Scale structure, coercion, and the interpretation of measure phrases in Japanese

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Note: This document is a March 4, 2011 prepublication version of:

ABSTRACT
This paper investigates the semantics of measure phrases in Japanese. Based on new data, we argue that the interpretation of measure phrases in Japanese is sensitive to scale structure such that (i) measure phrases are introduced by a degree morpheme that selects only for gradable predicates whose scale contains a minimal element (i.e., a lower closed scale) and (ii) violations to this restriction are repaired via coercion, which forces a comparative interpretation with a contextually determined standard and hence a minimal element.

We compare the Japanese facts to data in other languages and argue that the requirement of having a minimal element is not specific to Japanese, but universal. We show that languages may vary in how they deal with potential violations of this universal constraint, including coercion of a contextually recoverable derived minimal element (Japanese), ungrammaticality (e.g., Spanish, Korean, Russian), and a hybrid system of ungrammaticality for some adjectives and allowed constraint violation for others (e.g., English, German, Italian).

Key words: measure phrase, scale structure, absolute measurement, differential measurement, coercion, scale shift, crosslinguistic variation
1 Introduction

Measure phrases can be used with gradable predicates in two semantically distinct ways. In *absolute measurement*, the measure phrase specifies the degree to which an individual extends relative to some dimension, and in *differential measurement*, the measure phrase specifies the difference in degree between two individuals with respect to some dimension. In English, absolute measurement is expressed using the plain (unmarked) form of a gradable predicate and differential measurement is expressed using a comparative form, as in (1):

(1)   a. John is six feet tall.    *absolute measurement*
     b. John is six inches taller (than Bill).    *differential measurement*

Schwarzschild (2005) observes that there is both language-internal and crosslinguistic asymmetry between these two kinds of measurement. First, language-internally, the set of adjectives that permit measure phrases for absolute measurement is idiosyncratic and varies from language to language, whereas any adjective associated with a measurable scale can be used in a comparative construction with a differential measure phrase. For example, in French, *haut* ‘high’ is grammatical with absolute measurement, as in (2a), but *grand* ‘tall’ is not, as shown in (2b), though both are grammatical with differential measure phrases in comparative constructions, such as (2c,d). In English, whereas *tall* is compatible with both absolute and differential measurement, as shown in (1), *heavy* is unacceptable with absolute measurement but acceptable with differential measurement, as in (3).

(2)   a. **haut** de 1,27 m

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1 Schwarzschild (2005) uses the terms ‘direct measurement’ and ‘indirect measurement’, respectively, instead of the terminology we employ, ‘absolute measurement’ and ‘differential measurement’. Schwarzschild calls a measure phrase when it combines with a plain adjective a ‘direct measure phrase’ (*two feet tall*), and when it combines with a comparative or *too*-phrase an ‘indirect measure phrase’ (*two feet taller*). In anticipation of the Japanese data below, we define ‘absolute measurement’ and ‘differential measurement’ based purely on semantics, not on morphosyntax.
‘1.27 m high’
b. *grand de 1,27 m
   ‘1.27 m tall’
c. plus haut que la Tour Eiffel de 1 m
   ‘1 m higher than the Eiffel Tower’
d. plus grand que Mari de 2 cm
   ‘2 cm taller than Mari’

(3)   a. *5 lb heavy
   b. 5 lb heavier

Second, crosslinguistically, Schwarzschild (2005) generalizes that if a language allows a measure phrase to combine with a plain adjective, it also allows a measure phrase to combine with a comparative, but not vice versa. In other words, in some languages there is a general ban on absolute measurement but not on differential measurement, but there are no languages that allow absolute measure to the exclusion of differential measurement. In Spanish, for example, (4) exemplifies the patterning for all adjectives associated with a measurable scale. Measure phrases are acceptable in comparative constructions only:

(4)   a.*Juan es dos metros alto.
       Intended: ‘Juan is two meters tall.’
   b. Juan es dos centímetros más alto que Jorge.
       ‘Juan is two centimeters taller than Jorge.’

At first glance, Japanese appears to conform to Schwarzschild’s generalization and can be classified as a Spanish-type language, one that permits differential measurement but has a general ban on absolute measurement. Thus measure phrases are acceptable in comparative constructions and give rise to differential measurement, as in (5a), but cannot be used with simple adjectival predicates for absolute measurement, as seen in (5b).
(5)  a. Kono tana-wa ano tana yori (2-meetoru) takai.
    this shelf-TOP that shelf than 2-meter tall
    ‘This shelf is (2 meters) taller than that shelf.’
  b. Kono tana-wa (#2-meetoru) takai.
    this shelf-TOP 2-meter tall
    Intended: ‘This shelf is two meters tall.’

However, there are two interesting puzzles in the interpretation of Japanese measure phrases. First, whereas in Spanish, the direct combination of a measure phrase with an adjective leads to ungrammaticality, as in (4a) above, it is well documented that in Japanese, such a combination is allowed and gives rise to differential measurement, despite the absence of any overt comparative morphology (Snyder et al. 1995; Kikuchi 2006; Nakanishi 2007; Hayashishita 2009):

(6)  Differential measurement
  a. Kono tana-wa 2-meetoru takai.
    this shelf-TOP 2-meter tall
    ‘This shelf is 2 meters taller.’
    Not: ‘This shelf is 2 meters tall.’
  b. Kono roopu-wa 5-inchi nagai.
    this rope-TOP 5-inch long
    ‘This rope is 5 inches longer.’
    Not: ‘This rope is 5 inches long.’
  c. Kinoo-wa 5-do atataka-katta.
    yesterday-TOP 5-degree warm-PAST
    ‘It was 5 degrees warmer yesterday.’
    Not: ‘It was 5 degrees warm yesterday.’

What is puzzling is that there is no overt comparative morphology in the sentences in (6): without the measure phrases, these sentences would not have a comparative interpretation, but instead would have the expected positive semantics. The
transparent mapping between the form of the adjective (plain vs. comparative) and the interpretation of the measure phrase (absolute vs. differential) — which holds in all of the data Schwarzschild considers — breaks down here.

The second puzzle is that, contrary to previous claims, Japanese measure phrases do give rise to absolute measurement with a certain class of gradable predicates:

(7) *Absolute measurement*

a. Kono sao-wa 5-do magat-teiru.
   *this rod-TOP 5-degree bend-TEIRU*
   ‘This rod is 5 degrees bent.’
   *Not: ‘This rod is 5 degrees more bent.’*

b. Kono fusuma-wa 3-senti ai-teiru.
   *this sliding door-TOP 3-centimeter open-TEIRU*
   ‘This door is 3 centimeters open.’
   *Not: ‘This door is 3 centimeters more open.’*

c. Pisa-no syatoo-wa 3.97-do katamui-teiru.
   *Pisa-GEN leaning tower-TOP 3.97-degree incline-TEIRU*
   ‘The Leaning Tower of Pisa is 3.97 degrees inclined.’
   *Not: ‘The Leaning Tower of Pisa is 3.97 degrees more inclined.’*

d. Kono tokai-wa 2-fun hayai.
   *this clock-TOP 2-minute fast*
   ‘This clock is 2 minutes fast.’
   *Not: ‘This clock is 2 minutes faster.’*

Whereas in (6), the combination of a measure phrase with a gradable predicate results in an obligatory differential interpretation, (7) shows the opposite patterning: only the absolute interpretation is available. We claim that the
A descriptive generalization that characterizes the split in interpretation between (6) and (7) crucially relies on scale structure: in particular, adjectives that have a lower closed scale give rise to absolute measurement whereas adjectives that have a lower open scale give rise to differential measurement.

In making this descriptive generalization, we assume the theory of scale structure developed by Kennedy and McNally (2005) and Kennedy (2007a), who hypothesize the typology of scale structures in (8) and proceed to argue that this typology accurately derives empirical differences between so-called ‘relative’ gradable adjectives (assumed to have a totally open scale) and ‘absolute’ gradable adjectives (assumed to have a scale that is closed on one or both ends). Any given gradable adjective, on this theory, corresponds to one of these scale types as part of its lexical meaning. (See also Paradis 2001 and Rotstein and Winter 2004.)

(8) A typology of scale structures:

a. (Totally) open scale

b. Lower closed scale

c. Upper closed scale

d. (Totally) closed scale

As shown schematically in (8), totally open scales lack both minimal and maximal elements. This is in contrast to lower closed scales, which include a minimum element but no maximum element. Upper closed scales include a maximum but no minimum, and finally, totally closed scales include both a minimum and a maximum. One empirical test for the property of having a lower closed scale (with or without an upper closed scale as well) is that lower closed scale adjectives are generally felicitous with partially whereas lower open scale adjectives are not (Rotstein and Winter 2004):

(9) a. The rod is partially bent.  
   b. The door is partially open.  
   c. The tower is partially inclined.
In Japanese (and English), lower closed scale adjectives are also discernible based on entailment patterns: the negation of a lower closed scale adjective entails its antonym, as in (11), whereas the negation of an open scale gradable adjective does not, as in (12):

(11) Entailment patterns of a lower closed scale adjective:
      this rod-TOP bend-TEIRU-NEG this rod-TOP straight-PRED
      ‘This rod is not bent.’ ‘This rod is straight.’

(12) (Entailment patterns of a relative gradable adjective)
   a. Taro-wa se-ga takaku-\textit{nai}. \nnot b. Taro-wa se-ga hikui.
      Taro-TOP height-NOM tall-NEG Taro-TOP height-NOM short
      ‘Taro is not tall.’ ‘Taro is short.’

For further empirical concomitants of the distinctions in scale structure and for theoretical discussion of why these tests give us the results they do, the reader is invited to refer to the above-cited works. For our current purposes, it suffices to observe that the absolute vs. differential interpretational split illustrated in (6) and (7) correlates with whether the gradable predicate has a lower open or lower closed scale in the sense of Kennedy and McNally 2005 and Kennedy 2007a.

   Returning to the relationship between scale structure and measure phrases, we find that the acceptability of absolute measurement with lower closed scale predicates is not specific to Japanese but holds also in other languages that
otherwise have a general ban on absolute measurement, for example, Spanish, Korean, and Russian:²

(13) Esta varilla está doblada noventa grados.  

Spanish

dis rod is bent ninety degrees

‘This rod is ninety degrees bent.’

(14) i hwoychori-nun i-to (cengto) hwies-ta.  

Korean

this rod-TOP two-degree about bent-DECL

‘This rod is (about) two degrees bent.’

(15) Etot prut pognut na p’at’ gradusov.  

Russian

dis rod bent by five degrees

‘This rod is five degrees bent.’

In light of these observations, the purpose of this paper is to address the following two questions:

1. Why is it that in Japanese (and other languages that otherwise have a general ban on absolute measurement), lower closed scale adjectives pattern with comparatives in being acceptable with measure phrases?

2. How and why in Japanese (but not in other languages) does the direct combination of a measure phrase with a non-comparative adjective give rise to differential interpretation?

As for the first question, we argue that lower closed scale adjectives and comparative constructions constitute a natural class in that both are associated with scales that have a minimal element. With lower closed scale adjectives, the minimal element is built into the scale, and with comparative adjectives, the standard of

² It may be noticed that in both the Japanese sentences in (7a-c) and the Spanish, Korean, and Russian sentences in (13)-(15), the gradable predicates are all deverb al. Although there is a clear correlation among gradable predicates between being measurable and having a lower closed scale on the one hand and being deverb al on the other hand, we will argue below at the end of Sect. 3 that it is the semantics of the predicate and not its deverb al morphology that is crucial to the interpretation of the measure phrase.
comparison provides a derived minimal element. We show that this follows naturally from an approach to comparative semantics described in Kennedy and McNally 2005, Svenonius and Kennedy 2006, and Kennedy and Levin 2008, in which the function of comparative morphology is to turn a basic measure function into a derived ‘difference function’ whose minimal element corresponds to the degree associated with the standard of comparison (this approach was recently applied to Japanese by Kubota 2009).

To derive the fact that lower closed scale adjectives and comparatives freely combine with measure phrases, we propose a semantic selectional restriction on the Deg head Meas, the functional head that mediates the relation between a gradable predicate and a measure phrase (Svenonius and Kennedy 2006), such that it selects only for gradable predicates that are associated both with a salient measurement system and with a minimum element. We furthermore suggest that this semantic selectional restriction is universal, although some languages, such as English and French, are able to override it for a small, lexically idiosyncratic set of predicates.

As for the second question, we argue that in Japanese, when Meas combines with an open scale adjective, the conflict between the selectional restriction on Meas and the scale associated with the adjective gives rise to semantic coercion: the mismatch forces the adjective to take on a comparative interpretation with a contextually determined standard, thereby providing a minimal element. We call this coercion mechanism ‘scale shift’ (on analogy with ‘aspect shift’; de Swart 1998). We further argue that the reason this coercion strategy is not available in other languages that have a general ban on absolute measurement, such as Spanish, is because it is blocked (in the sense of Chierchia 1998) by the availability of overt comparative morphology which can provide the same function.

An important implication of this proposal is that the interpretation of measure phrases is sensitive to scale structure and that Schwarzschild’s generalization — that every language that allows absolute measurement also allows differential measurement but not vice versa — can be subsumed under a broader generalization. The apparent opposition between comparative and non-comparative adjectives with respect to measure phrase acceptability is actually an opposition
between predicates whose scales have a minimal element and predicates whose scales do not. Crosslinguistically, measure phrases are systematically more acceptable with predicates that provide a minimal element from which the measurement is computed.

The organization of this paper is as follows. Sect. 2 provides theoretical background on the semantics of gradable adjectives and reviews two previous analyses of the syntax and semantics of measure phrases, found in Schwarzschild 2005 and Svenonius and Kennedy 2006. Sects. 3 through 6 focus on Japanese. Sect. 3 reviews previous approaches to Japanese measure phrases. In Sect. 4, we investigate the semantics of absolute measurement in Japanese, and in Sect. 5, we show how the analysis extends naturally to comparatives constructions. In Sect. 6, we move on to the analysis of differential measurement in Japanese and propose our coercion-based account. Sect. 7 considers the proposals in crosslinguistic perspective and proposes two parameters of variation in the distribution and interpretation of measure phrases. Finally, Sect. 8 concludes.

2 Theoretical background and previous analyses of measure phrases

The purpose of this section is to review two previous approaches to the syntax and semantics of measure phrases, namely those found in Schwarzschild 2005 and Svenonius and Kennedy 2006. First we will present Schwarzschild’s account and argue that it falls short of capturing the important semantic generalization regarding the interpretation of Japanese measure phrases. Then we will present Svenonius and Kennedy’s account and show that although it captures important syntactic facts, it too falls short of capturing the semantic facts. The conclusion will be that a new account is called for which preserves the insights from the previous approaches but also accommodates the new semantic generalization.

Before reviewing the two approaches, a note is in order regarding the semantic type of gradable adjectives and its relevance for the analysis of measure phrases. There are two competing degree-based approaches to the semantic type of gradable adjectives. According to the more standard approach, gradable adjectives denote
relations between degrees and individuals (type <d,et>) (Cresswell 1977; Kennedy and McNally 2005):

$$[[\text{tall}]] = \lambda d \lambda x. \text{TALL}(x) = d$$

Under another approach, gradable adjectives directly encode measure functions from individuals to degrees (type <e,d>) (Bartsch and Vennemann 1973; Kennedy 1999; Kennedy 2007a):

$$[[\text{tall}]] = \lambda x. \text{TALL}(x)$$

A consequence of either approach is that bare predicative adjectives must combine with a (usually null) functional morpheme or type-shifter \textit{positive} that turns the adjective into a property of individuals. Under the <e,d> approach to gradable adjectives, for example, \textit{pos} looks something like the following:

$$[[\text{pos}]] = \lambda g <e,d> \lambda x. g(x) \geq \text{stnd}(g)$$

(adapted from Kennedy and Levin 2008)

Here, \text{stnd} is a function from gradable adjective meanings to degrees that returns a standard of comparison for the adjective: the minimum degree required to “stand out” in the context relative to the kind of measurement expressed by the adjective. For example, (19) shows the derivation for the semantics of \textit{John is tall}:

$$[[\text{John is tall}]] = [[[\text{pos}]]([[\text{tall}]])([[\text{John}]]))$$
$$= \lambda x. \text{tall}(x) \geq \text{stnd}(\text{tall})(\text{John})$$
$$= \text{tall}(\text{John}) > \text{stnd}(\text{tall})$$

‘John’s height is greater than a contextually determined standard.’
See Kennedy 2007a for a fuller exploration of the semantics of *pos*.

We now turn the discussion to measure phrases. When a gradable adjective combines with a measure phrase, as in (20), its analysis depends partly on what the assumptions are about the semantic type of the adjective.

(20) John is six feet tall.

Under the <d,et> analysis of gradable adjectives, the most straightforward account is one in which the measure phrase is assumed to be type <d> and directly saturates the degree argument of the predicate, thus yielding a property of individuals. Such an approach is found in, e.g., Cresswell 1976, von Stechow 1984, and Heim 2001. Another option would be to take the measure phrase to be a type <dt,t> quantifier. In other words, it could be the case that a measure phrase quantifies over degrees rather than denoting a degree. As we will review below, Schwarzschild 2005, although working with the <d,et> analysis of gradable adjectives, rejects these approaches.

Under the <e,d> analysis of gradable adjectives, on the other hand, either the measure phrase must be of a more complex type than simply <d>, or there must be extra structure involved to resolve the type mismatch between the type <e,d> predicate and the type <d> measure phrase. As we will review below, Svenonius and Kennedy (2006) argue for the latter approach.

Because our own approach makes crucial use of the machinery employed by Svenonius and Kennedy (2006), we will ultimately adopt the <e,d> analysis of gradable adjectives (see Sect. 4 below).

2.1 Schwarzschild 2005

On the basis of data from English, Italian, Dutch, German, French, Japanese, Russian, and Spanish, Schwarzschild (2005) arrives at two descriptive conclusions regarding the distribution of measure phrases:
1. If a language has direct measure phrases (i.e., measure phrases with plain, unmarked adjectives), it will have indirect measure phrases (i.e., measure phrases with comparatives), but not vice versa. (English, Italian, Dutch, German, French have both; Japanese, Russian, Spanish have only indirect measure phrases.)

2. Among languages that have direct measure phrases, the specific set of adjectives that allow them is lexically conditioned (English, Italian, Dutch, German, French).

In order to capture the first generalization, the key proposal Schwarzschild makes is that measure phrases are not arguments of gradable adjectives, but rather are predicates of gaps. As a consequence, they readily occur in comparative constructions, because such constructions provide a gap in degree between the target and the standard along some gradable dimension. For measure phrases to be able to occur in non-comparatives, extra machinery is required, since such constructions do not normally provide a gap. From this follows the crosslinguistic markedness of measure phrases with non-comparatives.

Adopting the view that gradable adjectives denote relations between individuals and degrees, Schwarzschild gives the following logical form for a basic comparative:

\[(21) \quad \text{John is taller than Mary.} \quad \exists h_j \exists h_m \text{tall}'(j, h_j) \& \text{tall}'(m, h_m) \& (h_j > h_m)\]

In prose, (21) states that there is some degree \(h_j\) and some degree \(h_m\) such that John is \(h_j\)-tall and Mary is \(h_m\)-tall, and \(h_j\) is greater than \(h_m\).

In the presence of a differential measure phrase, Schwarzschild proposes the following semantics:

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3 Schwarzschild claims that Japanese is one of the languages that do not allow measure phrases to combine directly with adjectives. Although Schwarzschild is correct that (relative) gradable adjectives with measure phrases in Japanese do not give rise to absolute measurement, he does not note that such combinations are grammatical with a differential interpretation.
(22) John is [two inches] taller than Mary.
    \[ \exists h_j \exists h_m \text{ tall}'(j, h_j) \& \text{ tall}'(m, h_m) \& 2\text{-inches}([h_j \rightarrow h_m]) \]

Here, \([h_j \rightarrow h_m]\) represents the gap between Mary’s height and John’s height, and the measure phrase is a predicate that gives the size of the gap.

In a non-comparative construction, on the other hand, there is no gap to be measured, but rather only a single point on a scale. Thus sentences like the following are correctly predicted to be ill-formed because measure phrases are predicates of gaps rather than of degrees:

(23) *Mary is [50 pounds] heavy.
    \[ \exists d \ [\text{heavy}'(m,d) \& 50\text{-pounds}'(d)] \] (underlined portion semantically ill-formed because 50-pounds’ is not a predicate of degrees)

Of course, measure phrases are not always banned in non-comparative contexts. Schwarzschild proposes three sources for apparent counterexamples to his proposal:

1. The Homonym Rule
2. Covert comparatives
3. Unambiguous interval-predicates

The *Homonym Rule* is a lexically-governed type-shifting rule that takes a relation between individuals and degrees and replaces the degree argument with an interval argument. It is repeated here verbatim:

(24) *Homonym Rule:*
    If A has meaning A’ that relates individuals to degrees, then A has a secondary meaning relating individuals to sets of degrees (intervals).
    The secondary meaning is given by: \( \lambda I. \lambda x. I = \{d : A'(x,d)\} \)
In English, the Homonym Rule applies to *tall, wide, deep, thick, old, long*, and *high*. This is meant to capture the fact that these adjectives can occur with measure phrases in non-comparative constructions to the exclusion of other adjectives. The idea is that when the Homonym Rule applies, the resulting interval argument becomes appropriate for a measure phrase predicate:

(25) Mary is [5 feet] tall.
    \[ \exists I \; [\text{tall}^2(m, l) \; \& \; 5\text{-feet}'(I)] \]

*Covert comparatives* are adjectives like *early* and *late* which, unlike other adjectives and like comparatives, can take a measure phrase in a *by*-phrase:

(26) a. He was late, by just two minutes.
    b.*He was tall, by just four feet.
    c. He was taller than me, by just four inches.

Schwarzschild argues that such adjectives have no inherent lower bound (we will question this view below). On Schwarzschild’s view, *late*, for example, relates events to times, and assuming time extends backwards without limit, the scale has no lower bound. In this sense, it is like a covert comparative, always requiring some contextually specified standard. For this reason, it can take a measure phrase.

*Unambiguous interval-predicates* are adjectives like *strong* as used in the following example, where *strong* makes reference to numerical size:

(27) The army is 1000 men strong.

The evidence that this use of *strong* is an unambiguous interval-predicate is that in the absence of a measure phrase, it takes on a different sense:
Having reviewed Schwarzschild’s proposals, let us now reconsider his system in light of the descriptive generalization regarding the interpretation of Japanese measure phrases. Since in Japanese, lower closed scale adjectives are not comparatives and yet still systematically accept measure phrases, Schwarzschild’s proposal provides three possible ways of accounting for them: either they are subject to the Homonym Rule, or they are covert comparatives, or they are unambiguous interval-predicates.

One option that we can immediately reject is to analyze lower closed scale adjectives as unambiguous interval-predicates. As the following data show, \textit{bent} can be used in its positive form and in degree questions and comparatives, and it then has the same sense as it does when used with a measure phrase:

(29) a. This rod is bent.
    b. This rod is more bent than that one.
    c. How bent is this rod?

The same facts hold for Japanese \textit{magat-teiru} ‘bent’:

(30) a. Kono sao-wa magat-teiru.
    this rod-TOP bend-TEIRU
    ‘This rod is bent.’

    b. Kono sao-wa ano sao-yori magat-teiru.
    this rod-TOP that rod-than bend-TEIRU
    ‘This rod is more bent than that rod.’

    c. Kono sao-wa dore-kurai magat-teiru-no?
    this rod-TOP how-degree bend-TEIRU-Q
'How bent is this rod?'

In Schwarzschild’s system, all of these uses of *bent* require a degree argument rather than an interval argument. Hence *bent* cannot be an unambiguous interval-predicate.

Another option would be to subsume lower closed scale adjectives under the Homonym Rule. While this would get the facts right, it would fail to capture the crosslinguistic generalization that lower closed scale adjectives are always licit with measure phrases. In Schwarzschild’s system, the Homonym Rule is the locus of idiosyncrasy, not systematicity.

The option deserving the most careful consideration is that lower closed scale adjectives are covert comparatives. In support of this view is the fact that at least some accept measure phrases in *by*-phrases, which Schwarzschild uses as a diagnostic for covert comparatives: Schwarzschild observes that measures phrases with *by* are unacceptable for absolute measurement, as shown in (31a), but acceptable with differential measurement, as in (31b), which for Schwarzschild suggests that sentences like (31c) involving the predicate *late*, where *by* measure phrases are also acceptable, are covert comparatives. (31d) shows that the same holds for the lower closed scale adjective *bent*.

(31.)  a. *John is tall [by six feet].
       b. John is taller than Bill [by two inches].
       c. John was late [by five minutes].
       d. This rod is bent [by five degrees].

However, one problematic aspect of Schwarzschild’s covert comparative analysis of adjectives like *early* and *late* — which is also problematic for extending this analysis to lower closed scale adjectives like *bent*, as we are entertaining here — is that it raises a question about how to analyze minimal pairs like (32) and (33).

(32.)  a. John was late.
b. John was later (than Bill).

(33.) a. This rod is bent.
   b. This rod is more bent (than that rod).

Both morphosyntactically and semantically, the minimal pairs in (32) and (33) look like garden-variety positive/comparative oppositions: the (a)-examples involve a positive-form adjective and the (b)-examples involve the corresponding comparative form. If the (a)-examples constitute covert comparatives, however, then their theoretical relationship to the (b)-examples is not straightforward.

An alternative approach that preserves the intuition that minimal pairs like (32) and (33) constitute positive/comparative oppositions, but which also leaves room for explaining the exceptionality of adjectives like *early* and *late*, is to view adjectives like *early* and *late* as belonging to a special subtype of lower closed scale adjectives: what sets them apart as a special subtype is that the minimal elements on their scales are supplied contextually. In the case of *early* and *late*, which involve a time scale, the minimal element is whatever point corresponds to ‘on time’. On this view, the (a)-examples above both involve positive-form lower closed scale adjectives: in (32a) it is asserted that John has an above-zero value on the ‘late’ scale whose minimal element is set to ‘on time’, and in (33a) it is asserted that the rod in question has an above-zero value on the ‘bent’ scale. In (32b), John and Bill are ranked asymmetrically on the ‘late’ scale, such that John ranks higher on the scale. And just as in (32a), the minimal element on this scale corresponds to ‘on time’. Evidence in support of such a view is the fact that many English speakers judge the following conjunction contradictory:

(34.) John was later than Bill, #but they were both early.
The contradictory nature of this conjunction suggests that the 'late' scale begins at 'on time' and does not include the time points that precede 'on time', for which the 'early' scale is used.⁴

In summary, an approach to adjectives like *early* and *late* in terms of scale structure both explains their exceptional behavior and is compatible with the fact that these adjectives have both positive and comparative uses. If this view is correct, it is expected that Schwarzschild’s ‘covert comparatives’ pattern with lower closed scale adjectives in systematically accepting measure phrases: ‘covert comparatives’ are just a special subtype of lower closed scale adjectives.

In light of these difficulties with accommodating our generalization under Schwarzschild’s system, a new explanatory mechanism is called for. First, however, we turn to a review of Svenonius and Kennedy 2006.

**2.2 Svenonius and Kennedy 2006**

Svenonius and Kennedy (2006) adopt the view that gradable adjectives directly encode measure functions, i.e., functions from individuals to degrees (Bartsch and Vennemann 1972, 1973; Kennedy 1999; Kennedy 2007a). They also take measure phrases to denote degrees. Consequently, a type mismatch would occur if a (type <d>) measure phrase combined directly with a (type <ed>) gradable adjective. The authors therefore propose that measure phrases are introduced by a special degree morpheme *Meas* with the following syntax and semantics:

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⁴The infelicity of (34) is weak: some speakers may accept this sentence, perhaps by being able to reset the minimum value on the scale between conjuncts. It is usefully contrasted, however, with examples like (i), which are robustly felicitous.

(i) John is taller than Bill, but they are both short.

On the view we adopt here (Kennedy 2001), *tall* and *short* both pick out the same set of degrees, but with opposite ordering relations. Hence the felicity of (i) is straightforwardly expected, in contrast to the (mild) infelicity of (34).
Although our focus here is on measure phrases, we note in passing that this approach fits in with a more general picture of the syntax and semantics of the adjectival projection that extends to the positive form, comparatives, and other degree constructions as well; see Kennedy 1999 for the details, and see Corver 1997 for discussion of the functional head analysis of the adjectival projection.

As seen here, Meas is a null functional head that selects for an appropriate gradable adjective as its complement and a measure phrase as its specifier. Semantically, the function of Meas is to prepare the measure-function-denoting adjective to combine with a degree-denoting measure phrase so that the result will be a property of individuals.

This view of measure phrases has two important advantages. First, it is able to account for lexical idiosyncrasy in the set of adjectives that can combine directly with measure phrases, by encoding such idiosyncrasy as arbitrary selectional restrictions on Meas. Since lexical entries (and in particular, lexical selectional restrictions) are standardly thought to be a primary locus of idiosyncrasy in natural language, the lexicon seems a natural place to encode idiosyncrasy in the distribution of measure phrases.

Second, by assuming that measure phrases are associated with a unique functional head, we gain a handle on syntactic phenomena that are sensitive to the presence of a measure phrase. The phenomenon that Svenonius and Kennedy focus on is a degree question construction in Northern Norwegian which is surface-string-
identical to a yes/no-question but which is grammatical only for adjectives associated with a measurable scale:

(37)  a. Er du gammel?
      are you old
      ‘Are you old?’ OR ‘How old are you?’
  b. Er ho flink?
      is she talented
      ‘Is she talented?’ (*Not: ‘How talented is she?’)

The authors capture this asymmetry by proposing that there is a null degree operator which can be introduced only by *Meas*:

(38)  [Op1 Er du[DegP t1 Meas gammel]]
      ‘What is the maximal degree $d$ such that you are $d$-old?’

Another construction sensitive to the presence of a measure phrase, discussed in Grano and Kennedy 2010, is the Mandarin transitive comparative (see also Xiang 2005 and Liu 2007). This is a special comparative construction in Mandarin that is grammatical only in the presence of a differential measure phrase:

(39)  zhangsan gao lisi *(yi-cun / yi-xie).
      Zhangsan tall Lisi one-inch / a-little
      ‘Zhangsan is (one inch / a little) taller than Lisi.’

It is also incompatible with adjectives that are not associated with a measurable scale:

(40)  *zhangsan gaoxing lisi (yi-xie).
      Zhangsan happy Lisi a-little
Grano and Kennedy capture these facts by proposing that the standard of comparison needs to be assigned abstract Case: in transitive comparatives, *Meas* is the only available Case assigner, and hence the obligatory status of the measure phrase follows. In Schwarzschild’s system, in which measure phrases are adjuncts, it is not clear how one would account for their obligatory status in Mandarin transitive comparatives.

Although Svenonius and Kennedy’s analysis is well suited to capturing lexical idiosyncrasy in the distribution of measure phrases and the syntactic sensitivity of measure phrases in certain constructions, its primary shortcoming is that it does not capture either Schwarzschild’s generalization or the generalization regarding Japanese: it does not follow from anything in Svenonius and Kennedy’s proposal that comparative or lower closed scale adjectives should pattern to the exclusion of other adjectival constructions in systematically allowing measure phrases.

We now turn to our analysis of Japanese measure phrases which retains both the semantic insights of Schwarzschild’s account and the syntactic insights of Svenonius and Kennedy’s account, while at the same time capturing the Japanese facts in a principled way. But before we do so, let us first review previous analyses of Japanese measure phrases.

### 3 Previous analyses of Japanese measure phrases

As we stated in the Introduction, in previous literature it is claimed that when a measure phrase combines directly with an adjective in Japanese, it has only a differential interpretation, with a contextually determined standard (Snyder et al. 1995; Schwarzschild 2005; Kikuchi 2006; Nakanishi 2007; Hayashishita 2009):

(41)  a. Kono tana-wa 2-meetoru takai.

      this shelf-TOP 2-meter tall

     ‘This shelf is 2 meters taller.’

     *Not: ‘This shelf is 2 meters tall.’*

     b. Kono roopu-wa 5-inchi nagai.
this  rope-TOP  5-inch  long
'This rope is 5 inches longer.'
Not: 'This rope is 5 inches long.'

c. Kinoo-wa  5-do  atataka-katta.
yesterday-TOP  5-degree warm-PAST
'It was 5 degrees warmer yesterday.'
Not: 'It was 5 degrees warm yesterday.'

Two kinds of approaches to these facts are found in previous literature. First, Snyder et al. (1995), in order to explain the obligatory differential reading for sentences like (41), follow ideas in Fukui 1986 and claim that AdjP in Japanese, unlike AdjP in English, lacks the specifier position that hosts a measure phrase:

(42)  a. English        b. Japanese
      [Adj - [Adj' A]]      [Adj A]
      (Snyder et al.'s 1994 proposal, as schematized by Hayashishita 2009: 96)

In this system, measure phrases in Japanese can combine with gradable adjectives only through the mediation of covert morphology that gives rise to a differential interpretation.

Second, in a different vein, Kikuchi (2006) attempts to derive the facts from the proposal that degree constructions give rise to a default comparative meaning in languages that do not have an overt morphological contrast between positive- and comparative-form adjectives. Since Japanese lacks an overt comparative morpheme like English –er/more, the default comparative value is chosen when a measure phrase is present.

An empirical shortcoming of both approaches is that neither consider examples like those in (7) above, which show that Japanese does allow absolute measurement in combination with certain kinds of predicates. Three of those examples are repeated here:
a. Kono sao-wa 5-do magat-teiru.
   this rod-TOP 5-degree bend-TEIRU
   ‘This rod is 5 degrees bent.’
   Not: ‘This rod is 5 degrees more bent.’

b. Kono fusuma-wa 3-senti ai-teiru.
   this sliding door-TOP 3-centimeter open-TEIRU
   ‘This door is 3 centimeters open.’
   Not: ‘This door is 3 centimeters more open.’

c. Pisa-no syatoo-wa 3.97-do katamui-teiru.
   Pisa-GEN leaning tower-TOP 3.97-degree incline-TEIRU
   ‘The Leaning Tower of Pisa is 3.97 degrees inclined.’
   Not: ‘The Leaning Tower of Pisa is 3.97 degrees more inclined.’

These examples are interpreted with absolute measurement, against the expectations of both Snyder et al. (1995) and Kikuchi (2006).

Before closing this section, we respond to a potential objection: one might object that the sentences in (43) are not problematic for the aforementioned analyses because the predicates in these examples are deverbal, and hence outside the empirical scope of these previous treatments (see also footnote 2 above). However, three pieces of evidence support the view that the predicates that give rise to absolute measurement in Japanese, although mostly deverbal, nonetheless have the same basic interpretation as gradable adjectives.

First, the [verb + teiru] predicates in (43) have a stative meaning just like gradable adjectives. As Kindaichi (1950, 1976) argues, the -teiru construction is associated with three distinct interpretations: an ongoing process interpretation analogous to the English progressive, shown in (44a), a perfective/resultative interpretation, shown in (44b), and a stative interpretation, shown in (44c). (See also Fujii 1966; Jacobsen 1992; Teramura 1984; Ogihara 1998; Shirai 2000; among many others.)
(44)  
a. Taro-wa ima ie-o tate-teiru.  (progressive)
   Taro-TOP now house-ACC build-TEIRU
   ‘Taro is now building a house.’
b. Ki-ga taore-teiru.  (perfective/resultative)
   tree-NOM fall -TEIRU
   ‘A tree is down (as a result of having fallen).’
c. Kono michi-wa magat-teiru.  (stative)
   this road-TOP bend-TEIRU
   ‘This road is curved.’ (Kindaichi 1976: 45)

In (44a), -teiru is interpreted as a progressive marker, in (44b) it is interpreted as a resultative marker, and in (44c) it is interpreted as a stative marker. As Kindaichi (1976: 45) argues, maga-teiru in (44c) denotes a state, as evidenced by the fact that it does not presuppose or entail a starting point or an endpoint. In this sense, the [verb+teiru] predicate in (44c) is semantically like an adjective. The intuition that predicates like maga-teiru ‘bent’ are not associated with a starting point or endpoint is supported by the felicity of the following dialogue:

(45)  
A: Kono sao-wa magat-tei-masu.5
   this rod-TOP bend-TEIRU-PERFORMATIVE.POL
   ‘This rod is bent.’
B: Naze mage-ta-no?
   why bend-PAST-Q
   ‘Why did you bend it?’
   no beginning-from this kind of shape -PRED.POL
   ‘No. It is like this from the outset.’

5 We use the performative honorific form masu here in order to approximate a natural discourse, but this does not affect our point; it does not contribute to the propositional meaning of the utterance.
The fact that speaker A can successfully deny speaker B’s question shows that the meaning of *magat-teiru* in (44c) is not inherently resultative. The same result holds for the other predicates in (44) if similar tests are applied. These predicates do not entail or presuppose that there was an event before the current state (although they pragmatically allow the possibility; see Jakobsen 1992:164).

Second, similarly to ‘genuine’ lexical adjectives, [verb+*teiru*] forms can be used attributively, as in (46):⁶

(46) 5-do  magat-teiru  sao
    5-degree   bend-TEIRU   rod
‘a/the rod that is 5 degrees bent’

The third piece of evidence for the idea that the [verb + *teiru*] construction is semantically adjectival has to do with modification structure. As the following example shows, the intensifier *totemo* can modify [verb + *teiru*]:

(47) a. Kono michi-wa  *totemo*  magat-teiru.
    this  road-TOP  very   bend-TEIRU
‘This road is very curved.’

b. * Kono michi-wa  *totemo*  magaru.
    this  road-TOP  very   bend

---

⁶ There exists also the so-called ‘adjectival relative’ construction (Kusumoto 2002; Ogihara 2004) — consisting of a verbal root and past tense morpheme -ta — which is another way of forming a prenominal modifier. As the following example shows, this construction admits measure phrases with an absolute interpretation:

(i) 5-do  magat-ta  sao
    5-degree   bend-PST   rod
a. ‘a/the rod that is 5 degrees bent’ (stative reading)
b. ‘a/the rod that got bent by 5 degrees’ (eventive reading)

Examples (i.a) and (46) are truth-conditionally equivalent. What is crucial here is the fact that in spite of the presence of morphological past tense, (i.a) does not necessarily entail a past event. This phenomenon illustrates that there are multiple ways (i.e., verb+*ta* and verb+*teiru*) to make ‘attributive’ adjectives using verbal morphology, and hence reinforces the view that the construction we are interested in is semantically adjectival. We thank an anonymous reviewer for drawing our attention to the adjectival relative construction.
The intensifier *tотeмo* can modify a verb only if the verb has a STATE component and a gradable property (cf. Tsujimura 2001). Here we can say that (47a) is felicitous because the resultative *-teiru* converts the non-stative meaning (47b) into a stative (i.e., adjectival) meaning.

The final piece of evidence is more direct: there are examples of absolute measurement that use non-deverbal adjectives. As the following example shows, *hayai* 'fast' gives rise to absolute measurement:

(48) Kono tokai-wa 2-fun hayai.

    this clock-TOP 2-minute fast

    ‘This clock is 2 minutes fast.’

    *Not:* ‘This clock is 2 minutes faster.’

Sentence (48) is interpreted with absolute measurement in the sense that it does not compare the accuracy of one clock to the accuracy of another clock; rather, it measures the accuracy of just one clock.

Based on the above evidence, we conclude that the predicates that give rise to absolute measurement in Japanese are of the same basic semantic type as those that give rise to differential measurement, in spite of the fact that some of them are syntactically deverbal. Hence we conclude that what gives rise to the interpretational asymmetry is not the morphosyntax of the predicate but rather the scale structure of the predicate.

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7 Tsujimura (2001: 44) argues that the gradable property needs to be associated with a nontrivial (i.e., contextual) standard, which would seem to exclude lower closed scale adjectives, insofar as a minimal element constitutes a non-contextual standard (cf. Kennedy 2007a). However, this generalization does not hold for (47a), where *magat-teiru* is interpreted as a lower closed scale adjective. This suggests that *tотeмo* can combine with both lower closed scale and open scale adjectives.

8 In Oghara (1998), *-teiru* is analyzed into two morphemes -te and iru, each of which makes an independent semantic contribution.

9 In Sect. 2.1 we argued that Schwarzschild’s ‘covert comparatives’ (e.g., *early*/late) are actually a subtype of lower closed scale adjectives. The same analysis can be made for Japanese *hayai* ‘fast’/*early*. 
4 The semantics of absolute measurement: sensitivity to scale structure

The purpose of this section is to account for why only the sentences in (50) and not those in (49) give rise to an absolute measurement interpretation.

(49) a. Kono tana-wa 2-meetoru takai.
   this shelf-TOP 2-meter tall
   ‘This shelf is 2 meters taller.’
   Not: ‘This shelf is 2 meters tall.’

b. Kono roopu-wa 5-inchi nagai.
   this rope-TOP 5-inch long
   ‘This rope is 5 inches longer.’
   Not: ‘This rope is 5 inches long.’

c. Kinoo-wa 5-do atataka-katta.
   yesterday-TOP 5-degree warm-PAST
   ‘It was 5 degrees warmer yesterday.’
   Not: ‘It was 5 degrees warm yesterday.’

(50) a. Kono sao-wa 5-do magat-teiru.
   this rod-TOP 5-degree bend-TEIRU
   ‘This rod is 5 degrees bent.’
   Not: ‘This rod is 5 degrees more bent.’

b. Kono fusuma-wa 3-senti ai-teiru.
   this sliding door-TOP 3-centimeter open-TEIRU
   ‘This door is 3 centimeters open.’
   Not: ‘This door is 3 centimeters more open.’

c. Pisa-no syatoo-wa 3.97-do katamui-teiru.
   Pisa-GEN leaning tower-TOP 3.97-degree incline-TEIRU
   ‘The Leaning Tower of Pisa is 3.97 degrees inclined.’
*Not:* 'The Leaning Tower of Pisa is 3.97 degrees more inclined.'

As discussed in the Introduction, the descriptive generalization is that the adjectives in (49) are open scale adjectives whereas those in (50) are lower closed scale adjectives.¹⁰

Taking Schwarzschild 2005 and Svenonius and Kennedy 2006 as two viable contenders for the proper analysis of the syntax and semantics of measure phrases, we now need to decide which of these accounts to adopt, and then revise it so that measure phrases are predicted to be systematically grammatical with lower closed scale adjectives. Here we choose to adopt and revise Svenonius and Kennedy’s analysis of measure phrases rather than Schwarzschild’s, for three reasons. First, Svenonius and Kennedy’s approach has the important advantage of associating the presence of a measure phrase with a special piece of morphology, namely the functional head *Meas.* As shown above in Sect. 2.2, something like this is needed to explain the distribution of Northern Norwegian null degree questions and Mandarin.

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¹⁰ Oda (2010) notes two potential counterexamples to the generalization that (open scale) adjectives in Japanese cannot take measure phrases with absolute interpretation, namely, when a degree demonstrative (see (i)) or degree question word (see (ii)) takes the place of a numerical measure phrase:

(i) John-wa sore-gurai [se-ga takai].
   "John-TOP that-much height-NOM tall"
   Not: 'John is that tall.'

(ii) John-wa dore-gurai [se-ga takai] no?
   "John-TOP that-much height-NOM tall Q"
   'How tall is John?' Not: 'How much taller is John?'

If ‘measure phrases’ are construed broadly to include corresponding demonstratives and question words, then (i) and (ii) stand as counterexamples to the generalization. As acknowledged by Oda, however, degree demonstratives and question words pattern unlike numerical measure phrases also in English, in that they are acceptable with negative members of antonym pairs, as in (iii).

(iii) a. *John is 1m short.*
    b. John is **that** short.
    c. **How** short is John?

While we remain agnostic about the proper analysis of degree demonstratives and question words (see Oda 2010 for one approach), we wish to point out that, as (iii) suggests, their exceptional behavior in Japanese should follow from the same principles that account for their exceptionally wide distribution in English. We thank an anonymous reviewer for drawing our attention to Oda’s work.
transitive comparatives. It is not clear how Schwarzschild’s approach, in which measure phrases are adjuncts, could be revised to handle such cases. Second, although Svenonius and Kennedy’s approach to measure phrase distribution is a syntactic one, their proposed denotation for \textit{Meas} in fact already imposes a semantic restriction on the kinds of gradable adjectives it can combine with; namely, there is a restriction to gradable adjectives whose scales are associated with a salient measurement system. Svenonius and Kennedy implement this as a domain restriction on the first argument of \textit{Meas}, and as we will show presently, it is a simple matter to add an additional condition to this domain restriction that gets the results right for Japanese. Third and finally, it will be shown in Sect. 5 below that this additional domain restriction, independently needed to capture the interpretation of measure phrases with Japanese lower closed scale adjectives, will also extend without additional stipulation to measure phrases in combination with full comparatives. As we will elaborate on in Sect. 7, a crosslinguistic extension of this idea will have the desirable result of capturing Schwarzschild’s generalization regarding the strong crosslinguistic acceptability of measure phrases with comparatives as opposed to non-comparatives. Thus we see our revised \textit{Meas} approach as combining the syntactic advantages of the Svenonius-Kennedy view of measure phrases with the semantic advantages of the Schwarzschild view of measure phrases, while at the same time accounting for the otherwise puzzling Japanese facts.

Adopting, then, the syntax for measure phrases proposed by Svenonius and Kennedy (2006), we can capture the fact that only lower closed scale adjectives give rise to absolute measurement in Japanese by imposing an additional semantic selectional restriction on \textit{Meas} which ensures that it can only combine with adjectives that have a minimum element. This semantic restriction is in addition to the semantic restriction already proposed by Svenonius and Kennedy (2006) that
Meas may only combine with gradable adjectives associated with scales that have measurable degrees.\textsuperscript{11}

(51) $[[\text{Meas}]] = \lambda g_{\leq d}: g$ is a function from objects to measurable degrees and $g$ has a minimum element $\lambda d \lambda x. g(x) \geq d$

As demonstrated by the entailment tests in the Introduction (repeated here in (52)-(53)), Japanese magat-teiru ‘bent’ is a lower closed scale adjective, whereas takai ‘tall’ is an open scale adjective.

(52) Entailment pattern of a lower closed scale adjective:

\begin{itemize}
  \item a. Kono sao-wa magat-teiru nai. $\Rightarrow$ b. Kono sao-wa masugu-da.
  \item yhis rod-TOP bend-TEIRU-NEG this rod-TOP straight-PRED
  \item ‘This rod is not bent.’ ‘This rod is straight.’
\end{itemize}

(53) Entailment pattern of a relative gradable adjective:

\begin{itemize}
  \item a. Taro-wa se-ga takaku nai. $\nRightarrow$ b. Taro-wa se-ga hikui.
  \item Taro-TOP height-NOM tall-NEG Taro-TOP height-NOM short
  \item ‘Taro is not tall.’ ‘Taro is short.’
\end{itemize}

Because magat-teiru ‘bent’ is a lower closed scale adjective, it has a minimum element and hence is compatible with Meas, thus correctly predicting the meaning in (54):

(54) Kono sao-wa 5-do magat-teiru.

\begin{itemize}
  \item this rod-TOP 5-degree bend-TEIRU
  \item ‘This rod is 5 degrees bent.’
\end{itemize}

\textit{Not:} 'This rod is 5 degrees more bent.'

\textsuperscript{11} Although we currently focus the discussion on Japanese, we will argue below in Sect. 7 that the proposed additional semantic restriction on Meas is in fact not limited to Japanese but is universal, and interacts with language-specific parameters to yield the attested crosslinguistic variation.
Japanese *takai* ‘tall’, on the other hand, has no minimum element and thus does not express absolute measurement when combined with a measure phrase:

(55) Kono tana-wa 2-meeteru takai.
this shelf-TOP 2-meter tall
‘This shelf is 2 meters taller.’

We return to the proper analysis of sentences like (55) in Sect. 6. First, however, we show how our account in its current form extends to measure phrases in combination with full comparative constructions.

5 Semantics of comparatives with measure phrases

The analysis of absolute measurement in Japanese as presented in the last section extends naturally to the semantics of comparatives with measure phrases, without further stipulation. In a regular Japanese comparative construction, the standard of comparison is introduced by the postposition *yori*, and a measure phrase (which is optional) measures the gap between the subject and the standard of comparison:

(56) a. Kono tana-wa ano tana-yori 2-meeteru takai.
this shelf-TOP that shelf-than 2-meter tall
‘This shelf is 2 meters taller than that shelf.’

this rod-TOP that rod-than 5-degree bend-TEIRU
‘This rod is 5 degrees more bent than that rod.’

Crucially, (56) shows that when the standard of comparison is spelled out overtly in a *yori*-phrase, the interpretational contrast between the two classes of gradable predicates (open scale vs. lower closed scale) does not arise. Both (56a), with an open scale adjective, and (56b), with a lower closed scale adjective, set up a
comparison between the subject and a standard, and the measure phrase specifies the difference.

Following Kennedy and Levin (2008), we adopt the idea that the function of comparative morphology is to turn a basic measure function into a difference function with a scale whose minimal element – the “derived zero” – corresponds to the degree introduced by the comparative standard (cf. also Kennedy and McNally 2005). Thus we posit the following denotation for yori:\footnote{The application of the ‘difference function’ approach to comparatives in combination with measure phrases is found in Svenonius and Kennedy 2006. We also acknowledge Kubota 2009 for suggesting the application of this semantics of comparatives to Japanese in particular. The proposal that the semantics of comparison is in the standard marker yori in Japanese (as opposed to in a null comparative morpheme) is not a standard approach. See Sect. 6 below for discussion. See also Kennedy 2007b for the proposal that universally, the semantics of comparatives is in the standard morphology.}

\begin{equation}
\text{(57)} \enspace [[\text{yori}]] = \lambda x \lambda g_{\prec d} \lambda y. \, g_{g(x)}^{\uparrow}(y)
\end{equation}

Here, yori takes an entity \( x \) and a gradable adjective \( g \) as arguments and returns a function \( \lambda y. \, g_{g(x)}^{\uparrow}(y) \), which maps entities to a derived scale \( g_{g(x)}^{\uparrow} \). The starting point of the derived scale corresponds to the degree introduced by the comparative standard \( x \). A consequence of this analysis is that like morphologically bare adjectives, comparative adjectives are also of type \( <e,d> \), and so they need to combine with pos, given in (58), in order to become properties of individuals (Kennedy and Levin 2008). Thus the structure of (59) below can be represented as (60):

\begin{equation}
\text{(58)} \enspace [[\text{pos}]] = \lambda g_{<e,d>} \lambda x. \, g(x) \geq \text{std}(g)
\end{equation}

(adapted from Kennedy and Levin 2008; cf. (18) above)

\begin{equation}
\text{(59)} \enspace \text{Kono tana-wa} \hspace{1cm} [\text{ano tana-yori takai}].
\end{equation}

this shelf-TOP that shelf-than tall

‘This shelf is 2 meters taller than that shelf.’
Earlier, we showed that in order to calculate the meaning of a sentence with a positive-form adjective such as John is tall, pos must combine with the adjective in order to relate a degree argument to a contextual standard. However, notice that the standard in (59) is not a contextually determined standard. The standard is ano tana ‘that shelf’.

We can explain how the choice of standards is properly regulated even given a single denotation for pos by appealing to Kennedy’s (2007a) principle of Interpretive Economy.

(61) Interpretive Economy:

Maximize the contribution of the conventional meanings of the elements of a sentence to the computation of its truth conditions. (Kennedy 2007a:36)

This economy principle requires that if a given adjective has a minimal element (whether built-in, in the case of lower closed scale adjectives, or derived, in the case of comparative difference functions), pos should choose this minimal element as its standard rather than introducing a contextual standard, since in so doing it maximizes the contribution of conventional meaning.

When a measure phrase is used, however, it is Meas rather than pos that turns the comparative into a property of individuals, and an important consequence of this approach is that since a standard of comparison provides a minimal element, comparative constructions with a measure phrase are straightforwardly compatible
with *Meas* regardless of the scale structure of the adjective itself, as in (62):\(^{13}\)

(62)

(63) shows the scale structures for *takai* ‘tall’ and *magat-teiru* ‘bent’ graphically. Although ‘tall’ lacks a minimal element and ‘bent’ has one, as indicated by o and • respectively, the crucial insight is that both take on a derived minimal element when a standard of comparison is introduced:

(63)

The desirable result is that lower closed scale adjectives and comparative constructions constitute a natural class in that both are associated with scales that have a minimal element. With lower closed scale adjectives, this minimal element is built-in, and with comparative adjectives, the standard of comparison provides a minimal element. This follows naturally from the approach to comparative semantics employed here, in which comparative morphology turns a basic measure function into a derived ‘difference function’ whose minimal element corresponds to the degree associated with the standard of comparison. We have thus explained why lower closed scale adjectives pattern with comparatives in accepting measure

\(^{13}\) The canonical position of the measure phrase in this construction is between *yori* and the adjective. We assume that at LF, the measure phrase combines with the constituent *[y yori A]* (Kubota 2009).
phrases in languages that otherwise have a general ban on absolute measurement. (See Sect. 7 for more on the crosslinguistic picture.)

6 Differential measurement in Japanese: a coercion-based approach

We now return to the semantics of differential measurement in Japanese. In Sect. 4 we argued for the following restriction in the predicates that combine with Meas:

(64) In Japanese, the direct composition of a measure phrase with a gradable predicate is possible only when the scale associated with the gradable predicate has a minimal element.

How can we derive the meaning of the following sentences, which seem to violate the constraint in (64)?

(65) a. Kono tana-wa 2-meetoru takai.
   this shelf-TOP 2-meter tall
   ‘This shelf is 2 meters taller.’
   Not: ‘This shelf is 2 meters tall.’

b. Konoroopu-wa 5-inchi nagai.
   this rope-TOP 5-inch long
   ‘This rope is 5 inches longer.’
   Not: ‘This rope is 5 inches long.’

c. Kinoo-wa 5-do atataka-katta.
   yesterday-TOP 5-degree warm-PAST
   ‘It was 5 degrees warmer yesterday.’
   Not: ‘It was 5 degrees warm yesterday.’

We argue that when a measure phrase combines with an adjective that does not have a minimal element, coercion happens and causes a ‘scale shift’: the scale
associated with the adjective is forced to take on a contextually recoverable minimal element.

This approach is inspired by de Swart’s (1998) ‘aspect shift’ coercion, which in turn builds on earlier work by Moens (1987). We see ‘aspect shift’ as a phenomenon analogous to Japanese differential measurement. Hence we begin by briefly considering de Swart’s ‘aspect shift’ coercion approach to English durative adverbials. By way of example, the verb phrase *play the sonata* in (66a) describes an event, which for de Swart means that it involves an inherent culmination point. Thus, it can co-occur with *in*-adverbials, as shown in (66b). On the other hand, the verb phrase *live in Paris* in (67a) describes a state. States are different from events in that they correspond to eventualities which do not have an inherent endpoint. Thus states (and processes, which we do not illustrate here) combine with *for*-adverbials rather than *in*-adverbials:

(66)  
   a. John played the sonata. \hspace{1cm} \text{(event)}
   b. John played the sonata in three hours.

(67)  
   a. Susan lived in Paris. \hspace{1cm} \text{(state)}
   b. Susan lived in Paris for three years.

However, if we imagine John playing the sonata over and over again, we can use *for*-adverbials for the predicate *play the sonata*:

(68)  
   John played the sonata for three hours. \hspace{1cm} \text{(state; by coercion)}

Accordingly, de Swart (1998) proposes that in (68), the presence of the durative adverbial gives rise to a coercion operator $C$ that shifts the eventuality from an event to a state:

(69)  
   $[\text{PAST } [\text{FOR three hours } [C [\text{John play the sonata}]]]]$
In de Swart’s system, this coercion operator, as well as others that de Swart proposes for effecting other kinds of aspectual transitions, is introduced only when there is a trigger (in this case, a for-adverbial). Furthermore, the coercion operator is different from a grammatical operator in that coercion is syntactically and morphologically invisible: it is governed by implicit contextual reinterpretation mechanisms triggered by the need to resolve an aspectual conflict (de Swart 1998: 360).

We propose that de Swart’s ‘aspect shift’ coercion extends naturally to a ‘scale shift’ coercion approach to Japanese differential measurement. In (70), for example, the presence of a measure phrase (and the concomitant presence of Meas) requires that the scale associated with takai ‘tall’ shift into a scale that has a minimal element corresponding to a contextually determined standard.

(70) Kono tana-wa 2-senchi takai.
   this shelf-TOP 2-cm tall
   ‘This shelf is 2 centimeters taller.’

The following figure graphically shows the scale shift proposed for (70):

(71) Scale shift of measure phrase in combination with takai ‘tall’:

\begin{itemize}
  \item[a.] takai₁ ‘tall’:
  \item[b.] takai₂ ‘taller’ (via coercion)
\end{itemize}

\[\sigma\leftarrow\hspace{1cm}\sigma\uparrow\]
\[\text{derived minimal element}\]

For concreteness, we follow de Swart in assuming that coercion occurs via special coercion operators. The coercion operator we propose is as follows:

(72) \([\text{[C}_s]\text{[[AD]]]} = \lambda g. \lambda x. g_g(s)^\uparrow(x)\)

(where \(s\) stands for a contextually determined object)
$C_s$ as defined in (72) coerces the meaning of an adjective to have a contextually
determined implicit standard from which a measurement is computable. The
following tree shows the full derivation of the interpretation of (70):

\[ (73) \]

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14 It is also worth noting that 'scale shift' arises in other contexts aside from measure phrases. For example, the minimal degree modifier sukosi 'a little' ordinarily requires an adjective with a minimal element, as in (i).

(i) Kono sao-wa sukosi magat-teiru.
   this rod-TOP a bit bent-TEIRU
   'This rod is a bit bent.'

However, sukosi can also combine with an adjective that has no minimal element, in which case it
gives rise to an 'excessive' reading:

(ii) Kono resutoran-wa sukosi takai.
    this restaurant-TOP a bit expensive
    'This restaurant is a bit (too) expensive.'

Whereas (i) means that the rod is close to the zero point on the scale associated with 'bent', (ii)
means that the restaurant exceeds a standard of excessiveness on the 'expensive' scale. We can
understand (ii) as involving another kind of scale shift: whereas [measure phrase + takai] results in a
scale shift that involves a contextually determined standard, [sukosi + takai] results in a scale shift
that involves a (vague) standard of excessiveness. The latter phenomenon is found also in English
and Dutch: see Bolinger (1972), Ernst (1984), and Klein (1998) for discussion of the use of modifiers
such as a bit and a little.
As we see in (73), the coercion operator $C_s$ intervenes in order to resolve the clash between the open scale associated with $takai$ ‘tall’ and $Meas$, which requires a lower closed scale adjective. The effect of the coercion operator is to introduce a contextual standard into the computation, which provides the minimal element in the measurement.  

So far we have restricted our discussion to open scale adjectives and lower closed scale adjectives. However, a brief remark is in order on upper closed scale adjectives. As shown in (74), an upper closed scale adjective cannot combine with a measure phrase (cf. Kubota 2009):

(74) ?? Kono fusuma-wa 3-senti simat-teiru.

this sliding door-TOP 3-centimeter close-TEIRU

*‘This door is 3 centimeters closed.’

??‘This door is 3 centimeters more closed than a contextually determined standard.’

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15 According to some definitions, ‘coercion’ applies only in cases of type mismatch. For example, Pustejovsky (1995) defines coercion as follows: "a semantic operation that converts an argument to the type which is expected by a function, where it would otherwise result in a type error" (Pustejovsky 1995: 111). de Swart’s (1998) coercion mechanism, however, does not involve a type mismatch, and neither does ours: open scale adjectives have the right type ($<ed>$) to combine with $Meas$; instead, the conflict has to do with scale structure.

16 Note that if we add an additive particle moo ‘additionally/more’ (e.g. moo 2-meetoru), the sentence can be interpreted as having a differential interpretation.
The adjective *simat-teiru* ‘closed’ has an upper closed scale, as evidenced by its felicity with *kanzen-ni* ‘completely’ (e.g., *Kono fusuma-wa kanzen-ni simat-teiru* ‘This door is completely closed’). Since it does not, however, have a lower closed scale, we correctly predict that (74) cannot mean ‘This door is 3 centimeters closed’. The remaining question is why (74) cannot be interpreted as differential measurement via coercion. We tentatively suggest that coercion cannot apply to upper closed scale adjectives because such adjectives have a salient endpoint: the upper endpoint seems to block the coercion strategy.

We conclude this section by forestalling two potential objections to the approach we advocate here. First, one might wonder why the overt morpheme *yori* cannot be used instead of the coercion operator $C_S$. Under our analysis, the meanings of $C_S$ and *yori* are essentially the same. They both provide a standard of comparison. We argue that this is due to a general syntactic constraint on adpositions in Japanese. In Japanese, adpositions must combine with an overt complement. Thus, *yori* cannot be used in sentences like (70), where there is no overt standard.

Second, one might also argue that it is a null comparative morpheme *MORE* rather than a null coercion operator that provides a comparative-like interpretation in the relevant examples: in this paper, we assume that it is *yori* that provides comparative semantics in Japanese comparative constructions, but some literature on Japanese comparatives (e.g., Beck et al. 2004) assumes that there is a null comparative morpheme *MORE* that serves this function. This alternative view might lead us to think that similarly to the case of English (e.g., *Tom is 2 cm taller*), there is

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17 For example, if the complement of the postposition *ni* ‘to’ is elided, the resulting sentence becomes ungrammatical:

(i) Taro-mo [__ (*ni)] i-tta.
   Taro also __ to go-PAST
   Intended meaning: ‘Taro also went to a contextually determined place.’

18 There is a comparative use of *yori* in Modern Japanese that does not require an overt standard of comparison. However, its use is highly restricted and is a relatively recent development in Japanese. See Sawada (to appear) and references therein.
a comparative morpheme MORE which provides a ‘contextually determined standard’ from which the measurement is computed.

However, the null comparative approach is problematic for the following two reasons. First, it cannot explain the asymmetry between (75a) and (75b).

(75) a. Kono tana-wa 2-meetoru takai.
    this shelf-TOP 2-meter tall
    ‘This shelf is 2 meters taller.’

b. Kono tana-wa takai.
    this shelf-TOP tall
    ‘This shelf is tall.’ (Not: This shelf is taller.)

If the measure phrase is deleted in (75a), the resulting sentence is not interpreted as a comparative. (75b) cannot be interpreted as ‘This shelf is taller than a contextually determined object’. By analyzing (75a) as an instance of coercion, we have a way of understanding why the comparative interpretation is systematically restricted to cases involving a measure phrase.  

Second, the null comparative morpheme approach would encounter difficulties in explaining the difference between absolute and differential measurement:

(76) a. Kono tana-wa 2-meetoru takai.
    this shelf-TOP 2-meter tall
    ‘This shelf is 2 meters taller.’

b. Kono sao-wa 5-do magat-teiru.
    this rod-TOP 5-degree bend-TEIRU
    ‘This rod is 5 degrees bent.’

    Not: ‘This rod is 5 degrees more bent.’

19 Oda (2008) and Beck (2008) develop the idea that Japanese adjectives are inherently comparative and context dependent. According to their analysis, the semantics for takai ‘tall’ is represented in (i):

(i) \([\text{takai } c]] \equiv \lambda x. \max(\lambda d. x \text{ is } d \text{-tall}) > g(c)\)

However, it is not obvious how this approach explains basic positive/comparative oppositions such as This shelf is tall vs. This shelf is taller.
The null comparative morpheme approach cannot derive why a comparative-like interpretation arises only when phrases are combined with an adjective that has no minimal element. Our coercion approach, on the other hand, does derive the contrast between (76a) and (76b): the comparative-like interpretation in (76a) is the outcome of a coercion mechanism that is restricted to open scale adjectives.

7 Typological speculations

In the preceding sections, we argued that the interpretation of measure phrases in Japanese is sensitive to scale structure such that (i) the functional head that introduces measure phrases selects only for gradable predicates that have a minimal element and (ii) violations to this restriction are repaired via coercion, which forces a comparative interpretation with a contextually determined standard and hence a minimal element.

A natural question to ask is how the system borne out in Japanese compares to other languages. As discussed in the Introduction, many languages, such as Spanish, Korean, and Russian, disallow absolute measure phrases, and in these languages, unlike Japanese, absolute measure phrases result in strict ungrammaticality rather than a forced comparative interpretation:

(77) * Pedro es un metro alto. (Spanish)
   Pedro is one meter tall
(78) * i kenmwul-un sip mite khu-ta. (Korean)
   this building-TOP ten meter tall-DECL
(79) * On dva metra vysokij. (Russian)
   he two meters tall (Matushansky 2002:241)

In a comparative construction, on the other hand, measure phrases are perfectly grammatical in these languages:
As reviewed above, it is on the basis of this kind of data that Schwarzschild (2005) proposed his generalization that all languages that allow absolute measure phrases allow differential measure phrases but not vice versa. Strikingly, however, as mentioned in the Introduction, all three of these languages pattern like Japanese in that adjectives with a lower closed scale allow absolute measure phrases:

(80) Pedro es un metro más alto que Jorge. (Spanish)
Pedro is one meter more tall than Jorge
‘Pedro is one meter taller than Jorge.’

(81) i kenmwul-un sip mit te khu-ta. (Korean)
this building-TOP ten meter more tall-DECL
‘This building is ten meters taller.’

(82) On na metr vyshe Billa (Russian)
he by meter high.MORE Bill.GEN
‘He is one meter taller than Bill.’

(83) Esta varilla está doblada noventa grados. (Spanish)
this rod is bent ninety degrees
‘This rod is ninety degrees bent.’

(84) i hwoychori-nun i-to (cengto) hwies-ta. (Korean)
this rod-TOP two-degree about bent-DECL
‘This rod is (about) two degrees bent.’

(85) Etot prut pognut na p’at’ gradusov. (Russian)
this rod bent by five degrees
‘This rod is five degrees bent.’

What this suggests is that our proposal regarding the semantic selectional restriction on Meas in Japanese is in fact universal: all of the languages that we know of allow absolute measure phrases with predicates that have a minimal element, whether the minimal element is the consequence of an inherently lower closed scale
or the consequence of a standard of comparison. Thus we hypothesize that the
following denotation for $Meas$, which we proposed for Japanese, is universal:

$$[[Meas]] = \lambda g_{\leq d} : g \text{ is a function from objects to measurable degrees and } g$$

has a minimal element $\lambda d \lambda x. g(x) \geq d$

This proposal subsumes Schwarzschild's generalization but additionally predicts
that lower closed scale adjectives should pattern with comparatives in allowing
measure phrases.

As for the observed crosslinguistic variation, we speculate that it is the
consequence of two interdependent parameters:

$$[[87]]$$

1. A language {does, does not} allow measure phrases with a lexically
   idiosyncratic set of open scale adjectives. (English, Italian, Dutch, German,
   French do; Japanese, Spanish, Korean, Russian do not.)

2. Among languages that do not allow measure phrases with a lexically
   idiosyncratic set of open scale adjectives: a language {does, does not} have a
   covert mechanism for coercing a comparative interpretation to grammatically allow a measure phrase to combine with an open scale
   adjective. (Japanese does; Spanish, Korean, Russian do not.)

As for the first parameter of variation, we do not know of any independent
grammatical properties that correlate with the settings. The split seems to cut
across languages that are typologically quite heterogeneous. We hypothesize that in
languages that allow measure phrases with certain open scale adjectives, what
happens is that $Meas$ specifies a set of adjectives that it can combine with (cf.
Svenonious and Kennedy 2006), which can override the general semantic restriction
that is normally operative.

It is theoretically possible that in these languages there is another type of
cocercion at work, which forces open scale adjectives to adopt a lower closed scale.
However, this kind of coercion is not productive in the languages we know of. For example, we would have to say that in English, the adjective *tall* can be coerced into having a lower closed scale (e.g., *6 feet tall*) but the adjective *heavy* cannot (e.g., *5 pounds heavy*). And as mentioned above, this is a matter of language-specific idiosyncrasy: German *schwer* ‘heavy’ is compatible with a measure phrase (Schwarzschild 2005).

As for the second parameter, we speculate that there is a principled reason for the split between Japanese, on the one hand, and Spanish, Korean, and Russian, on the other. Recall that in our analysis of Japanese, comparative semantics is provided by *yori* in sentences where there is an overt standard of comparison:

(88) Kono tana-wa ano tana-*yori* (2-meetoru) takai.
    this shelf-TOP that shelf-than 2-meter tall
    ‘This shelf is (2 meters) taller than that shelf.’

In the absence of an overt standard of comparison, *yori*, as an adposition, is syntactically disallowed, and so when a measure phrase is present, a covert comparative operator arises through coercion:

(89) Kono tana-wa 2-meetoru *Cs* takai.
    this shelf-TOP 2-meter tall
    ‘This shelf is 2 meters taller.’

We suggest that the crucial difference in Spanish, Korean, and Russian is that comparative semantics is provided not by the standard marker but rather by morphology that attaches to the gradable adjective (*más* in Spanish, *te* in Korean, and inflectional morphology on the adjective itself in Russian).20

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20 This proposal commits us to the view that in languages that have overt comparative morphology (Spanish, Korean, Russian), the semantics of comparison is located on the comparative morphology itself, whereas in languages that lack overt comparative morphology (Japanese), the semantics of comparison is located on the standard morphology.
We suggest that the comparative morphology in these languages blocks the use of the covert coercion operator posited for Japanese. The principle at work here can be thought of as a version of Chierchia’s (1998) Blocking Principle, whose original wording is provided here:

(93) **Blocking Principle** (‘Type shifting as last resort’)

For any type shifting operation \( \tau \) and any \( X \):

*\( \tau(X) \) if there is a determiner \( D \) such that for any set \( X \) in its domain,\n  
\( D(X) = \tau(X) \)

(Chierchia 1998:360)

Although as conceived, the Blocking Principle is specific to competition between covert type shifters and overt determiners, we suggest that it can be generalized to competition between any covert coercion operator (whether it type shifts or shifts in some other way, as in de Swart’s aspect shift or our scale shift) and any functional morpheme (whether a determiner or, as in our case, a comparative morpheme). The only caveat is that the competition must be between items that have the same syntactic distribution.

Our modified version of Chierchia’s Blocking Principle is as follows:
(94) Blocking Principle ('Coercion as last resort')
For any coercion operator Op and any X:
*Op(X) if there is a functional morpheme F such that for any argument X in its domain, F(X) = Op(X) and F has the same syntactic distribution as Op.

Thus in Spanish, Korean, and Russian, the syntactic availability of overt comparative morphology blocks the introduction of a covert operator. In Japanese, on the other hand, because comparative semantics is provided by *yori, which syntactically requires an overt standard, Cs (i.e., the coercion operator for scale shift) is not blocked, and hence coercion results.

8 Conclusions
In this paper we investigated the syntax and semantics of measure phrases in Japanese and proposed an analysis that addresses crosslinguistic variation in the interpretation of measure phrases. We argued that the interpretation of measure phrases in Japanese is sensitive to scale structure such that (i) the functional head Meas that introduces measure phrases selects only for gradable predicates that have a minimal element and (ii) violations of this restriction are repaired via coercion, which forces a comparative interpretation with a contextually determined standard and hence a minimal element.

We extended our analysis of the interpretation of Japanese measure phrases and argued that the requirement of having a minimal element in order to compute measurement is not specific to Japanese but rather is universal. We showed that languages may vary in how they deal with potential violations of the universal semantic constraint, including coercion of a contextually recoverable derived minimum element (e.g. Japanese), ungrammaticality (e.g. Spanish, Korean, Russian), and a hybrid system of ungrammaticality for some adjectives and allowed constraint violation for others (e.g. English, German, Italian).
A major theoretical implication of this proposal is that the interpretation of measure phrases is sensitive to scale structure. Scalar sensitivity in the interpretations of measure phrases is another piece of supporting evidence for positing scale structure (i.e., open vs. closed) as a linguistically significant parameter in the lexical semantics of adjectives (Kennedy and McNally 2005).

Furthermore, our analysis sheds new light on the typology of measure phrase interpretation. We showed that Schwarzschild’s crosslinguistic generalization—that every language that allows absolute measurement (a measure phrase with a positive form adjective) also allows differential measurement (a measure phrase with a comparative form) but not vice versa — can be subsumed under a broader semantic generalization. Namely, if a language allows measurement in the absence of a minimal element, then it allows measurement from a minimal element, but not vice versa. The apparent opposition between comparative and non-comparative adjectives with respect to measure phrase acceptability is actually an opposition between predicates that have a minimal element and predicates that do not.

This paper leaves open a number of topics to be explored, and we close by mentioning three of them. First, a broader typological survey needs to be conducted in order to test our theory. We have not yet encountered languages which behave similarly to Japanese in the interpretation of measure phrases, but our theory predicts that if a language does not use comparative morphology for differential measurement and also does not allow measure phrases with a lexically idiosyncratic set of open scale adjectives, it should behave like Japanese in exhibiting ‘scale shift’ coercion.

Second, there is a question of whether there are languages that allow absolute measurement in a fully productive way. We observed that languages like English, German, and Italian allow measure phrases with a lexically idiosyncratic set of open scale adjectives; however, we have not seen a language which allows measure phrases to combine with open scale measurable adjectives generally. If such a language exists, then it might support the idea that absolute measure phrases with open scale adjectives constitute another kind of coercion, which turns an open scale into a lower closed scale. Further typological surveys need to be done.
Finally, we observed a tendency for predicates that give rise to absolute measurement to be deverbal (i.e., verb-*teiru* in Japanese), whereas predicates that give rise to differential measurement tends to be adjectival. As far as we know, the verb-*teiru* form never gives rise to coerced differential measurement. Thus it appears that there is a correlation between scale structure (i.e., lower open vs. lower closed) and morphology (i.e., adjectival vs. deverbal); this correlation deserves to be studied in more detail.

**Acknowledgments**

The authors are grateful to Chris Kennedy for valuable discussion and insightful comments on this material. In addition, thanks are due to Peter Alrenga, Anastasia Giannakidou, Russell Lee-Goldman, Yusuke Kubota, an anonymous referee, and the editors of *Natural Language Semantics* for their valuable comments and suggestions. We also wish to thank audience members at ‘In Search of Meaning in the Midwest’ (3rd Annual Midwest Semantics Workshop) at the Ohio State University in October 2008, a Semantics Lab meeting at the University of Chicago in October 2008, and the 35th Annual meeting of the Berkeley Linguistics Society in February 2009, where earlier versions of this work were presented. Finally, we are grateful to our native informants of Spanish, Korean, Russian, and Japanese. This paper is based upon work supported by the National Science Foundation under Grant no. BCS-0620241 to Chris Kennedy.

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