shouzhi.  
‘Zhangsan is three centimeters/three inches/three fingers taller than Lisi.’  
b. *Zhangsan bi Lisi piaoliang san du.  
Zhangsan SM Lisi pretty three degree  
Intended: ‘Zhangsan is three degrees prettier than Lisi.’

(5a) is acceptable because *gao ‘tall(er)’ compares objects relative to their positions on a scale of height, which is one for which various measurement systems are defined (inches, centimeters, etc.). In contrast, *piaoliang ‘pretty’ compares objects relative to the beauty scale, which is not one that has a conventional measurement system, and as a result, the differential measure phrases in (5b) are unacceptable.²

The groupings in (6a-b), taken (mostly) from Xiang 2005, exemplify the gradable predicates that are grammatical and ungrammatical, respectively, in the transitive comparative construction:

(6)  

²One might ask why the phrase yi dian ‘a bit’ is compatible both with adjectives like *gao ‘tall’ and like *piaoliang ‘pretty’, and yet does not license a transitive comparative in the latter: compare (1a) and (2a) to (1b) and (3a). The answer is that “indefinite degree terms” like a bit, a little, etc. are ambiguous: they can function either as true measure phrases or as degree modifiers, which we assume have different syntactic and semantic properties (see e.g. Doetjes 1997; Neeleman, van de Koot, and Doetjes 2004; Kennedy and McNally 2005b). This is shown (for English) by the following examples, which demonstrate that a bit can appear both in contexts like (i) which allow the degree modifier very but disallow a measure phrase, and in contexts like (ii) which allow MPs but disallow very.

(i)  
a. a bit/*40°/very warm  
b. a bit/*35 kg/very heavy  
c. a bit/*20 kph/very slow  

(ii)  
a. deepen the hole a bit/2 feet/*very  
b. raise the curtain a bit/1 inch/*very  
c. cool the soup a bit/3 degrees/*very
b. **Ungrammatical in transitive comparative:** *piaoliang* ‘pretty’, *xixing* ‘careful’, *gaoxing* ‘happy’, *youqu* ‘interesting’, *ganjing* ‘clean’, *shufu* ‘comfortable’, *mingliang* ‘bright’

All of the predicates in (6a) use scales that are associated with conventional measurement system (linear extent, weight, time, age, speed) and all allow differential measure phrases in the comparative. None of the predicates in (6b) have these properties. Some of the predicates in (6a) also allow measure phrases in their non-comparative, ‘positive’ uses. For example:

(7) Zhangsan liang mi gao.
    Zhangsan two meter tall
    ‘Zhangsan is two meters tall.’

However, as noted by Xiang, the crucial factor determining whether the predicate can be used in a transitive comparative is whether the predicate allows a differential measure phrase. For example, *pang* ‘fat’ disallows measure phrases in non-comparative contexts (8a) but allows them when used comparatively (8b) and accordingly is grammatical in a transitive comparative (8c) (Xiang 2005, p. 167):

(8) a. *Zhangsan shi bang pang.*
    Zhangsan ten pound fat
    *Intended: ‘Zhangsan is 10 pounds fat.’*

b. Zhangsan bi wo pang shi bang.
    Zhangsan SM 1sg fat ten pound
    ‘Zhangsan is ten pounds fatter than me.’

c. Zhangsan pang wo shi bang.
    Zhangsan fat 1sg ten pound
    ‘Zhangsan is ten pounds fatter than me.’

While the set of gradable predicates that allow measure phrases in non-comparative forms varies idiosyncratically both within and across languages, it is generally the case that the corresponding comparative form allows them, if the predicate uses a scale with a conventional measuring system and the language has measure phrases in the first place (Schwarzschild 2005; see also Svenonius and Kennedy 2006; Sawada and Grano to appear). We return to this point in some detail in sections 2 and 5.

The purpose of this paper is to develop an account of Mandarin transitive comparatives that explains the two constraints noted by Xiang — why a differential phrase is obligatory, and why the adjective in the transitive comparative must use a scale with a defined measurement system — and in so doing, to argue for a syntactic analysis in which the distribution of measure phrases is mediated both by
the semantic properties of gradable predicates and by the functional morphology of
the adjectival projection. In particular, building on the proposal that argument DPs
in Mandarin require Case, we argue that there are two case assigners for standards
of comparison in Mandarin: the standard marker bi familiar from comparatives like
those in (1), and a covert morpheme that is involved in the projection of a measure
phrase, which combines only with predicates that use scales with defined measure-
ment systems. Svenonius and Kennedy (2006) have previously argued for the exis-
tence of such a functional element based on the syntax of certain degree questions
in a dialect of Norwegian; we claim here that the behavior of Mandarin transitive
comparatives can also best be explained in terms of the syntactic properties of this
functional expression (namely, its case-assigning ability).

Although our focus in this paper is on the transitive comparative construc-
tion in Mandarin, it is worth pointing out that this construction is not unique to
Mandarin but is in fact pervasive in Chinese languages and is found even in at least
one non-Chinese language group. In a sampling of seven geographically representa-
tive Chinese varieties (Standard Mandarin, Shaighainese, Hong Kong Cantonese,
Taiwanese, Chaozhou, Fuzhou and Hakka), Ansaldo (1999) finds that all seven va-
rieties have the transitive comparative construction.3 Morev (1998) reports as well
on an analogous construction found in languages of the Kam-Sui group of Tai-
Kadai (data is cited from Mulao, Maonan, and Kam), spoken primarily in southern
China but genetically unrelated to Chinese. In spite of its apparent ubiquity in
the languages of China, however, the construction has received very little attention
in theoretical literature. The basic descriptive generalization is found in descrip-
tive grammars (e.g., Chao 1968), and also in recent theoretical work on Mandarin
comparatives (Xiang 2005; Erlewine 2007), but Liu (2007) provides what is to our
knowledge the only attempt at a theoretical account of the pattern of data. (Though
see Mok 1998 for a syntactic analysis of the equivalent construction in Cantonese.)

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3Ansaldo (1999) also shows that in some Chinese varieties, the measure phrase is not oblig-
atory in the transitive comparative. For example, Ansaldo provides the following sentence from
Chaozhou, spoken in south-eastern China:

(i)  i  ho  ua.
   3sg good 1sg
   ‘He is better than me.’ (Ansaldo 1999:43)

We are not aware of any documentation of such constructions other than the brief remarks in
Ansaldo’s work, and so caution is in order in analyzing them. Nonetheless, we note that in this
particular example, it is not simply the case that a measure phrase is optional; it is also the case that
the gradable predicate is one for which a measurement system is undefined. The analytical connec-
tion between comparatives in these languages and transitive comparatives in varieties that show the
restrictions documented above (such as Mandarin) is something that we will unfortunately not be
able to establish in this paper.
The organization of this paper is as follows. Section 2 provides the theoretical background on the syntax and semantics of gradable predicates, with particular attention to competing accounts of the distribution of measure phrases. Section 3 presents our analysis of the Mandarin transitive comparative construction in detail, which we believe argues in favor of a theory of the distribution of measure phrases that is stated in terms of both syntactic and semantic factors. We provide independent support for the analysis, and discuss further distinctions between transitive and bi-comparatives. Section 4 compares our analysis to prior proposals by Mok (1998) and Liu (2007), demonstrating that our analysis provides a more comprehensive and explanatory account of the data. Finally, section 5 couples our syntactic analysis with a compositional semantics for measurement structures, and extends our proposals to measure phrases in non-comparative predicates.

2 Theoretical background on the syntax and semantics of measure constructions

2.1 Degree relations and the distribution of measure phrases

A common hypothesis about the semantics of gradable predicates — those predicates that are acceptable in comparative constructions — is that they denote relations between individuals and degrees, where degrees are values that provide a basis for ordering objects relative to some dimension (see Cresswell 1977; von Stechow 1984a; Bierwisch 1989; Kennedy 2001; Schwarzschild and Wilkinson 2002; Heim 2006; Bale 2009). The denotation of the English adjective tall, on this view, is (9), which is true of an individual \( x \) and a degree of height \( d \) just in case \( x \)’s height is at least as great as \( d \).

\[
(9) \quad \text{[tall]} = \lambda d \lambda x. \text{height}(x) \geq d
\]

This kind of lexical meaning provides a way of explaining the distribution and interpretation of gradable adjectives in various degree constructions, such as comparatives, superlatives, excessives, intensification structures, and so forth. In short, all of these constructions involve manipulating the value of the degree argument of the adjective, deriving properties of individuals which differ in how much of the measured property the individual has to have in order for the property to be true (see Kennedy and McNally 2005a). For example, combination of tall with the comparative -er than Lee (given appropriate assumptions about the meaning of the comparative) derives a property that is true of an individual just in case its height is
equal to a degree which exceeds Lee’s height.⁴

Of interest to us is the analysis of M(earse) P(hrase)/adjective combinations. The most straightforward account of collocations like 2 meters tall is one which assumes as in (10a) that the measure phrase denotes a degree (or a generalized quantifier over degrees), and directly saturates the degree argument of the adjective, as in (10b).

(10) a. \[ [2 \text{ meters}] = 2m \]
    b. \[ [\text{tall}][[2 \text{ meters}]] = \lambda x. \text{height}(x) \geq 2m \]

The acceptability of MPs with comparatives, as well as their “differential” interpretations, can be accounted for in a similar way, by assuming that in addition to saturating the degree argument of the adjective, the comparative morphology introduces a second degree argument which represents the difference between two values on a scale, namely the positions of the “target” and “standard” of comparison (a more formal statement of this idea will be developed as we proceed).

This simple analysis cannot be the whole story, however, because not all adjectives combine with MPs. Some failures of composition have a straightforward explanation: if a MP denotes a degree on a scale that is distinct from the one used by a particular adjective, then composition will be ruled out as a kind of selectional restriction violation. This explanation accounts for the unacceptability of collocations like ??20 kilograms tall, as well as the impossibility of measure phrases with adjectives like intelligent, beautiful, happy, etc., which (we may assume) use scales without defined measurement systems.

Slightly more complicated are cases like the ones in (11a), which show that MPs do not combine with negative-pole adjectives; compare the corresponding examples in (11b).

(11) a. *1 meter short, *10 years young, *3 fathoms shallow
    b. 1 meter tall, 10 years old, 3 fathoms deep

We cannot simply say that e.g. short uses a scale that is incompatible with the degrees picked out by MPs like 1 meter: this would be conceptually problematic, given the intuition that we use short to talk about heights, and empirically problematic, given that MPs are acceptable with comparative forms of these adjectives:

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⁴Paradoxically, the unmarked “positive” form of a gradable adjective turns out to have the most complicated semantic analysis. The usual assumption is that the adjective combines with a null morpheme which fixes the degree argument to a value that exceeds a contextually appropriate standard of comparison. See Kennedy 2007b for discussion of the positive form generally, and see Liu 2010b and Grano 2010 for discussion of the positive form in Mandarin specifically, which is of some interest since it is often (but not always) marked by the morpheme hen.
(12) 1 meter shorter, 10 years younger, 3 fathoms shallower

However, a number of authors have argued that although degrees of shortness are in some sense degrees of height, they are distinct from degrees of tallness precisely in being unmeasurable, e.g. because they do not included a fixed origin point (see Seuren 1978; von Stechow 1984b; Bierwisch 1989; Kennedy 2001 for different ways of implementing this idea). Comparative forms such as those in (12), in contrast, do include such an origin point, namely the position on the scale of a standard degree, which is implicit in (12) but is normally introduced by than. If this is correct, then the unacceptability of the examples in (11a), in contrast to their counterparts in (11b) and (12), can be explained in much the same way as cases like *20 kilograms tall: the degrees denoted by the MPs are not part of the domain from which negative-pole adjectives select their degree arguments.

Unfortunately, this kind of explanation does not extend to the most problematic set of facts for the standard analysis, which involve positive-pole adjectives that clearly involve scales with defined measurement systems, yet still forbid MP/adjective composition outside of comparatives. (13a) provides some examples from English; (13b) shows that the MPs are compatible with the adjectives’ scales.

(13) a. *$200 expensive, *20° warm, *100 tons heavy, *60 kph fast, ...
   b. $200 dollars more expensive, 20° warmer, 100 tons heavier, 60 kph faster, ...

The situation is further complicated by the fact that the acceptability of collocations like the ones in (13a) differs cross-linguistically in what appears to be an arbitrary and idiosyncratic way. (14) shows that MPs combine with expensive and warm in Norwegian, and (15) shows that MPs combine with heavy and fast in German.

(14) a. ei 200 kroners dyr lampe
   a 200 crowns expensive lamp  
   ‘a 20 dollar (*expensive) lamp’
   b. 20 grader varmt vann
   20 degrees warm water  
   ‘20 degree (*warm) water’  
   Norwegian

(15) a. 100 Tonnen schwer
   100 tons heavy  
   ‘100 tons (*heavy)’
   b. 60 Stundentkilometer schnell
   60 hour.kilometers fast  
   ‘60 kilometers (*fast)’  
   German
At the same time, some languages are even more restrictive than English. In Japanese, virtually all non-comparative adjectives resist composition with a measure phrase, though the corresponding comparatives are fully acceptable.\(^5\)

\[(16)\]
\[\begin{array}{ll}
\text{a.} & *2\text{-meter spine.high} \\
& \text{‘2 meters tall’} \\
\text{b.} & *5\text{-inch long} \\
& \text{‘5 inches long’}
\end{array}\]

\[(17)\]
\[\begin{array}{ll}
\text{a.} & 2\text{-meter that than spine.high} \\
& \text{‘2 meters taller than that’} \\
\text{b.} & 5\text{-inch that than long} \\
& \text{‘5 inches longer than that’}
\end{array}\]

\(\text{Japanese}\)

These facts are mysterious if gradable adjectives with meanings equivalent to English *tall, long, expensive, warm, fast* and *heavy* all have the semantic analysis hypothesized above, as relations between degrees and individuals. While it might be possible to say that languages like Japanese simply assign different lexical meanings to such adjectives, in particular ones that do not involve degrees (though the fact that gradable adjectives in Japanese combine freely with other kinds of degree morphology would then need to be explained), the variation between otherwise similar languages like English, Norwegian and German would remain a puzzle.

### 2.2 Measure phrases as predicates of intervals

One solution to this puzzle is proposed by Schwarzschild (2005), who builds his analysis on the observation that Japanese-type languages seem to be the norm, rather than the exception. Specifically, it is generally the case that if a language allows MPs to combine with gradable predicates at all, it will allow such combinations in comparatives, and the MPs will denote differences, as described above. Some languages in addition allow composition of MPs with noncomparative adjectives, but only on a language-specific and idiosyncratic basis. Given this observation, Schwarzschild hypothesizes that, contrary to standard assumptions, the meaning of a lexical gradable adjective is not compatible with the meaning of a measure phrase, though the meaning of its derived (comparative, excessive, etc.) forms may be.

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\(^5\)See Sawada and Grano (to appear) for a more nuanced discussion of the facts in Japanese.
Schwarzschild implements this hypothesis by modifying the simple analysis of MPs given above, and replacing it with one in which MPs are predicates of scalar intervals, which are formally convex sets of degrees (sets of degrees without “gaps”; see Landman 1991, p. 110). The measure phrases 2 centimeters and 2 kilograms, on this view, have meanings along the lines of (18), where their arguments are intervals on the appropriate scales. (We indicate the scale for 2 meters as one of “linear extent”, to reflect the fact that it combines with any adjective that provides a perspective on this dimension, such as tall, wide, long, deep, etc.)

\[
\begin{align*}
\text{(18)} & \quad \text{a. } [\text{2 centimeters}] = \lambda i \subset D_{\text{lin. ext.}}\cdot 2\text{cm}(i) \\
& \quad \text{b. } [\text{2 kilograms}] = \lambda i \subset D_{\text{weight}}\cdot 2\text{kg}(i)
\end{align*}
\]

Comparatives, in Schwarzschild’s analysis, express relations between individuals and intervals: \(a \text{ is more } G \text{ than } b\) is true just in case there is a positive difference — an interval — between \(a\) and \(b\) on the \(G\)-scale. As long as the scale is one for which a measurement system is defined, composition with a MP is acceptable, and the semantic contribution of the MP is to measure the extent of the interval separating the compared objects.

For example, setting aside details of composition, the comparatives taller than Kim and heavier than Kim have the meanings in (19a-b), respectively.

\[
\begin{align*}
\text{(19)} & \quad \text{a. } \lambda I\lambda x. I(\text{height}(x) - \text{height}(k)) \\
& \quad \text{b. } \lambda I\lambda x. I(\text{weight}(x) - \text{weight}(k))
\end{align*}
\]

Since these expressions select for intervals, they may combine with the MPs in (18a-b), deriving the properties in (20a-b).

\[
\begin{align*}
\text{(20)} & \quad \text{a. } \lambda x. 2\text{cm}(\text{height}(x) - \text{height}(k)) \\
& \quad \text{b. } \lambda x. 2\text{kg}(\text{weight}(x) - \text{weight}(k))
\end{align*}
\]

(20a) is true of an object if the interval separating its height from Kim’s height measures two centimeters, and (20b) is true of an object if the interval separating its weight from Kim’s weight measures two kilograms; in both cases, this is exactly what we want.

For non-comparative adjectives, Schwarzschild maintains the standard analysis: lexical adjectives are type \(d, et\) and so expect an argument that denotes a degree. Measure phrases, however, are predicates of intervals — sets of degrees — and so direct composition of a MP with a gradable adjective is ruled out on type-theoretic grounds (though see below for some questions about this result). This correctly predicts the unacceptability of ??2 kilograms heavy, but also predicts that 2 meters tall should be ill-formed. This is actually a good result, according to Schwarzschild, given the fact that languages that allow MP+noncomparative ad-
jective composition appear to be the exception rather than the rule, and when they do allow for them they do so in an idiosyncratic and language-specific way, as we have already seen. To account for such structures, Schwarzschild proposes the type-shifting rule in (21), which applies only to adjectives that are marked as undergoing it, the set of which can vary from language to language.

(21) If $\alpha$ has a meaning of type $\langle d, et \rangle$ and $\alpha \in A_{meas}$, there is an $\alpha'$ such that 

$$[\alpha'] = [\lambda I \lambda x. I = \{d | [\alpha](d)(x)\}]$$

In English, for example, $A_{meas}$ includes tall, deep and old but not heavy; in German, it also includes heavy; in Japanese, it is empty (though see Sawada and Grano to appear). If an adjective is marked to undergo this rule, then it will allow composition with a measure phrase via predicate modification and existential closure, deriving (22) as the meaning of *Kim is 2 meters tall.*

(22) $\exists I[2m(I) \land I = \{d | \text{height(kim)} \geq d\}]$

We fully agree with Schwarzschild’s contention that the proper analysis of measure phrase composition is one which predicts that constructions like 2 meters tall are the special case. However, there are two features of Schwarzschild’s specific implementation of this idea that we wish to call attention to. The first involves a crucial but potentially problematic assumption that must be made in order to make the type-theoretic account of the distribution of MPs work. Specifically, Schwarzschild must stipulate that even though intervals are formally defined as sets of degrees, measure phrases qua predicates of such sets have a semantic type that is not based on the semantic type $d$ of degrees. Without this stipulation, we would presumably want to analyze MPs as expressions of type $\langle\langle d, t \rangle, t \rangle$, on analogy with the semantic type $\langle\langle e, t \rangle, t \rangle$ of quantified noun phrases, which are predicates of sets of individuals in Generalized Quantifier Theory (Barwise and Cooper 1981). Although such an analysis would still rule out direct composition of a MP (type $\langle\langle d, t \rangle, t \rangle$) with a gradable adjective (type $\langle\langle d, et \rangle$) on type-theoretic grounds, the particular type-mismatch that we find here is a familiar one: it is the same sort of mismatch that arises when a quantified noun phrase appears in an internal argument position. Such type mismatches are usually assumed to be repaired by a rule of Quantifier Raising (or the equivalent), and so the same should be true for a measure phrase.

Consider for example (23), which would be a possible Logical Form for *Kim is 20 kilograms heavy* if the semantic type of the MP were $\langle\langle d, t \rangle, t \rangle$ (assuming the general framework for LF construction and interpretation in Heim and Kratzer 1998).
The sister of the raised MP in (23) denotes the degree function $\lambda d. \text{heavy}(\text{kim}) \succeq d$, which is the characteristic function of the convex set of degrees ranging from the lower limit of the weight scale to the degree corresponding to Kim’s weight. This set is in turn equivalent to one of the intervals that $20 \text{ kilograms}$ is true of just in case Kim’s weight is 20 kilograms. Given the unacceptability of *Kim is 20 kilograms heavy, it must be the case that (23) is not a possible LF, a result that Schwarzschild achieves by stipulating that predicates of intervals are not type ⟨⟨d, t⟩, t⟩, but rather some independent type ⟨t, d⟩. But given the equivalence between sets of degrees and intervals — which the Homonym Rule in (21) crucially relies on — this stipulation is somewhat ad hoc.

The second feature of Schwarzschild’s analysis that we wish to mention does not have the same kinds of consequences for the overall account of MP distribution, but it does raise a question about the kind of predictions that the analysis makes. At its core, Schwarzschild’s analysis is a lexico-semantic one, in the sense that the distribution of MPs is fully a function of meanings: MPs may appear either with expressions that introduce intervals as a matter of meaning, such as comparatives, or with expressions that undergo the lexically-specified Homonym Rule, provided in both cases that the scales used by the relevant terms are scales for which measurement systems are defined and that the intervals that the terms introduce are of the right sort. (See Schwarzschild’s account of 1 meter tall vs. *1 meter short.) This kind of analysis therefore does not lead us to expect any special syntactic features to be associated with the presence of a measure phrase. In the case of comparative constructions in particular, since all comparatives are type-wise compatible with measure phrases, and the distribution of measure phrases is fully determined by lexical semantics (i.e., whether the scale of comparison is one for which a measurement system is defined), there is no expectation that the class of comparatives
that allow for measure phrases should be syntactically different in an interesting way from the class of comparatives that do not. But the facts that we outlined at the beginning of the paper demonstrated that in Mandarin, it is precisely the former class that shows a syntactic alternation between the bi-comparative and the transitive comparative, suggesting that the presence of a measure phrase is indicative not only of special semantic features, but also of special syntactic ones. The analysis we consider in the next section spells this idea out in more detail.

2.3 *Severing the degree argument from the adjective*

A different approach to the distribution of measure phrases is proposed in Svenonius and Kennedy 2006. Svenonius and Kennedy start from Schwarzschild’s intuition that direct composition of a MP with a (noncomparative) gradable predicate should be ruled out on type-theoretic grounds, but account for the “exceptional” cases of MP/adjective composition that we find in languages like English, German and Norwegian in lexico-syntactic terms, rather than lexico-semantic terms; i.e., in terms of selection rather than type-shifting.

The first part of the analysis involves a “decompositional” variant of the traditional analysis of gradable adjective meaning: instead of treating them as relations between degrees and individuals, Svenonius and Kennedy follow a different tradition which analyzes gradable adjectives as *measure functions*: expressions of type $\langle e, d \rangle$, which map individuals to degrees that represent the extent to which they possess some scalar property (Bartsch and Vennemann 1973; Kennedy 1999). The adjective *tall*, on this view, just denotes the *height* function which formed a component of its meaning on the relational analysis discussed in section 2.1 (see (9)). This hypothesis immediately derives the basic incompatibility between gradable adjectives and measure functions: if MPs are type $d$ (or type $\langle d, t \rangle$, $t$) and saturate degree argument positions, then direct composition with a gradable adjective (type $\langle e, d \rangle$) is ruled out on type-theoretic grounds: since gradable adjectives do not have degree arguments, direct composition with a degree-denoting term is impossible. And unlike what we saw with Schwarzschild’s analysis, this is not the kind of type mismatch that could potentially be repaired by LF-movements, so there is no need to introduce extra stipulations designed to rule out such a move.

Instead, Svenonius and Kennedy propose that the type-mismatch between a measure phrase and a gradable adjective is resolved through the mediation of functional morphology; or, to put it another way, that degree arguments are not lexical arguments of gradable adjectives, but are rather introduced by a layer of functional morphology above the adjective, much in the same way that external arguments of verbs are thought to be introduced by voice morphology (Kratzer 1996). This hypothesis is not ad hoc, but is instead quite natural in the context of the measure
function analysis of gradable adjectives, since such a theory is already committed to
the position that a predicate headed by a gradable adjective must include some func-
tional morphology: if lexical adjectives are type \( \langle e, d \rangle \), they do not denote prop-
ties of individuals. Since full adjectival predicates do denote properties, something
needs to “do the right thing” to the adjective. According to Kennedy (1999), this is
the job of degree morphology, which in English occupies a functional head in the
extended projection of the adjective (Abney 1987; Corver 1990, 1997; Grimshaw
1991):

(24)

\[
\begin{array}{c}
\text{DegP} \\
\text{Deg} \quad \text{AP} \\
\Downarrow \\
\text{A}
\end{array}
\]

Deg heads are generally of the semantic type \( \langle \langle e, d \rangle, \langle e, t \rangle \rangle \) (where “…” stands
for any additional arguments that a particular Deg head might introduce). The most
basic Deg head is the null positive morpheme \( pos \), which turns a measure func-
tion into a property that is true of an object if it possesses a degree of the relevant
property that exceeds an appropriate standard of comparison (see note 4). Other
elements of the category Deg include the question word \( how \), degree \( that \), excessive
\( too \), and, in many analyses, comparative morphology, though we will crucially not
adopt that assumption here, for reasons to be explained shortly.

To account for the distribution of measure phrases, Svenonius and Kennedy
propose that among the inventory of degree morphemes is a null head \( \mu \), whose
semantic and syntactic function is to introduce a degree argument. The denotation
of \( \mu \) is spelled out in (25a); composition of \( \mu \) with a gradable adjective produces a
meaning that is basically identical to the denotation of a gradable adjective on the
relational analysis discussed in section 2.1, as shown in (25b) for the adjective \( tall \),
and so allows for composition with a measure phrase.

(25) a. \[ [[\text{Deg}\mu]] = \lambda g \lambda d \lambda x. g(x) \geq d \]
b. \[ [[\text{Deg}\mu]]([[\text{tall}}]]) = \lambda d \lambda x. \text{height}(x) \geq d \]

According to Svenonius and Kennedy, \( \mu \) differs from e.g. the positive degree mor-
pHEME, which may combine with any gradable adjective, in having stricter selec-
tional restrictions: it combines freely with comparative adjectives, but only idiosyn-
cratically with non-comparative adjectives, in a way that must be listed in its lexical
entry on a language-specific basis. Crucially, since \( \mu \) is the only means of intro-
ducing a degree argument, an account of the distribution of measure phrases can be
reduced to an account of the distribution of $\mu$, so that language-specific idiosyncrasies can be captured in a simple and straightforward way: in terms of the formal properties of a single functional head.\(^6\)

In English, then, both (26a) and (26b) are fully interpretable, and have the expected meanings (which is actually a good result, because we know exactly what the former is supposed to mean, even though it is ungrammatical), but (26a) is ill-formed given the assumption that $\mu$ does not select for heavy in English.

(26) a. *DegP

\[
\text{MP} \quad \text{Deg'} \quad \text{Deg} \quad \mu \\
\text{10 kg} \quad \text{Deg} \quad \text{A} \quad \text{heavy}
\]

b. DegP

\[
\text{MP} \quad \text{Deg'} \quad \text{Deg} \quad \mu \\
\text{2 m} \quad \text{Deg} \quad \text{A} \quad \text{tall}
\]

In German, the selectional properties of $\mu$ allow for composition with schwer ‘heavy’, rendering the German version of (26a) grammatical; in Japanese, $\mu$ selects for neither segatakai ‘tall’ nor omoi ‘heavy’, so both of (26a-b) are impossible.

Before discussing comparatives in more detail, we wish to highlight a feature of this analysis of measure phrase distribution that crucially distinguishes it from the one discussed in the previous section. In this analysis, the class of adjectival predicates that accept measure phrases are syntactically distinguished from the class of adjectival predicates that do not, in two ways. The first has to do with argument projection. Since $\mu$ is (by hypothesis) the only way to project a degree argument, only the class of adjectives that accept measure phrases should have degree arguments. Svenonius and Kennedy show that this feature of the analysis explains an otherwise puzzling set of facts involving degree questions in Northern Norwegian. In this language, verb-initial questions of the form verb subject gradable-adjective can be assigned interpretations as degree questions, but only if the predicate is one that licenses measure phrases.

For example, (27a) can have either a yes-no interpretation (as expected for a verb-initial question), or a degree question that is parallel to the English translation.\(^7\)

(27) a. Er du gammel?

are you old

\(^6\)One question that Svenonius and Kennedy sidestep is whether the selectional properties of $\mu$ are purely syntactic, or whether they can be derived from its meaning. We return to this question in section 5.

\(^7\)There is a stress difference associated with the two readings: the yes-no question involves stress on gammel; the degree reading has stress on er. See Endresen 1985.
’Are you old?’
’How old are you?’
b. Er hun ung?
’Is she young?’
’*How young is she?’
c. Er du trøtt?
’Are you tired?’
’*How tired are you?’

(27b-c), however, only have interpretations as yes-no questions. As shown in (28), only *gammel* ‘old’ allows a measure phrase: *ung* disallows one because it is a negative adjective; *trøtt* ‘tired’ because there is no measurement system for fatigue.

(28) a. 8 maaneder gammel
     8 months   old
 b. *8 maaneder ung
     8 months   young
 c. *8 søvnløse netter trøtt
     8 sleepless nights tired

Svenonius and Kennedy’s analysis of these facts runs as follows. In addition to the overt degree operator, which like English *how* combines directly with a gradable adjective (i.e., it is a member of the category Deg), the relevant dialects of Norwegian contain a null *w*-operator which binds a degree argument position, as an alternative means of creating a degree question reading. Only those adjectives that can combine with *µ* project a degree argument; therefore, only those adjectives that support measurement permit verb-initial strings to be parsed as degree questions.

The second syntactic distinction between the Svenonius and Kennedy analysis and the Schwarzschild analysis involves formal morphosyntactic features. In addition to its semantic features, *µ* could in principle have formal syntactic or morphological features which distinguish it from other degree morphemes; indeed, if *µ* is an actual syntactic object, we expect to be able to find morphosyntactic evidence for its presence. Although the absence of such evidence would not provide a conclusive argument against it, all things being equal, we expect such evidence to exist. Furthermore, since the presence of a measure phrase entails the presence of *µ*, it follows that all and only those predicates that combine with measure phrases should manifest the formal morphosyntactic features associated with *µ*. In other words, we expect the class of predicates that allow measure phrases to display morphosyntactic properties which can be linked to the formal features of *µ*, and which the class of predicates that do not allow measure phrases do not display. As we will show in section 3, the Mandarin transitive comparative facts verify this expecta-
tion. Before we can explain how, though, we must say a bit more about the relation between $\mu$ and comparatives in general.

### 2.4 The difference function analysis of comparatives

Before turning to our analysis of Mandarin transitive comparatives, we need to lay out our assumptions about the syntax and semantics of comparatives, in the context of the analysis of gradable adjectives and measure phrases presented in the previous section. As noted above, Svenonius and Kennedy assume that although $\mu$ selects only idiosyncratically for lexical adjectives, it combines freely with comparative adjectives. In making this claim, they follow Corver 1997 in assuming that comparative morphology is not in the category Deg (see also Bresnan 1973; Neeleman et al. 2004), but rather occupies a second functional layer between the adjective and Deg. Since the details of Corver’s analysis are not crucial for us, we will make the simplifying assumption that comparative morphemes are lexical affixes, and that adjectives to which they have attached bear the feature [COMP], which is selected by $\mu$, licensing structures like (29a-b).

(29)

a. DegP
   \[\text{MP} \rightarrow \text{Deg'} \rightarrow \text{Deg} \rightarrow \mu \rightarrow \text{AP} \rightarrow \text{COMP} \rightarrow \text{heavier} \rightarrow \text{PP} \rightarrow \text{than Kim}\]

b. DegP
   \[\text{MP} \rightarrow \text{Deg'} \rightarrow \text{Deg} \rightarrow \mu \rightarrow \text{AP} \rightarrow \text{COMP} \rightarrow \text{taller} \rightarrow \text{PP} \rightarrow \text{than Kim}\]

Semantically, we follow Faller (2000); Kennedy and McNally (2005a); Svenonius and Kennedy (2006) and Kennedy and Levin (2008) in analyzing comparative adjectives as special kinds of measure functions, called “difference functions”, which measure the degree to which two objects diverge relative to a scalar dimension (cf. Schwarzschild 2005, which is a different implementation of the same basic idea). The intuition underlying this analysis is the following: if heavy is a function from individuals to values on the weight scale, as in (30a), then heavier than Kim is a function from individuals to the subpart of the weight scale that begins with Kim’s weight, as shown in (30b), and consequently measures the (positive) extent to which an object diverges from Kim in weight.
In (30b), Kim’s weight is a “derived zero point”: objects whose weights are less than or equal to Kim’s are mapped to this point (they have zero “heavier-than-Kim-ness”), and objects that are heavier than Kim are mapped to positive values that correctly reflect their ordering relative to the initial weight scale (they have positive degrees of “heavier-than-Kim-ness”).

An important difference between comparative and non-comparative adjectives is that the former have an extra “standard” argument, syntactically marked by than in English, which provides the basis for determining the zero point on the derived scale (i.e., the point relative to which differences are calculated). To keep things simple, we will ignore a great deal of work on the syntax and semantics of comparative standards, and assume that they always denote an expression of the same type as the external argument of the measure function. The comparative morphology thus turns a regular measure function of type \(\langle e, d \rangle\) into a difference function of type \(\langle e, \langle e, d \rangle \rangle\), where the first argument (the standard) provides the basis for determining the derived zero point on the difference scale. We will use the notation \(m_y\) to represent the difference function based on measure function \(m\) and standard \(y\), which maps entities in its domain onto the part of the \(m\) scale that uses the position of \(y\) (i.e., the value that we get by applying \(m\) to \(y\)) as a zero point, in the way described above. The comparative morphology then can be assigned the denotation in (31a), which reflects the fact that it both introduces a standard argument and turns a measure function into a difference function; adding the standard as in (31b) returns a difference function.\(^8\)

\(^8\) We thus ignore for the purpose of this paper the fact that in many languages (including English), standards can be provided either by a term of the same semantic type as the external argument of the comparative or directly by a degree-denoting expressions; this distinction is manifested in the syntax in the difference between “phrasal” and “clausal” comparatives (Hankamer 1973; Hoeksema 1983; Heim 1985; Bhatt and Takahashi 2007; Kennedy 2007a). Degree-denoting standards do not present a problem for the difference function analysis of comparatives generally; quite the contrary: such standards directly provide the derived zero point for a difference scale. Since our primary goal in this paper is to give an account of Mandarin transitive comparatives, our decision to ignore degree-denoting standards is justified by the fact that numerous researchers have concluded that this language does not allow them: see Xiang 2003, Erlewine 2007, and Lin 2009 for arguments to this effect. However, a fully general account of comparatives cross-linguistically must countenance both degree-denoting standards and standards of other semantic types. See Kennedy 2007a for general discussion of these issues.

\(^9\) We assume with most work on comparatives that standard morphemes like English than and Mandarin bi are semantically vacuous. See Liu 2010a in particular for the view Mandarin bi is like English than in being semantically vacuous. This keeps things simpler for now, and does not bear on our overall proposal, but we suspect that it is ultimately the wrong assumption, for reasons having
\[
\text{a. } [\text{COMP}] = \lambda g_{(e,d)} \lambda y. g_y^e \\
\text{b. } [\text{heavier}_{\text{COMP}}(\text{than } \text{Kim})] = \text{weight}_{\text{kim}}^f
\]

Returning to the structures in (29), since difference functions are type-wise \(\langle e, d \rangle\) (after composition of the comparative adjective and the standard term), composition with \(\mu\) returns a denotation of the right sort. The DegP \(10\text{ kg heavier than } \text{Kim}\), for example, has the meaning in (32), which is true of an object if the positive difference between its weight and Kim’s weight is at least 10 kilograms.

\[
\lambda x. \text{weight}_{\text{kim}}^f(x) \geq 10\text{kg}
\]

In the absence of a measure phrase, a comparative adjective (plus standard) must combine with the null degree head \(\text{pos}\), since just like a lexical adjectives it needs to be converted from a measure function to a property. The resulting meaning is exactly what we want, given the extra assumption that standards of comparison for adjectives that have scales with minimum values is just the minimum itself (Kennedy 2007b). Thus \(\text{heavier than } \text{Kim}\) denotes the property of having a degree of “heavier-than-Kim-ness” which exceeds the minimum value on the difference scale; since this value corresponds to Kim’s weight, the comparative requires its argument to be heavier than Kim, which is exactly what we want.

### 3 Analysis of Mandarin transitive comparatives

#### 3.1 A Case-based account

As outlined at the beginning of this paper, the two important properties of the Mandarin transitive comparative construction are that it is compatible only with predicates that accept differential measure phrases ((33a) vs. (33b)), and the measure phrase must be overt (33a):

\[
\text{a. } \text{Zhangsan gao Lisi *(yi mi / yi dian)].} \\
\text{Zhangsan tall Lisi one meter / one dot} \\
\text{‘Zhangsan is one meter / a little taller than Lisi.’}
\]

\[
\text{b. } \text{Zhangsan congming Lisi (yi dian).} \\
\text{Zhangsan smart Lisi one dot} \\
\text{‘Zhangsan is (a little) smart than Lisi.’}
\]

\[\text{to do with the distinctions mentioned in note 8: if a language makes a morphological distinction between individual-denoting standards and degree-denoting standards, it always does so in the standard morphology, never in the comparative morphology. This suggests that the standard morphology is playing a more prominent semantic role than is typically assumed.}\]
Here, we develop an analysis of these facts in terms of Case assignment: the (un)acceptability of a transitive comparative is a function of whether or not the standard argument is assigned Case, which is in turn a function of whether or not the measure-phrase introducing functional head $\mu$ is part of the structure. In what follows, we justify these claims and fill out the details of the analysis, starting with bi-comparatives, and then moving to transitive comparatives.

Following Li 2008 and Huang et al. 2009, we assume that argument DPs in Mandarin need Case and that adjectives are not Case assigners.\(^{10}\) Evidence for these assumptions comes from facts like (34).

(34) \begin{align*}
\text{a. } & *\text{wo feichang shangxin tade qushi.} \\
& \text{1sg extremely sad his pass.away} \\
& \text{\textit{Intended: ‘I am extremely sad about his death.’}} \\
\text{b. } & \text{wo } \textbf{dui} \text{ tade qushi feichang shangxin.} \\
& \text{1sg on his pass.away extremely sad} \\
& \text{‘I am extremely sad about his death.’} \text{ (Huang et al. 2009:22)}
\end{align*}

According to Huang et al. (2009), (34a) is ungrammatical because the adjective \textit{shangxin} ‘sad’ cannot assign Case to its thematic argument, the DP \textit{tade qushi} ‘his death.’ The structure can be rescued, however, by inserting the dummy element \textit{dui} as a Case-assigner, which appears with the object to the left of the main predicate.

Turning to comparatives, on the assumption that comparative adjectives are similar to other adjectives in not assigning Case, the ungrammaticality of examples like (35a-b) is straightforwardly explained: the standard arguments do not receive Case.

(35) \begin{align*}
\text{a. } & *\text{Zhangsan gao Lisi.} \\
& \text{Zhangsan tall Lisi} \\
& \text{\textit{Intended: ‘Zhangsan is taller than Lisi.’}} \\
\text{b. } & *\text{Zhangsan congming Lisi.} \\
& \text{Zhangsan smart Lisi} \\
& \text{\textit{Intended: ‘Zhangsan is smarter than Lisi.’}}
\end{align*}

\(^{10}\)Whether or not Mandarin even has a class of lexical items that can be called ‘adjectives’ as distinct from ‘verbs’ is a contentious issue; see Paul 2005; Huang et al. 2009; Grano 2010 for the view that there is such a category and see McCawley 1992 for an example of the opposing view. For the purpose of the present analysis, this issue may be orthogonal, and ‘adjectives’ could be understood to mean ‘intransitive (stative) verbs’ without losing the crucial idea that they are unable to assign Case.
As we saw in (34), these structures can be rescued by adding a case assigner, which in comparatives is the morpheme *bi*. In other words, we claim that *bi* is functionally parallel to *dui* above, and that the contrast between the examples in (35) and those in (36) is fully parallel to the one in (34).

    Zhangsan SM Lisi tall
    ‘Zhangsan is taller than Lisi.’

b. Zhangsan *bi* Lisi congming.
    Zhangsan SM Lisi smart
    ‘Zhangsan is smarter than Lisi.’

In ruling out structures like those in (35) as Case violations, however, we appear to predict that transitive comparatives should in general be impossible. Our problem now is to explain why the Case violation can be repaired either by the addition of *bi* or, in the case of comparatives formed from adjectives that use scales with conventional measure systems, by the addition of a measure phrase:

(37) Zhangsan gao Lisi san gongfen / yi dian.
    ‘Zhangsan is three centimeters/a bit taller than Lisi.’

Evidently examples like (37) include an unpronounced Case assigner, whose distribution is restricted just to comparatives containing the relevant set of adjectives, and which appears only if a measure phrase is present. The question is what this Case assigner is, and the analysis of measure phrase distribution presented in section 2.3 provides an answer: it is the measure-phrase introducing morpheme *µ*.

Before providing the morphosyntactic details of our analysis, we need to note an important feature of the syntax of measure phrases in Mandarin, which distinguishes them from e.g. English and Norwegian: in Mandarin comparatives, measure phrases obligatorily follow both the comparative adjective and the standard, in both *bi*-comparatives and in transitive comparatives. This is illustrated in (38).

(38) a. Zhangsan {*liang cun}* bi Lisi {*liang cun}* gao {*liang cun*}.
    Zhangsan two inch SM Lisi tall

---

11 We remain agnostic as to the actual syntactic status of *bi*, which has received different analyses by different researchers. Liu (1996) and Lin (2009) treat *bi* as a preposition which forms a constituent with the standard, while Xiang (2005) and Erlewine (2007) analyze it as the head of a functional projection above AP. For reasons that will become clear shortly, our overall analysis is a slightly better fit with the second type of approach to *bi*, but it is also consistent with the first kind of approach.
‘Zhangsan is two inches taller than Lisi.’

b. Zhangsan {* liang cun} gao {* liang cun} Lisi {liang cun}.

Zhangsan two inch tall Lisi
‘Zhangsan is two inches taller than Lisi.’

There is, furthermore, evidence that the measure phrases in these examples are asymmetrically c-commanded by the standard argument. As shown by Xiang (2005), the measure term yiban ‘half’ in examples like those in (39) can only be understood as picking out a measure relative to the length of the standard, not relative to the length of the target.

(39) a. Zhe-gen shengzi bi na-tiao bandeng chang yiban.
    this-CL rope SM that-CL bench long half

b. Zhe-gen shengzi chang na-tiao bandeng yiban.
    this-CL rope long that-CL bench half

‘This rope is longer than that bench by half (of the length of the bench/*rope).’

Assuming that yiban contains an implicit argument variable (half of x) that is linked to the closest c-commanding antecedent, these facts indicate that differential measure phrases are asymmetrically c-commanded by the standard argument, in both bi- and transitive comparatives.

Xiang captures this strutural relation by adopting a “DegP Shell” analysis of comparatives (cf. Larson 1988, 1991). In this analysis, the standard and differential terms are arguments of a Deg head which selects the differential term as its complement and the standard term as its specifier, and introduces comparative semantics. The resulting DegP merges as the complement of an adjective, which itself projects a higher level of DegP structure. In both bi-comparatives and transitive comparatives, the standard term then raises to SpecAP; the difference between the two structures is that in bi-comparatives, the higher Deg projection is filled by bi, as shown in (40a), while in transitive comparatives, it is filled via head-movement of the adjective, as in (40b).12

12Xiang also claims that the lower Deg head, which she glosses as EXCEED, raises and incorporates into the adjective. Since this point is not relevant to the criticisms that we raise in the next paragraph, we do not represent it here.
The problem with this analysis, as Xiang acknowledges, is that it does not lead to an explanatory account of the restrictions on transitive comparatives. The problem is that each of the three main syntactic components of comparison — the upper and lower Deg heads and the adjective — are necessarily present in all comparatives, regardless of whether the adjective uses a scale with a defined measurement system, and regardless of whether a measure phrase is projected: the lower Deg head introduces comparative semantics, the adjective introduces the scale, and the higher Deg head hosts bi or a raised adjective. Since there is no structural element that is unique to transitive comparatives, the best that can be done is to stipulate the conditions for adjective raising: only when the adjective uses the appropriate scale and only when a measure phrase is present. But such an analysis fails to explain why these restrictions hold.

Fortunately, we now have the pieces in place to modify Xiang’s analysis in such a way as to achieve an explanatory account of the facts. The crucial move is to separate the semantics of comparison from the syntax of measurement, so that we can associate the latter with the distribution of the morpheme μ, thereby providing a means of syntactically distinguishing comparatives with measure phrases from those without. The first step in doing this involves adopting the assumption that we made earlier about comparative semantics in English and Norwegian: the move from a measure function to a difference function is not mediated by an element of the category Deg, but rather by an affix or lexical feature. ¹³ The second step is to

¹³In fact, this assumption is arguably even more justified in Mandarin, given that there is no morphological distinction between comparative and non-comparative adjectives (a feature that Mandarin shares with a large portion of the world’s languages; see Ultan 1972). Indeed, Sybesma (1999)
incorporate Svenonius and Kennedy’s analysis of measure phrase syntax, whereby the presence of a measure phrase indicates the presence of $\mu$, and crucially, to hypothesize further that $\mu$ can value a Case feature on the standard DP, obviating the necessity of insertion of $bi$ just in case a measure phrase is projected.

There are two potential implementations of this analysis that correctly derive the configurational relations identified by Xiang. The first maintains a Larson/Xiang DegP shell structure, with a single modification: the lower Deg head is headed by $\mu$, as in (41), and is projected only when a measure phrase is present.

(41)

```
DegP
  Deg AP
   DP A'
    | Lisi ACOMP
    | gao DegP
    |   Deg DP
    |    | $\mu$ liang cun
```

The two surface word orders can then be derived by hypothesizing that $\mu$ optionally raises to the higher Deg position, pulling the adjectival head along with it, and putting it in a position to assign Case to the standard. (We assume with Koopman (1984); Travis (1984); Li (1990) that Case in Mandarin is assigned from left to right.) When this movement occurs, the output is the transitive comparative structure shown in (42a); when it does not occur, $bi$ must be inserted as usual, as shown in (42b).\footnote{If it turns out that $bi$ is better analyzed as a preposition that forms a constituent with the standard, as argued by Liu (1996) and Lin (2009), then we can eliminate the higher projection of Deg and assume instead that in transitive comparatives, the adjective+$\mu$ head raises to some other functional projection above AP, and in $bi$ comparatives it does not.}

\footnote{argues that in Mandarin, the comparative form of the adjective is the morphologically unmarked option, and the positive form is derived (most neutrally, via the addition of $hen$ ‘very’). We do not need to make this assumption (and Grano 2010 explicitly argues against it), though it is compatible with our overall approach to transitive comparatives. See also Huang 2006; Gu 2008; Liu 2010b for various approaches to the analysis of $hen$.}
The second implementation of our analysis involves the hypothesis that in Mandarin, unlike English and Norwegian, $\mu$ does not head its own functional projection, but is instead an affix that attaches directly to the adjective, deriving a new head which selects for a measure phrase:

$$\text{(43) } \begin{array}{c}
\text{DegP} \\
\text{Deg} \\
\text{gao} \mu \\
[\text{ACC}] \\
\text{DP} \\
\text{Lisi} \\
\text{A}' \\
\text{A''} \\
\text{A'''} \\
\text{gao} \mu \\
\text{DP} \\
\text{liang cun} \\
\end{array}$$

The underlying structure in (43) can then be mapped onto surface representations that are configurationally identical to (42a-b) except for the absence of a lower DegP projection, so the two implementations equally well derive the asymmetric structural relation between the standard and the differential observed by Xiang.
Although our core proposals are compatible with both the DegP-shell structure in (41) and the $\mu$-affix approach in (43), in what follows, we will adopt the latter $\mu$-affix approach because it has the advantage of reducing the syntactic difference between English-type measure constructions and Mandarin-type measure constructions to a familiar point of crosslinguistic variation. In particular, on this view, $\mu$ is a morpheme that gets realized in some languages (including English) as a functional head that projects over a particular lexical category (AP), and in other languages (including Mandarin) as an affix that attaches to that lexical category.

To summarize, our analysis (on either implementation) consists of two core proposals. First, as proposed in Svenonius and Kennedy 2006, projection of a measure phrase both requires, and is required by, the presence of the degree morpheme $\mu$, which may combine only with gradable adjectives (comparative or otherwise) that use scales with defined measurement systems. Second, in addition to licensing projection of a measure phrase, $\mu$ has its own unique syntactic properties, which in Mandarin include the ability to value Case on the standard DP. These two proposals together successfully derive the fact that transitive comparatives are acceptable only with comparative adjectives that use defined measurement systems, and only when a differential measure phrase is projected.\footnote{An audience member at the 2009 Annual Research Forum of the Linguistic Society of Hong Kong asks whether this account predicts that a gradable transitive verb such as xihuan ‘like’ should allow both a regular $bi$ comparative like (ia) and a ‘ditransitive comparative’ like the ungrammatical (ib), since transitive verbs are Case assigners.

(i) a. Zhangsan $bi$ Lisi xihuan Wangwu (yi dian).
   Zhangsan SM Lisi like Wangwu (one dot)
   ‘Zhangsan likes Wangwu (a bit) more than Lisi does.’

   b. *Zhangsan xihuan Wangwu Lisi (yi dian).
      Zhangsan like Wangwu Lisi (one dot)
      \textit{Intended: ‘Zhangsan likes Wangwu (a bit) more than Lisi does.’}

In fact, our analysis does not predict (ib) to be well-formed, assuming that a transitive verb assigns Case only to its thematic arguments. Comparatives always involve the addition of an argument (the comparative standard), and so necessitate one additional instance of Case-assignment.}

3.2 Independent evidence: chu and guo

Additional support for the two parts of our analysis — the Case-based account of “bare” standards, and the hypothesis that Case in transitive comparatives is assigned specifically by $\mu$ — comes from the interaction of Mandarin comparatives with two overt morphemes in the language. Evidence that transitive comparatives involve a case-assigning functional head that is linked to the distribution of measure phrases comes from the behavior of the overt affix $chu$, whose lexical meaning is ‘exit’
or ‘go beyond.’ As the following examples show, this affix may combine with a gradable adjective in both the bi-comparative and the transitive comparative, but only when a measure phrase is also projected:

(44) a. Zhangsan gao chu lisi liang cun.
    Zhangsan tall CHU Lisi two inch
    ‘Zhangsan is two inches taller than Lisi.’

    b. *Zhangsan gao chu lisi.
    Zhangsan tall CHU Lisi

(45) a. Zhangsan bi Lisi gao chu liang cun.
    Zhangsan SM Lisi tall CHU two inch
    ‘Zhangsan is two inches taller than Lisi.’

    b. *Zhangsan bi Lisi gao chu.
    Zhangsan SM Lisi tall CHU

The ungrammaticality of (44b) is unsurprising given the independent fact that transitive comparatives require a measure phrase; more striking is the ungrammaticality of (45b), which shows that chu is in general disallowed when there is no measure phrase. We believe that this indicates that chu is an overt counterpart of \( \mu \), and interpret facts like those in (44)-(45) as support for our analysis.\(^{16}\)

Independent evidence for a Case-based account of the distribution of bare standards comes from the behavior of the morpheme guo ‘exceed’/’surpass’, discussed in some detail by Liu (2007).\(^{17}\) As shown by (46), this morpheme can combine with an adjective to license a comparative construction with a bare standard:

\(^{16}\)The distribution of chu is actually more restricted than its null counterpart \( \mu \). First, chu may not combine with negative antonyms like ai ‘short’:

(i)  Zhangsan ai (*chu) lisi liang cun.
    Zhangsan short (*CHU) Lisi two inch
    ‘Zhangsan is two inches shorter than Lisi.’

Second, chu cannot appear with noncomparative adjectives:

(ii) *zhangsan {liang mi} gao (*chu) {liang mi}.
    Zhangsan two meter tall (*CHU) two meter
    ‘Zhangsan is two meters tall.’

These facts can be explained by assuming that chu has more restrictive selectional requirements than \( \mu \), something that is not unexpected if both are independent lexical items in a particular affixed class. We return to this issue in section 5 (see note 19), where we provide a semantics for \( \mu \) and the constructions in which it appears.

\(^{17}\)Liu (2007) in fact argues that the guo-comparative and transitive comparative are closely related, with the latter involving a covert ‘weak’ version of guo which Liu argues is responsible for the obligatory status of the measure phrase. See section 4 below, where we review this approach in
Unlike $chu$, however, $guo$ cannot be analyzed as an overt realization of $\mu$, for three reasons. First, as seen in (46), the measure phrase is optional in this construction. Second, as shown in (47), $guo$ can be used even with adjectives that are not associated with a measurable scale, such as $piaoliang$ ‘pretty’:

(47) Zhangsan piaoliang $guo$ lisi.
    Zhangsan pretty EXC Lisi
    ‘Zhangsan is prettier than Lisi.’

Finally, $guo$ can co-occur with $chu$ in the same construction:

(48) Zhangsan gao $chu$ $guo$ lisi liang cun.
    Zhangsan tall CHU EXC Lisi two inch
    ‘Zhangsan is two inches taller than Lisi.’

We conclude that although it is not a realization of $\mu$, $guo$ provides yet another means for assigning Case to the standard. This supports the general idea that when the morpheme $bi$ is absent from a comparative, something else must be present to assign Case to the standard: this can be the silent morpheme $\mu$, its overt counterpart $chu$, or the morpheme $guo$.

3.3 Additional differences between transitive and $bi$ comparatives

In the next section, we compare our analysis of Mandarin transitive comparatives to previous accounts. For the sake of completeness, however, we would like to document two additional differences between $bi$-comparatives and transitive comparatives before moving to this discussion. The first difference, observed by Xiang (2005, p. 206), has to do with the interpretation of indefinite standards. Xiang points out that whereas $bi$-comparatives allow generic standards (49a), transitive comparatives do not (49b) (cf. the non-generic standards in (50a–b), which are grammatical in both constructions):

(49) a. zhe zhi gang-chusheng de xiao luotuo bi ma da (yi-dian).
    this CL just-born PRT small camel SM horse big (one-dot)
    ‘This new-born camel is (a little) bigger than a horse.’

b. *zhe zhi gang-chusheng de xiao luotuo da ma yi-dian.
    this CL just-born PRT small camel big horse one-dot

more detail and argue that it is not adequate.
Intended: ‘This new-born camel is a little bigger than a horse.’

(50) a. zhe zhi gang-chusheng de xiao luotuo bi na pu ma da this CL just-born PRT small camel SM that CL horse big (yi-dian).
   (one-dot)
   ‘This new-born camel is (a little) bigger than that horse.’

   b. zhe zhi gang-chusheng de xiao luotuo da na pu ma yi-dian.
   this CL just-born PRT small camel big that CL horse (one-dot)
   ‘This new-born camel is a little bigger than that horse.’

Xiang (2005) accounts for this difference by building on the idea that generic DPs are mapped onto the restriction of a generic operator and that the structure of a sentence determines a partitioning of material into restriction and scope (Diesing 1992). Xiang proposes that in Mandarin comparatives, the position of the adjective determines the partitioning, and that only in the case of bi-comparatives, where the adjective stays low, can the standard (optionally) escape the scope and be mapped onto the restriction, thus yielding a generic reference. Our syntactic analysis also captures this difference, insofar as the structural configurations of bi-comparatives and transitive comparatives are the same as in Xiang’s analysis.

The second difference has to do with the distribution of the additive morpheme geng ‘even (more)’, which as Liu (2007) shows is allowed in bi-comparatives but not transitive comparatives.

(51) a. Zhangsan bi Lisi geng gao.
   Zhangsan SM Lisi even more tall
   ‘Zhangsan is even taller than Lisi.’

   b. *Zhangsan geng gao Lisi liang cun.
   Zhangsan even more tall Lisi two inch

On our view, this difference follows from the independent fact that geng is in general semantically or pragmatically incompatible with measure phrases, as illustrated with the following bi-comparative:

(52) *Zhangsan bi Lisi geng gao liang cun.
    Zhangsan SM Lisi even more tall two inch

Since transitive comparatives grammatically require a measure phrase, we thereby explain the contrast in (51).

Liu entertains and ultimately rejects this explanation on the basis of the following minimal pair (Liu 2007:fn16), showing that geng is compatible with the differential yi-xie in the bi-comparative but not the transitive comparative:
In light of this data, Liu suggests that geng is ungrammatical in transitive comparatives because transitive comparatives involve a silent version of the verb guo ‘exceed’ (see section 4 below), which is dynamic and therefore conflicts with the restriction of geng to stative predicates.

We have two comments to make here. First, Liu’s suggestion is problematic because there is no independent evidence that transitive comparatives have a dynamic interpretation. Although it is conceivable that they involve a silent version of ‘exceed’, which etymologically may be a dynamic verb, we are not aware of any synchronic evidence that transitive comparatives have a dynamic interpretation, and they fail standard tests for dynamicity, such as compatibility with the progressive marker zai:

(54) *zhangsan zai gao lisi liang cun.
    Zhangsan PROG tall Lisi two inch
    Intended: ‘Zhangsan is exceeding Lisi in height by two inches.’

Second, we believe that (53) is not sufficient for demonstrating the compatibility of geng with measure phrases. In particular, as we have argued above (see note 2), indefinite degree terms like yi-xie ‘a little bit’ are ambiguous between true measure phrases and degree modifiers which have different syntactic and semantic properties. We therefore suggest that in (53a), the presence of geng forces a degree modifier interpretation of yi-xie, which is acceptable because bi-comparatives do not require measure phrases. In (53b), on the other hand, the degree modifier interpretation of yi-xie is not available because transitive comparatives require a measure phrase, but the measure phrase interpretation is also unavailable because of its semantic or pragmatic conflict with geng.

3.4 Summary

Summing up, we have argued that the acceptability of the bi- vs. transitive comparative construction in Mandarin is a function of whether the standard DP is able to receive abstract Case. For adjectives like gao ‘tall’ that are associated with measurable scales, the Case assigner can be either bi, as in (55a), or the functional element µ (and its overt counterpart chu), which combines with the adjective if and only if a MP is projected, as in (55b). When neither of these elements is present, the
resulting structure is ungrammatical, as in (55c).

(55)  Adjectives with measurable scales

a. bi DP_{stnd} A\{COMP\}(+\mu\:DP_{meas})  \text{bi assigns Case to DP}_{stnd}

b. A\{COMP\}+\mu\:DP_{stnd}\:DP_{meas}  \text{\mu assigns Case to DP}_{stnd}

c. *A\{COMP\}\:DP_{stnd}  \text{DP}_{stnd} \text{does not get Case}

For adjectives that are not associated with a measurable scale, such as gaoxing ‘happy’ and piaoliang ‘beautiful’, bi is again an appropriate case assigner, as in (56a), but as schematized in (56b), \mu (or chu) is independently ruled out since it is incompatible with this kind of adjective. (Both kinds of adjectives also permit combination with the morpheme guo ‘exceed’, as shown in section 3.2, which also licenses a kind of transitive comparative structure, albeit one with slightly different distributional properties.)

(56)  Adjectives without measurable scales

a. bi DP_{stnd} A\{COMP\}  \text{bi assigns Case to DP}_{stnd}

b. *A\{COMP\}+\mu\:DP_{stnd}\:DP_{meas}  \text{\mu cannot combine with A}

c. *A\{COMP\}\:DP_{stnd}  \text{DP}_{stnd} \text{does not get Case}

The Case-assigning capacity of \mu invites a comparison to voice morphology. Semantically, \mu is similar to e.g. little \textit{v} in that its semantic function is to mediate between a lexical verb and an “extra” argument: the external argument in the case of \textit{v}, and the degree argument in the case of \mu. We have in effect proposed here that \textit{v} and \mu (in Mandarin at least) share a syntactic property as well, in licensing Case on an internal argument of the lexical projection with which they combine: the theme argument of a transitive verb in the case of \textit{v}, and the standard argument of a comparative adjective in the case of \mu.\textsuperscript{18}

A further parallel between \mu and \textit{v} that makes the analogy even stronger is that both may impose apparently arbitrary restrictions on the kinds of complements they combine with. Whereas most functional morphemes are indiscriminate in this regard (e.g., it would be odd to find a language in which a past tense morpheme may combine only with an arbitrarily restricted set of verbs), we pointed out in section

\textsuperscript{18}We also note that on our analysis, \mu need not assign Case each time it is projected, but does so only when the adjective+\mu complex is in a structurally appropriate position to do so. This is another way in which \mu is parallel to \textit{v}. On the assumption that the latter element is present in sentences containing unergative intransitive verbs, it typically does not assign Case, but it may do so in the presence of an argument that is introduced by a resultative secondary predicate:

(i)  

a. John ran.

b. John ran the pavement thin.
2.1 above that not all non-comparative adjectives, even among those with appropriate scales, can combine with MPs (e.g., 2 meters tall vs. *2 pounds heavy). As discussed in section 2.3, Svenonius and Kennedy (2006) capture this via a lexical selectional restriction on $\mu$. Similarly, not all verbs can be used transitively or take an external argument, and insofar as this is not entirely reducible to semantic differences among verbs, it can be captured by imposing a lexical selectional restriction on $v$. (See also, however, section 5 below, where we discuss an alternative to the lexical selection view of $\mu$: Sawada and Grano (to appear) argue for an account in terms of semantic domain restriction.)

4 Comparison to previous approaches

Aside from Xiang 2005, we are aware of two previous theoretical approaches to the transitive comparative construction: Mok 1998 and Liu 2007. Mok (1998) analyzes the Cantonese equivalent of the transitive comparative (his ‘obligatory measuring comparative’), which is illustrated in (57). As we see here, Cantonese is like Mandarin in requiring an overt differential measure phrase in this construction.

(57) Keoi gou Aa Can *(loeng cyun).
     3sg    tall Aa Can *(two    ‘inch)
     ‘He is two inches taller than Aa Can.’ (adapted from Mok 1998:109)

Mok’s analysis is concerned primarily with the syntax of this construction and in particular on establishing the right constituency. Mok argues that the predicate in a transitive comparative has the following structure (Mok 1998, p. 112):

(58) \[
\begin{array}{c}
\text{VP} \\
\text{V} \\
gou \\
\text{VP} \\
\text{DP} \\
\text{Aa Can} \\
\text{V'} \\
v \\
\text{MP} \\
gou \\
\text{loeng cyun}
\end{array}
\]

Here, the adjective (or rather, verb, on Mok’s view) forms a constituent with the measure phrase, with the standard of comparison sitting in specifier position, and
the surface word order is derived via head-movement of the verb to a higher V position. This proposed syntax shares a number of important properties with the structure we have advocated for the Mandarin transitive comparative (and Xiang’s (2005) structure on which it is based), namely, the ideas that (1) the adjective (or verb) forms a constituent with the measure phrase, (2) the standard of comparison sits in [Spec,VP] (our [Spec,AP]), and (3) the surface word order is derived via head-movement of the adjective (verb) into a structurally higher position.

The important difference between our approach and Mok’s, however, is that in Mok’s approach, the measure phrase combines directly with the adjective or verb rather than being introduced by the degree morpheme \( \mu \). Mok claims that the fact that the measure phrase is obligatory in the transitive comparative provides evidence for his proposed constituency: he reasons that because the measure phrase and the gradable predicate form a constituent, it is possibly to say that they “jointly” license the standard of comparison and are thus both required. However, Mok does not have anything to say about why the standard of comparison must be licensed in this way, or about how it is that a “joint” A+MP structure ends up having the licensing properties it does. Our analysis, in contrast, answers both of these questions: the standard DP must receive Case, and \( \mu \), which is present if and only if a MP is also present, is a Case assigner.

We turn now to Liu 2007. Liu’s approach involves a comparison between the transitive comparative (in Liu’s terminology, the ‘X A (Y) D comparative’) and another comparative construction which Liu claims is closely related, namely, the \textit{guo}-comparative mentioned in section 3.2 above and exemplified in (59).

\begin{enumerate}
\item [(59)] Zhangsan gao \textit{guo} Lisi (san gongfen).
\item Zhangsan tall exceed Lisi three centimeter
\item ‘Zhangsan is (three centimeters) taller than Lisi.’ (Liu 2007:74)
\end{enumerate}

Liu compares the \textit{guo}-comparative with the transitive comparative with respect to a number of properties. Among the differences Liu points out between the \textit{guo}-comparative and the transitive comparative are the following:

First, \textit{guo}-comparatives are restricted to positive members of antonym pairs whereas transitive comparatives are not:

\begin{enumerate}
\item [(60)] a. Zhe tiao shengzi \{chang / *duan\} \textit{guo} na tiao liang yingchi. 
\item this CL rope long / short exceed that CL two inch
\item ‘This rope is two inches longer than that one.’
\item b. Zhe tiao shengzi \{chang / duan\} na tiao liang yingchi.
\item this CL rope long / short that CL two inch.
\item ‘This rope is two inches longer/shorter than that rope.’
\end{enumerate}
Second, *guo*-comparatives are compatible with any kind of gradable adjective (modulo the restriction just mentioned) whereas transitive comparatives require an adjective associated with a measurable scale:

(61) a. Zhe ge nühai pioliang *guo* na ge nühai hen duo.
    this CL girl beautiful exceed that CL girl very much
    ‘This girl is a lot more beautiful than that one.’

b. *Zhe ge nühai pioliang na ge nühai san du.
    this CL girl beautiful that CL girl three degree

Finally, in *guo*-comparatives, the standard is obligatory and the measure phrase is optional, whereas in transitive comparatives, the reverse is the case: the standard is optional but the measure phrase is obligatory.

    Zhangsan tall exceed Lisi ten centimeter
    ‘Zhangsan is (ten centimeters) taller than Lisi’

b. Zhangsan gao (Lisi) *(shi gongfen).
    Zhangsan tall Lisi ten centimeter
    ‘Zhangsan is ten centimeters taller (than Lisi).’

Liu’s analysis of these two comparative constructions builds on the idea in Schwarzschild and Wilkinson 2002 that gradable adjectives are relations between degree intervals and individuals and that comparison involves two predicates of intervals in addition to a predicate which asserts a gap between the two intervals. On this approach, a measure phrase is a way of overtly spelling out the “gap” predicate (in the absence of an overt measure phrase, a covert differential SOME asserts a contextually specified minimum gap). For example, the sentence in (63a) has the interpretation in (63b) (using the notation from section 2.2), which is true just in case the interval separating Zhangsan’s height from Lisi’s height is equal to three centimeters (cf. Liu 2007, p. 80).

(63) a. Zhangsan gao *guo* Lisi san gongfen.
    Zhangsan tall exceed Lisi three centimeter
    ‘Zhangsan is three centimeters taller than Lisi.’

b. *3cm(height(z) − height(l))*

From here, Liu argues that the differences noted between the transitive comparative and the *guo*-comparative follow from the proposal that transitive comparatives involve a “weak” version of the *guo* comparative morpheme. On his view, both positive and negative members of antonym pairs are allowed with the transitive comparative because “the ‘weakness’ of the covert verbal suffix ... in the lexical
meaning makes its selection restriction on the adjective less strict than that of the overt verbal suffix” (p. 82). The standard of comparison is optional with the transitive comparative because “the ‘semantic content’ of the covert verbal suffix ... is so bleached that its ‘transitivity’ force becomes weaker than that of the overt verbal suffix guo” (p. 82). Finally, Liu suggests that the measure phrase in transitive comparatives is obligatory because the “semantic content [of the null weak version of guo] is bleached to an extent that ... it is not strong enough to function as predicate to describe the interval argument of adjectives” (p. 81).

We have three criticisms of this analysis. The first is that Liu’s notions of “weak” and “bleached” are not well-defined, and the relation between weakness/bleachedness and overt vs. covert morphology is not formalized, making it impossible to test the broader predictions of the proposals, and weakening its explanatory force. The second criticism is empirical, and involves the differences between the morphemes guo and chu that we observed in section 3.2 above. Both morphemes are overt, so (modulo the concerns about predictive power raised above), Liu’s analysis would seem to predict that they should pattern together with respect to the distribution of measure phrases, and differently from his hypothesized null, “weak” morpheme in transitive comparatives. However, the data presented in section 3.2 show that in fact, chu patterns with transitive comparatives (and is in fact more restrictive, which would be surprising if overt morphemes are “stronger” than covert ones; see note 16).

Finally, a third problem with this approach is that it does not explain why it is in particular measure phrases, and not differential expressions more generally, that trigger the use of Liu’s weak comparative morpheme. In Schwarzschild and Wilkinson’s system upon which Liu’s analysis is based, measure phrases are just one subtype of a larger class of differentials that include for example yi dian ‘a little’ as in (64). Hence we lose the ability to explain the contrast in grammaticality between (64a) and (64b).

(64) a. *Zhangsan congming Lisi yi dian.
   Zhangsan smart Lisi one dot
   ‘Zhangsan is (a little) smarter than Lisi.’

   b. Zhangsan gao Lisi yi dian.
   Zhangsan tall Lisi one dot
   ‘Zhangsan is one meter / a little taller than Lisi.’

In this minimal pair, the only difference is the gradable predicate. Under Liu’s account, it is not clear why transitive comparatives are allowed with predicates like gao ‘tall’ but not with predicates like congming ‘smart’. In the analysis presented in the previous section, on the other hand, this contrast follows automatically from...
the fact that gao but not congming uses a scale that supports measurement, and so is able to combine with μ.

5 The grammar of measurement

As we argued in the previous section, we believe that our analysis in its general form provides an account of transitive comparatives that has more explanatory power than previous alternatives. In this final section, we want to address some syntactic and semantic questions about our analysis that stem from our assumption that μ in Mandarin is an affix rather than the head of an independent functional projection, as in Svenonius and Kennedy 2006, as well as some more general questions about cross-linguistic variation and the linguistic encoding of measurement.

As noted above, the central syntactic difference between our analysis of measurement constructions in Mandarin and the analysis proposed by Svenonius and Kennedy (2006) has to do with the morphosyntactic status of μ: in the latter work, μ is the head of an extended projection of A; in the current proposal, it affixes to A and does not head an independent functional projection. We made this modification to accommodate both the word order in Mandarin (in which the measure phrase appears on the right) and Xiang’s (2005) observation that the standard asymmetrically c-commands the differential measure phrase, and in section 3.1, we showed how the analysis supports an account of the distributional properties of Mandarin transitive comparatives. What we want to do now is show that the affixal analysis of μ supports a more general account of the syntax and semantics of measure phrases in Mandarin, in both comparative and non-comparative predicates.

Let us begin with basic questions of semantic composition. The assumption that μ is an affix in Mandarin is fully compatible with the semantic hypothesis that degree morphology turns a measure function into a property, which was the basis for the denotation that Svenonius and Kennedy proposed for μ in English and Norwegian, repeated in (65).

(65) \[ [μ] = λg(ε, δ) λdλx.g(x) ≥ d \]

This denotation correctly captures the interpretation of measure phrases in predicates formed out of non-comparative adjectives in Mandarin. As shown by (66), measure phrases surface to the right of a non-comparative adjective, in the same position that we saw in comparative constructions. (MPs may also precede non-comparative adjectives, a point to which we return presently.)

(66) Zhangsan gao liang mi.
Zhangsan tall two meters
‘Zhangsan is two meters tall.’
Assuming as above that \( \mu \) affixes to an adjective, licensing projection of a measure phrase, the structure of the AP in (66) is as shown in (67), and the denotation given for \( \mu \) in (65) derives the correct interpretation for the predicate.

\[
\text{(67)} \\
\text{AP} \\
\lambda x. \text{height}(x) \geq 2m \\
\text{A} \\
\lambda d \lambda x. \text{height}(x) \geq d \\
\text{MP} \\
\text{2cm} \\
\text{liang mi} \\
\text{A} \\
\text{Af} \\
\text{height} \\
\lambda g \lambda d \lambda x. g(x) \geq d \\
\text{gao} \\
\mu
\]

However, unlike what was the case in Norwegian and English, the denotation of \( \mu \) given in (65) fails to derive a correct meaning for comparatives in Mandarin. Comparative adjectives in all three languages (and presumably universally) have an extra argument — the standard term — and so have a different semantic type from non-comparative adjectives: \( \langle e, \langle e, d \rangle \rangle \) instead of \( \langle e, d \rangle \). In English and Norwegian, the standard argument is a complement of the comparative adjective, and so is saturated prior to composition with \( \mu \). This means that a comparative AP and a non-comparative AP have the same semantic type, and given the difference-function semantics of comparatives, are able to compose with \( \mu \) in exactly the same way to derive the correct truth conditions (see section 2.4).

In contrast, the order of composition in Mandarin is different. In particular, \( \mu \) combines with the comparative adjective before the standard argument has been saturated. To accommodate this difference, we need to posit a second denotation for “comparative” \( \mu \) in Mandarin. The right denotation can be straighforwardly defined in terms of the basic meaning of \( \mu \) as shown in (68a), which simplifies to (68b).

\[
\text{(68)} \\
a. \quad [\mu_{\text{COMP}}] = \lambda g_{\langle e, \langle e, d \rangle \rangle} \lambda d \lambda y. [\mu](d)(g(y)) \\
b. \quad [\mu_{\text{COMP}}] = \lambda g_{\langle e, \langle e, d \rangle \rangle} \lambda d \lambda y \lambda x. g(y)(x) \geq d
\]

The move from \( \mu \) to \( \mu_{\text{COMP}} \) is thus a simple matter of type-shifting, which might look \textit{ad hoc} at first, but in fact is independently necessary for any kind of morphology that can combine with functors that have different numbers of arguments, such as transitive and intransitive verbs, or adjectives with different numbers of arguments. For example, if comparative morphology combines directly with an adjec-
tive, as we have assumed here, then we need to posit a similar kind of type-flexibility to accommodate the fact that COMP combines equally well with one-place adjectives (e.g., tall/taller) and two-place adjectives (e.g., proud/prouder).19

Putting (68) together with the semantics of comparative adjectives that we provided in section 2.4, we derive the correct denotations for the AP structures that underlie both transitive and bi-comparatives in Mandarin, assuming that the meanings are computed based on the pre-movement representation in (69).

(69)

Before turning to a discussion of more general issues, we would like to point out that, in addition to deriving the correct truth conditions for comparative and non-comparative predicates with MPs, our analysis explains an otherwise puzzling asymmetry noted by Liu (2007:fn. 16). Sentences that have a post-adjectival measure phrase in combination with an adjective that allows measure phrases in the non-comparative form give rise to a comparative/non-comparative ambiguity:

(70) Zhangsan gao liang mi.
    Zhangsan tall two meter
    ‘Zhangsan is two meters tall.’
    OR ‘Zhangsan is two meters taller (than some salient individual).’

19We also note that the behavior of the morpheme chu, discussed in section 3.2, can be straightforwardly explained by assuming that it is the pronunciation of a particular form of $\mu_{COMP}$ (one which combines only with the comparative forms of positive members of an antonym pair; see note 16), but not $\mu$. 

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As noted above, it is also possible for the measure phrase to precede the adjective, but the result is a string that is unambiguous: (71) has only the non-comparative interpretation.

(71) Zhangsan liang mi gao.
    Zhangsan two meter tall
    ‘Zhangsan is two meters tall.’
    NOT ‘*Zhangsan is two meters taller.’

The descriptive generalization here is that when the measure phrase follows the gradable predicate, the interpretation can either be non-comparative or comparative (provided the adjective is one that allows measure phrases in its non-comparative form), whereas when the measure phrase precedes the gradable predicate, the interpretation is obligatorily non-comparative.

The fact that APs with post-adjectival measure phrases have both comparative and non-comparative interpretations is not surprising, given two independent facts about the language: comparative adjectives are identical to non-comparative adjectives in their surface morphology, as we have seen, and Mandarin generally allows for argument positions to be filled by the null pronoun pro (Huang 1984, 1989). It follows that the predicate in (70) can be parsed either as in (72a), which gives the non-comparative meaning, or as in (72b), which derives the comparative meaning.20

20We show the complex adjective-µ head as having undergone string-vacuous movement in (72b) because we assume that pro, like other DPs, must receive Case. Given the fact that bi insertion is incompatible with a null standard, as shown by (i), the only way to license Case on pro is for the adjective-µ head to raise, just as in transitive comparatives with overt standards.

(i) *Zhangsan bi gao liang mi.
    Zhangsan SM tall two meter
    Intended: ‘Zhangsan is two meters taller.’
Turning to (71), the simplest explanation is to assume that a measure phrase can merge with a $\mu$-affixed noncomparative adjective either as its complement, as in (72a), or as its specifier, as in (73).

This option is not available for comparative adjectives, however, because the specifier of AP is filled by the standard argument. This explains the lack of ambiguity in (71).

We now turn to a more general question about the syntax and semantics of measurement constructions that arise in the context of the analysis we have adopted to explain Mandarin transitive comparatives. As we discussed initially in section 2.1, there are idiosyncratic restrictions on measure phrase distribution with non-comparative adjectives. Mandarin is similar to English in that the distribution of measure phrases with non-comparative adjectives is somewhat idiosyncratic. For example, (70) and (71) above show that $gao$ ‘tall’ allows for a measure phrase in the noncomparative form, while (74) shows that $pang$ ‘fat’ only allows measure phrases in the comparative:
As discussed in section 2.3, Svenonius and Kennedy (2006) account for cases like this by hypothesizing that $\mu$ selects generally for comparative adjectives, but arbitrarily for non-comparative ones, in a way that can vary from language to language. Our hypothesis that $\mu$ is an affix in Mandarin is fully compatible with this kind of explanation of facts like (74), albeit at the word level rather than phrasal level: we simply assume that affixal $\mu$, like its functional head variant, has selectional properties which allow it to combine freely with comparative adjectives, and idiosyncratically with non-comparatives, and that pang is not among the set of non-comparative adjectives that it selects for. On this view, the structure in (75a) is thus fully interpretable, but is ungrammatical because it violates the selectional properties of $\mu$; (75b), on the other hand, is both interpretable and grammatical, given the assumption that $\mu$ selects generally for comparative adjectives.

This account certainly works, and has the analytical advantage we noted earlier in section 2.3: idiosyncratic distinctions like *10 pounds heavy vs. 10 inches tall are captured in the selectional properties of a single lexical item, $\mu$. However, it is worth asking whether such properties are purely formal, or whether they are based in some aspect of the meaning of $\mu$ and the meanings of the expressions it composes with: the adjectival head (a measure function) and the measure phrase (a degree, quantifier over degrees, or property of degrees, depending on one’s analysis). On this alternative view, there would be nothing syntactically problematic about a structure like (75a), but there would be some crucial difference in meaning between noncomparative pang (or English heavy) and comparative pang$_{\text{COMP}}$.
(or English heavier) which would render composition of $\mu$ with the former uninterpretable but composition with the latter interpretable.

The most salient semantic difference between $\text{pang}_{\text{COMPL/heavier}}$ and $\text{pang/heavy}$ is that the former is a difference function and the latter is a “regular” measure function. Among other things, this distinction has consequences for the scalar properties of the two terms: difference functions (by definition) use scales with minimal elements (the degree that corresponds to the position of the standard on the scale); regular measure functions may or may not use scales with minimal elements. The analytical question is whether this difference can be exploited in a way that can explain the (apparently) idiosyncratic variation we find across languages in the set of non-comparative adjectives that allow measure phrases. Sawada and Grano (to appear) attempt to do exactly this. In particular, Sawada and Grano argue on the basis of data from Japanese, Spanish, Korean and Russian that comparative adjectives pattern systematically with non-comparative adjectives that have a minimal element (i.e., adjectives with a lower closed scale in the sense of Kennedy 2007b; e.g., bent, open) in being acceptable with measure phrases cross-linguistically, and propose to explain this in terms of a semantic domain restriction on $\mu$. On top of this, some languages such as English and Mandarin allow measure phrases with an idiosyncratic set of open scale adjectives, which might also be understood as involving a kind of domain restriction. We do not have the space here to fully assess this line of reasoning, but we see it as a plausible and potentially more explanatory variant of the selection-based analysis proposed in Svenonius and Kennedy 2006.

That said, we also want to emphasize that the selection-based account of measure phrase distribution is not the only theoretical advantage of the idea that measure phrases (and degree arguments more generally) are introduced by a special functional element $\mu$. As we pointed out in section 2.3 (see also the discussion at the end of 2.2), a second feature of this proposal, and arguably the more important theoretical one, is that it associates a very specific type of syntactic representation to measurement constructions: one which includes a designated functional element $\mu$. As such, it provides a basis for explaining purely syntactic phenomena that correlate with the presence of measure phrases — and indeed generates the expectation that such phenomena should exist — something that distinguishes the analysis from purely semantic approaches to measure constructions, such as Schwarzschild 2005. Svenonius and Kennedy (2006) argue that null degree questions in Northern Norwegian are best explained in terms of this analysis of the grammar of measurement; in this paper, we have made the case that Mandarin transitive comparatives are another.
References


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