Aspectual composition with motion verbs in Japanese: A scale-based account

1 Introduction

Motion verbs are known to exhibit complex aspectual properties cross-linguistically and their classification and analysis are often problematic, raising important issues for lexical semantics research. Japanese is no exception in this respect (see Tsujimura 1994; Kageyama 1997; Matsumoto 1997; Ueno 2007; Iwamoto 2008; Kitahara 2009 for some previous studies). There are essentially three interrelated issues in this empirical domain.

First, motion verbs exhibit the phenomenon of VARIABLE TELICITY, whereby the sentence is ambiguous between telic and atelic interpretations, when they occur with path-denoting expressions (*walk the trail in/for three hours*). Variable telicity is a phenomenon that is observed in a much wider domain of aspectual composition, including degree achievements (*straighten in/for 3 minutes*) and verbs that take incremental themes (*eat the apple in/for 3 minutes*). The parallel between motion verbs and such constructions have often been noted in the literature (see, for example, Tenny 1994; Jackendoff 1996; Krifka 1998), but how to explain their parallel behavior in a theoretically principled manner is still an open question.

Second, motion verbs pose an interesting challenge to an otherwise robust tendency in lexicalization patterns that has come to be known as the MANNER/RESULT COMPLEMENTARITY (Rappaport Hovav and Levin 2010). This principle states that non-stative verbs across languages are classified into two broad groups of 'manner' verbs (such as *sing*, *dance*, *flash* and *tremble*) and 'result' verbs (such as *break*, *melt*, *die* and *arrive*). The central prediction of this hypothesis is that verbs encoding the two types of meaning simultaneously are non-existent across languages, despite the fact that there is inherently nothing inconsistent or incoherent about such concepts themselves. Certain (putative) counterexamples to the manner/result complementarity have been raised in the recent literature (see, e.g., Beavers and Koontz-Garboden 2012; Husband 2011), and the type of meaning expressed by manner

of motion verbs (at least in some languages including Japanese) seem to be similar to such apparent counterexamples. Manner of motion verbs such as *aruku* 'walk', *hasiru* 'run' and *nagareru* 'flow' intuitively entail change of location and at the same time specify the manner in which the change of location comes about.[1]

Third, and finally, there is the question of how to situate motion verbs in any given language—Japanese in the present case—in a wider typological perspective. It has often been suggested in the literature that Japanese exemplifies the class of so-called verb-framed languages in the Talmian typology, in which the notion of motion is encoded in the verb rather than in a 'satellite' (Matsumoto 1997; see also Miyajima 1984). However, recent rethinking of the Talmian typology (Kageyama 1997; Ono 2009; Beavers et al. 2010) suggests that the original Talmian typology which presupposes a binary classification of all languages into the two broad classes of 'verb-framed' and 'satellite-framed' languages is too coarse, and that the typology itself needs to be rearticulated to accommodate more nuanced patterns exhibited by the world's languages. As I discuss below, Japanese also exhibits patterns that do not fit neatly into the traditional characterization as a verb-framed language. But there is currently no consensus as to what a more adequate typology would be and how the empirical patterns exhibited by Japanese is to be captured in a revised typological classification. Any adequate analysis of motion verbs in Japanese should address this larger theoretical issue.

The goal of the present paper is to shed a new light on these questions by formulating an

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[1]I hasten to add here that the relationship between lexically-encoded meaning (which is a theoretical notion) and entailment (which can be diagnosed directly) is subtler than often assumed. This is an important point and I will return to it in section 3.2. But note crucially that, unless one states explicitly the conditions under which some implication of the sentence is to be taken to reflect lexically-encoded meaning, the hypothesis itself becomes irrefutable and thus vacuous. Thus, Rappaport Hovav and Levin's (2010, 23) own standpoint according to which they 'take lexicalized meaning to be those components of meaning that are entailed in all uses of (a single sense of) a verb, regardless of context' gives us a good starting point. According to this criterion, as I discuss in the next section, Japanese manner of motion verbs clearly count as a counterexample to the manner/result complementarity.

explicit analysis of motion verbs in Japanese, building on a new strand of research in lexical semantics which takes the notion of SCALE as a primitive (Hay et al. 1999; Kennedy and McNally 2005; Kennedy and Levin 2008; Beavers 2013; Piñón 2008; Kennedy 2012). The scale-based approach has already been successfully applied to complex empirical phenomena in the aspectual domain, most notably, the variable telicity effects of degree achievements (Kennedy and Levin 2008) and also incremental theme verbs (Piñón 2008; Kennedy 2012). However, since this line of research is still relatively new, there are many empirical domains to be explored and theoretical questions to be investigated, especially in relation to broader implications for lexicalization patterns and crosslinguistic typology. In view of this, motion verbs provide a particularly attractive domain of inquiry, given the set of empirical and theoretical problems that they invoke (as outlined above). The present paper aims to address these problems. The paper is structured as follows. In section 2, I lay out the key empirical data involving motion verbs in Japanese. I then present a scale-based analysis of these data in section 3, formulating an explicit analysis of variable telicity in aspectual composition. In section 4, I provide a brief comparison of the proposed analysis with two major previous proposals. I conclude the paper in section 5, by offering somewhat speculative remarks on larger typological implications of the proposed approach.

2 Motion verbs and their aspectual properties

As noted by previous authors (see especially Kageyama (1997), Ueno (2007) and Kitahara (2009)), motion verbs in Japanese can be classified into two types: MANNER OF MOTION VERBS and DIRECTIONAL MOTION VERBS. Examples of each type are given in (1):[2]

(1)   a. **manner of motion verbs**

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[2]In addition to the two types of verbs listed in (1), there are verbs that denote goal-oriented changes of location such as *tuku* 'arrive' and *hairu* 'enter'. These verbs and directional motion verbs have in common the property that they take -*ni*-marked goal phrases. I set aside these verbs here, however, since they do not exhibit any aspectually complex properties (in particular, these verbs are not compatible with path phrases) and can therefore be simply analyzed as achievement verbs.

aruku 'walk', *hasiru* 'run', *nagareru* 'flow', *oyogu* 'swim', *korogaru* 'roll'

b. **directional motion verbs**

noboru 'ascend', *oriru* 'descend', *agaru* 'ascend', *sagaru* 'descend', *susumu* 'proceed', *modoru* 'return'

Intuitively, the two types of verbs contrast with one another in terms of what aspect of motion events they lexically encode: directional motion verbs encode the directionality of motion whereas manner of motion verbs encode the manner in which something moves. In other words, manner of motion verbs do not themselves directly encode change of location as their lexicalized meaning, and (underlyingly) they essentially belong to the same class as more prototypical activity verbs such as *odoru* 'dance' and *utau* 'sing'.

Reflecting this basic meaning difference, the two types of verbs contrast with one another both in terms of argument structure and lexical aspectual properties. As often noted in the literature (Yoneyama 1986; Kageyama 1997; Beavers 2008), directional motion verbs are compatible with *-ni*-marked goal phrases whereas manner of motion verbs are not:[3]

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[3]Unlike *-ni*, the postpositions *-made* and *-e(-to)* are compatible with manner of motion verbs:

(i) a. Ken-ga   eki-made   arui-ta.
         Ken-NOM station-till walk-PAST
         'Ken walked to the station.'

     b. Ken-ga   eki-e(-to)   arui-ta.
         Ken-NOM station-toward walk-PAST
         'Ken walked toward the station.'

As noted by several authors (see, e.g., Kageyama (1997); Ueno (2007); Beavers (2008)) the *-made* phrase is not a goal argument but is an adjunct that delimits the event. Thus, (ia) cannot be used as evidence for the claim that Japanese manner of motion verbs are compatible with goal marking. Similarly, as discussed by Kageyama (1997), *-e(-to)* is different from the genuine goal marking by *-ni* in that (ib) does not entail that the station was reached, as evidenced by the fact that the following example does not sound contradictory:

(ii) Ken-wa   eki-e(-to)   arui-ta-ga,   eki-ni-wa   tuka-nakat-ta.
      Ken-NOM station-toward walk-PAST-but station-DAT-TOP arrive-NEG-PAST
      'Ken walked toward the station, but didn't reach it.'

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(2) a. ??Isi-ga   Ken-no **asimoto-ni** korogat-ta/subet-ta.
      pebble-NOM Ken-GEN underfoot-DAT roll-PAST/slide-PAST

      intended: 'A pebble rolled/slid over to Ken's feet.'

    b. Kaisoo-ga   **kaimen-ni** agat-ta   / **kaitei-ni**   sizun-da.
      seaweed-NOM sea.level-DAT ascend-PAST   sea.bottom-DAT sink-PAST

      'The seaweed floated up to the surface / sank down to the bottom of the sea.'

    c. ??Hi-no   tama-ga **taigan-ni**   hikat-ta/moe-ta.
      fire-GEN ball-NOM opposite.bank-DAT flash-PAST/burn-PAST

      intended: 'A fireball went to the opposite bank flashing/burning.'

Manner of motion verbs in Japanese are different from their English counterparts in this respect and behave more like genuine activity verbs, which are similarly incompatible with goal phrases (as in (2c)). The two types of motion verbs are different in terms of their basic aspectual properties as well. As shown in (3), a directional motion verb is telic (with an explicit goal argument) whereas a manner of motion verb is atelic:

(3) a. Ken-wa **3-zikan*(-de)** santyoo-ni   nobot-ta.
      Ken-TOP 3-hour-in   mountaintop-DAT ascend-PAST

      'Ken climbed to the mountaintop in three hours.'

    b. Ken-wa **3-zikan(*-de)** arui-ta.
      Ken-TOP 3-hour-in   walk-PAST

      'Ken walked for three hours.'

But manner of motion verbs (at least in Japanese) are also different from genuine activity verbs in that they entail change of location.[4]

(4) a. #Ken-wa onazi basyo-de aruki-tuzuke-ta.
      Ken-TOP same place-LOC walk-continue-PAST

      intended: 'Ken kept walking in the same place.'

    b. Ken-wa onazi basyo-de odori-tuzuke-ta.
      Ken-TOP same place-LOC dance-continue-PAST

      'Ken kept dancing in the same place.'

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[4]This contrasts with English manner of motion verbs such as *walk* as in *John walked in place for hours*, where not even a relative change of location is entailed. As in (4a) below, a corresponding Japanese example is strictly infelicitous.

Assuming that Ken performed the relevant action on a non-moving floor, (4a) is infelicitous whereas there is nothing wrong with (4b). In other words, the type of activity denoted by manner of motion verbs cannot be performed without resulting in some change of location of the agent or theme. But some caution is needed here in characterizing the notion of change of location. in particular, as noted by Matsumoto (1996b), we need to distinguish between the notions of GEOGRAPHICAL change of location and RELATIVE change of location in discussing the entailments of these verbs. Note that it *is* possible to use manner of motion verbs to describe situations in which no change of location in the geographical sense is entailed:

(5) Ken-wa   ugoku   hodoo-o   hantai-gawa-ni   arui-ta.
     Ken-TOP moving walk-ACC opposite-direction-DAT walk-PAST
     'Ken walked on the moving walk backwards (without changing his position).'

(5) only shows that Japanese manner of motion verbs do not entail geographical change of location (in this respect, they contrast with directional motion verbs, which do have such entailments). Crucially, relative change is still entailed, since, as evidenced by the infelicity of (4a), *aruku* cannot be used to describe a situation in which one just moves one's body parts (legs, etc.) in a 'walking manner' without resulting in any forward movement on a non-moving floor.

Before moving on, I would like to clarify another potential point of confusion, a terminological one. In certain approaches to verb meaning (especially ones based on predicate decomposition), the notion of change of location is taken to be inherently tied to a template of 'result'-type verb meanings (which lexically belong to the class of achievements and are thus necessarily telic), which is taken to be incompatible with 'manner'-type meanings that activity predicates express. This is one typical way in which the manner/result complementarity is accounted for in the literature, especially in decomposition-based approaches to verb meaning. On the basis of this theoretical presumption, one might claim that what manner of motion verbs encode is not change of location but something like 'trajectory along a path'. My use of the term 'change of location' is purely descriptive and is not meant to be tied to

this specific theoretical claim. Readers who subscribe to this assumption should replace my term 'change of location' with 'trajectory along a path' (or whatever equivalent notion they prefer), and no confusion should arise in the ensuing discussion.

In the rest of this section, I go over properties of the two types of motion verbs that motivate a scale-based analysis. What is intriguing in these data is that, notwithstanding the basic lexical aspectual distinction (telic vs. atelic), the two types of verbs show parallel behaviors in many empirical phenomena. Moreover, some of these phenomena neutralize their basic aspectual distinction.[5]

The first such evidence for the 'neutralization' effect comes from compatibility with directional auxiliary verbs *iku* 'go' and *kuru* 'come' (Yoneyama 1986):[6]

(6)   a. Isi-ga   Ken-no   asimoto-ni   korogat-te/subet-te **it-ta**/**ki-ta**.
             pebble-NOM Ken-GEN underfoot-DAT roll-TE/slide-TE   go-PAST/come-PAST
             'A pebble rolled/slid over to Ken's feet.'

      b. Kaisoo-ga   kaimen-ni   agat-te   / kaitei-ni   sizun-de
             seaweed-NOM sea.level-DAT ascend-TE   sea.bottom-DAT sink-TE

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[5]The term 'neutralize' here is meant to be a descriptive term only, without any theoretical content. I use it solely for the purpose of characterizing the superficially observed patterns of telicity (which can be diagnosed by standard tests such as the compatibility with 'in/for'-adverbials) in related, but distinct empirical phenomena.

[6]It is important to make sure that the verbs *iku* and *kuru* are used as auxiliary verbs and not as main verbs in (6), since the *-te* form used to mark the motion verb here has a separate use as a 'conjunction' marker (where the *-te*-marked clause or VP is syntactically subordinate but is semantically related to the tensed main clause in a coordination-like meaning). It is easy to show that the use of *iku* and *kuru* here is not that of a main verb. Note that, if the *-te*-marked motion verbs are removed, the sentences are infelicitous, a fact that would be unexpected if *iku* and *kuru* were functioning as main verbs in (6a) and (6b):

(1)   a.#Isi-ga   Ken-no   asimoto-ni   **it-ta**/**ki-ta**.
           pebble-NOM Ken-GEN underfoot-DAT go-PAST/come-PAST
           intended: 'A pebble moved over to Ken's feet.'

      b.#Kaisoo-ga   kaimen-ni/kaitei-ni   **it-ta**/**ki-ta**.
           seaweed-NOM sea.level-DAT/sea.bottom-DAT go-PAST/come-PAST
           intended: 'The seaweed moved to the surface/bottom of the sea.'

it-ta/ki-ta.
go-PAST/come-PAST

'The seaweed floated up to the surface of the sea / sank down to the bottom of the sea.'

c.??Hi-no   tama-ga taigan-ni   hikat-te/moe-te   **it-ta/ki-ta**.
fire-GEN ball-NOM opposite.bank-DAT flash-TE/burn-TE go-PAST/come-PAST

intended: 'A fireball went to the opposite bank flashing/burning.'

Note that manner of motion verbs pattern with directional motion verbs rather than genuine activity verbs here. Intuitively, this is because directional auxiliaries require their complements to express the meaning of motion. Also, when the directional auxiliary is present, manner of motion verbs become compatible with *-ni*-marked goal phrases. When an explicit goal phrase is present in the directional auxiliary construction, both types of verbs behave as telic predicates (thus, the sentences in (6) are compatible with 'in'-adverbials only).

As noted already by Yoneyama (1986), the existence of directional auxiliary verbs poses a difficulty to a strictly binary classification of language types in Talmy's (1985) work. The incompatibility of goal phrases with manner of motion verbs noted above in (2a) suggests a classification of Japanese as a verb-framed language, but the pattern we see in (6a) seems to show that the verb can encode both the manner and path at the same time, instantiating a pattern that is sometimes called 'equipollent' (cf. Beavers et al. (2010)).

It is not just directional auxiliaries that induce this type of aspectual neutralization. Perhaps a cross-linguistically more commonly found type of aspectual neutralization with motion verbs comes from constructions with path phrases. The pattern in Japanese here is more or less the same as what has been observed in other languages including English (see, for example, Tenny (1994)).

(7)   a. Ken-wa   **sono yamamiti-o**   san-zikan(-de) arui-ta/hasit-ta.
          Ken-TOP that   mountain.trail-ACC three-hour-in   walk-PAST/run-PAST

       'Ken walked/ran that mountain trail in/for three hours.'

       b. Ken-wa   **sono yamamiti-o**   san-zikan(-de) nobot-ta/agat-ta.
          Ken-TOP that   mountain.trail-ACC three-hour-in   ascend-PAST

       'Ken climbed that mountain trail in/for three hours.'

    c.??Ken-wa **sono yamamiti-o** odot-ta/nai-ta.
       Ken-TOP that mountain.trail-ACC dance-PAST/cry-PAST

      'Ken went on that mountain trail by dancing/crying.'

Again, the pattern intuitively makes sense: the key difference between manner of motion verbs and genuine activity verbs is that the former entails change of location whereas the latter does not. This entailment plays a crucial role in licensing a path phrase, an expression that further specifies the path along which the change of location expressed by the verb takes place.

Note moreover that, when they occur with path phrases, both manner of motion verbs and directional motion verbs become aspectually ambiguous. As in (7), for both types of verbs, with the 'in'-phrase *san-zikan-de*, the sentence exhibits the 'total' interpretation which asserts that the path has been moved on from end to end, whereas with the 'for'-phrase *san-zikan*, it exhibits the 'partial' interpretation which only entails that part of the path has been moved on. This ambiguity is essentially parallel to the variable telicity effects found with degree achievement verbs (*The sky darkened in/for three hours*) and incremental theme verbs (*John ate the apple in/for three minutes*), as noted by previous authors (Krifka 1989; Tenny 1994). In the next section, I show that the variable telicity effect observed in the path phrase construction above receives a uniform analysis via the notion of scale structure, which is independently motivated for the analyses of the other two types of phenomena.

There is further evidence for a scale-based analysis of motion verbs. As noted by Kitahara (2009), just like gradable adjectives, the two types of motion verbs can license measure phrases (as in (8)) and degree modifiers (as in (9)):

(8)   a. Ken-wa **300-meetoru** arui-ta/hasit-ta.
         Ken-TOP 300-meter   walk-PAST/run-PAST

         'Ken walked/ran 300 meters.'

   b. Ken-wa (yama-o)   **300-meetoru** nobot-ta/ori-ta.
         Ken-TOP mountain-ACC 300-meter   ascend-PAST/descend-PAST

         'Ken ascended/descended (the mountain) 300 meters.'

(9) a. Ken-wa   sono yamamiti-o   {**sukosi**/**hanbun**/**hotondo**}
Ken-TOP that mountain.trail-ACC   a little/half/almost
arui-ta/hasit-ta.
walk-PAST/run-PAST

'Ken walked/ran {some/half/most} of the mountain trail.'

b. Ken-wa   sono yamamiti-o   {**sukosi**/**hanbun**/**hotondo**}
Ken-TOP that mountain.trail-ACC   a little/half/almost
nobot-ta/ori-ta.
ascend-PAST/descend-PAST

'Ken ascended/descended {some/half/most} of the mountain trail.'

A related, yet less often discussed type of evidence for a parallel between the two types of verbs (which the analysis I propose below captures explicitly by an (extended) notion of scale) comes from modification by incremental measurement modifiers (called the 'N-by-N modifiers' by Henderson (2013)). In Japanese, expressions such as *ippo-ippo* 'step by step', *itidan-itidan* 'step by step' (for stairs), *itimai-itimai* 'piece by piece', *N-zutu* 'N-by-N' belong to this type of modifiers. As discussed by Henderson (2013), these expressions impose a condition on the unfolding of a change such that the change occurs in increments and that each of these increments has the length of one unit by the measurement scale named. For evidence that this type of modifier is incompatible with non-scalar predicates, see Henderson (2013). The two types of motion verbs are both compatible with these incremental modifiers:

(10) a. Ken-wa   sono yamamiti-o   **ippo-ippo**/**ippo-zutu** arui-ta.
Ken-TOP that mountain.trail-ACC step-step/stepwise   walk-PAST
'Ken walked the mountain trail step by step.'

b. Ken-wa   sono yamamiti-o   **ippo-ippo**/**ippo-zutu** nobot-ta.
Ken-TOP that mountain.trail-ACC step-step/stepwise   ascend-PAST
'Ken ascended the mountain trail step by step.'

Finally, the two types of motion verbs show a parallel behavior with respect to what I here call 'path-denoting adverbial clauses', exemplified by the following data:

(11) a. yuruyakana saka-o   nobot-te   hasiru-to, . . .
gentle   slope-ACC ascend-TE run-as
'as you drive on the gentle slope, . . . '

    b. sanryou-zoini Yokoo-yama-o   koe-te   arui-ta-node
       ridge-along   Mt. Yokoo-ACC go.across-TE walk-PAST-because

       'because we walked across Mt. Yokoo along the ridge'

(12)   a. sonogo, … yama-o   koe-te   susun-da.
       then   mountain-ACC go.across-TE proceed-PAST

       'then, we went across the mountain'

    b. dangai-no yama-ni-wa   doragon-o   katadot-ta tonneru-o   toot-te
       cliff-ACC   mountain-DAT-TOP dragon-ACC modelled   tunnel-ACC go.through-TE
       noboru-koto-ga   deki,
       ascend-NMLZ-NOM possible

       'it is possible to go through the dragon-modelled tunnel to the top of the cliff'

In these examples, there is an adverbial clause headed by a directional motion verb marked by *-te* which modifies the main clause (which is headed by either a manner of motion verb or a directional motion verb). The adverbial clause indicates the structure of the path for the motion entailed by the main verb.[7] So far as I am aware, this type of sentences have not been discussed in the literature, but attested examples can be easily found (as in (11) and (12)). These examples are similar to the examples involving path phrases and directional auxiliaries discussed above in that, intuitively speaking, both the main verb and a 'modifier' simultaneously characterize the 'scale' (in a suitably extended sense) involved in the event described by the sentence. It should also be noted that, like directional auxiliary verbs, the existence of this construction is somewhat at odds with the standardly accepted classification of Japanese as a verb-framed language in the Talmian typology since the path is encoded in a modifier clause rather than the verb in the examples in (11) where the verb in the main

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[7]For many examples of this type, due to the ambiguity of the *-te* form noted above, there is an alternative interpretation—irrelevant for the present discussion—where the events denoted by the adverbial clause and by the main clause occur in a temporal sequence ('A and then B').

clause is a manner of motion verb.

3   A scale-based analysis of motion verbs

In this section, I propose an analysis of motion verbs in Japanese by building on recent scale-based approaches to verb meaning. The analysis I formulate below follows previous research in this domain by taking the notion of scale as a primitive and exploiting the notion of SCALE STRUCTURE (which distinguishes between open-ended and closed scales) as a key analytical concept. At the same time, the present work goes beyond previous research by further articulating the operations involved in aspectual composition with the notion of SCALE COMPOSITION. I show that this extension of the scale-based approach proves useful in characterizing the empirical properties of motion verbs in Japanese reviewed in the previous section. In particular, the proposed analysis explains both the similarities and differences between the two types of motion verbs naturally, offering a principled account of their variable telicity properties while also capturing their basic aspectual distinction. The present approach also has interesting implications for the other two issues noted in section 1, namely, lexicalization constraints and the typological classification of Japanese verbs. Since addressing these latter points requires situating the present work in the context of a wider literature both empirically and theoretically, I defer discussions of these points to sections 4 and 5, respectively.

Before moving on, a brief comment is in order regarding the relationship between the present scale-based approach and the previous literature. First, it should be noted that the notion of scale, as applied to the analysis of motion verbs in what follows, should be understood in an extended sense, and that trying to draw a direct analogy to the adjectival domain is sometimes misleading. Though there is an obvious intuitive connection between the two empirical domains, and the very use of the notion of scale is meant to capture that connection explicitly, it should be kept in mind that the analysis of motion verbs presented below should primarily be understood and evaluated by and of itself. I will explain all the underlying notions and assumptions necessary to make sense of the proposed analysis and its

predictions, independent of the way the notion of scale is understood in the previous literature.

Second, as noted briefly in the introduction, the parallel between path constructions, degree achievements and incremental theme verbs in the way verbal telicity is affected by the mereological structures of the dependents of the verb has been noted by many previous authors. One major approach to this parallel is to take the path construction to be the most basic and extend the analysis to other cases by making the notion of 'path' suitably abstract (for example, see Tenny (1994) and Krifka (1998) for general suggestions along these lines; Zwarts (2005) for an empirical application of the path-based approach to English path-denoting prepositional phrases, and Zwarts and Winter (2000) for precise mathematical foundations for the notion of path).

The scale-based approach I adopt here (which has already been extended to the treatment of incremental theme verbs; cf. Kennedy 2012) embodies similar analytic intuitions overall as the path-based approach proposed by these authors (or, for that matter, the more general mereological approach due to Krifka (1989, 1992)), but there is one important difference between the two that becomes crucial in the formulation of the specific analysis of aspectual composition I formulate below: in the scale-based analysis of aspectual composition, the notions of SCALE STRUCTURE and STANDARD OF COMPARISON on a scale play crucial roles in predicting the variable telicity effects. This is an important theoretical point, since how to provide a principled account of variable telicity is the central question in any analysis of aspectual composition but previous approaches have failed to offer a completely successful solution to this problem. This point was originally argued at length by Kennedy and Levin (2008) with respect to degree achievements in English. I will show below that, by extending this approach to motion verbs in Japanese, a similarly simple and explicit analysis of aspectual composition becomes available, which at the same time has certain interesting implications for the more general issue of lexicalization. So far as I am aware, there is no direct analog of the notions of scale structure and standard of comparison in path-based (or mereological) approaches, and current accounts of aspectual composition in these approaches (such as Tenny

(1994) and Jackendoff (1996))—though similar in spirit to the scale-based analysis I propose below—remain at fairly intuitive levels as to how exactly the formal details of aspectual composition is to be worked out (including an account of variable telicity). Though a detailed comparison of the two approaches is beyond the scope of the present paper, I believe that the simple analysis of aspectual composition that the scale-based approach offers exploiting the independently motivated scalar notions makes it at least an interesting alternative to the perhaps more familiar path-based approach.

3.1 Measure functions

There are various ways of representing verb meanings by taking the notion of scale as a basis. Here, I adopt the MEASURE FUNCTION-based approach by Kennedy and Levin (2008) (K&L). The notion of measure function enables one to talk about events associated with verbs in scale-based terms conveniently, and it also lends itself to a relatively simple technical implementation. In this section, I review K&L's analysis of degree achievements and introduce the basic ingredients of a scale-based analysis of verb meaning. The central goal of K&L's work is to explain the different telicity effects observed with degree achievement verbs in English, found in data such as the following:

(13) a. The rod straightened in/for 3 hours.

b. The box emptied in/for 3 hours.

c. The shirt dried in/for 3 hours.

(14) a. The rope lengthened #in/for 3 hours.

b. The hole widened #in/for 3 hours.

c. The fog thickened #in/for 3 hours.

As shown in (13) and (14), verbs such as *straighten*, *empty* and *dry* allow for both telic and atelic interpretations whereas verbs such as *lengthen*, *widen* and *thicken* allow only for an atelic interpretation (thus, *in*-PPs are infelicitous for them except in special contexts in

which some fixed upper bound is set up).[8]

The key analytic intuition behind K&L's proposal is that this difference reflects the different structures of the scales associated with the underlying adjectives. Specifically, adjectives such as *straight*, *empty* and *dry* (underlying the verbs in (13)) are associated with scales with maximum endpoints (such adjectives are called MAXIMALLY CLOSED SCALE adjectives), and their truth is determined in reference to that endpoint. That is, the sentence *The rod is straight* is true just in case the rod is completely straight. By contrast, adjectives such as *long*, *wide* and *thick* (underlying the verbs in (14)) are associated with scales that do not have any such fixed endpoints (OPEN SCALE adjectives). For these adjectives, the truth is determined in reference to some contextually determined threshold; thus, *The rod is long* is true just in case the length of the rod exceeds some contextually determined length standard. In verbal predication, both examples in (13) and (14) have an atelic reading that asserts that there was some change in degree in the relevant property from the initial state, but (13) additionally has a telic reading which asserts that the endpoint of the original adjectival scale was reached.

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[8]I set aside the inchoative reading ('took N time to start Ving'). As shown by the example in (i) involving a stative verb, inchoative readings are generally available regardless of the lexical aspect of the predicate, and hence should be treated by a separate mechanism.

(i)   I suddenly fell asleep and then was awake in three hours.

Relatedly, one might think that the following type of example would pose a problem for K&L's approach since the sentence appears to be interpreted in both the telic and atelic readings at the same time:

(ii)   The rod straightened in a minute, but only for ten minutes.

But note that the first conjunct *in a minute* is interpreted in the inchoative sense, not the real telic sense (in the sense of K&L), the latter of which targets the maximum endpoint of the scale. This type of 'zeugmatic' conjunction of telic/atelic readings seems generally available if the 'telic' reading is an instance of an inchoative reading:

(iii)   I was awake in an hour but only for three hours.

K&L formulate their analysis within the general setup of SCALE-BASED semantics (Kennedy and McNally 2005; Kennedy 2007), in which degrees are taken to be primitives. The set of semantic types thus includes d for degrees together with other standard semantic types such as e (for individuals), t (for truth values) and i (for temporal intervals). Degrees can be formally modelled by some kind of dense ordering, typically an interval of real numbers between 0 and 1 with possibly the maximal and the minimal elements, depending on the structure of the scale. I leave aside the exact formal implementation of the notion of scale since it is not crucial for either K&L's analysis of degree achievements or its extension I propose below.

The notion of MEASURE FUNCTION plays a key role in K&L's analysis of degree achievements. Intuitively, a (verbal) measure function is a function which keeps track of the progress of the process or event associated with the verb along the timeline. For a degree achievement verb, the measure function is a function that measures the amount of degree change in the relevant property (for example, for *straighten*, this is the degree of straightness) over the course of some temporal interval.[9] Formally, such verbal measure functions are obtained from the underlying adjectival measure functions via the process of measure function conversion. For example, the measure function for the verb *straighten* is defined on the basis of the underlying adjectival measure function **straight** (of type $\langle e, d \rangle$) as a measure function of type $\langle e, \langle i, d \rangle \rangle$ (which I abbreviate as μ in what follows) as in (15):

(15) $[\![\text{straighten}]\!] = \lambda x \lambda t.\textbf{straight}^{\uparrow}_{\textbf{straight}(x)(\textbf{init}(t))}(\textbf{fin}(t))$

The subscript $\textbf{straight}(x)(\textbf{init}(t))$ and the uparrow $\uparrow$ together indicate that this measure function has a (derived) minimum endpoint corresponding to the straightness of x at the beginning of t. The measure function returns a differential (or comparative) degree that designates the relative degree of straightness of x at the end of t measured against this minimum

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endpoint.[10] Truth relative to intervals is determined by the following verbal *pos(itive)* morpheme, which is an operator of type $\langle \mu, \langle e, \langle i, t \rangle \rangle \rangle$ that takes a verbal measure function (of type μ) and returns a predicate of individuals relative to temporal intervals of type $\langle e, \langle i, t \rangle \rangle$ (here and in what follows, I use the letter $\mathcal{M}$ for writing variables over measure functions of type μ):

(16) $[\![pos_v]\!] = \lambda \mathcal{M} \lambda x \lambda t.\mathbf{stnd}(\mathcal{M}, \mathcal{M}(x)(t))$

The *pos* operator in (16) says that a sentence containing a verb that denotes a measure function is true just in case the degree that the verbal measure function returns for the interval at which it is evaluated satisfies the 'standard' value of the scale associated with the verbal measure function. Thus, the notion of standard plays a crucial role in defining the truth conditions for sentences containing degree achievements. Unlike Kennedy (2007) and K&L, who take the **stnd** operator to be a function returning the degree corresponding to the (unique) standard value associated with a measure function, I take **stnd** to be a relation between measure functions and degrees, following the relational definition of standard in Kennedy and McNally (2005).[11] More specifically, I assume that the **stnd** relation is defined as follows:

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[10]This essentially amounts to the claim that the semantics of degree achievements contains that of comparatives at its core. See Bobaljik (2012, chapter 5) for cross-linguistic morphological evidence for this assumption.

[11]The functional definition of **stnd** in Kennedy (2007) is potentially problematic for measure functions with both minimum and maximum endpoints (such as those for adjectives like *transparent* and *open*, and degree achievements like *straighten*). For such fully closed scales, both endpoints should be made available as the standard value, but a function, by definition, always returns a unique value for any given input. One might argue that this problem can be avoided by making the **stnd** function sensitive to an additional (perhaps lexical) parameter. While such a move seems indeed motivated for deverbal adjectives—see Kennedy and McNally (2005) for some discussion on the way in which the standard is chosen for deverbal adjectives on the basis of the event structure of the underlying verbs—the nature of the additional parameter is unclear for degree achievements. For this reason, I will not explore this possibility and simply adopt the relational definition of standard due to Kennedy and McNally (2005).

(17) If both **MIN**($\mathcal{M}$) and **MAX**($\mathcal{M}$) are well-defined, then either of the following holds:

- for any degree $d > \mathbf{min}(\mathcal{M})$, $\mathbf{stnd}(\mathcal{M}, d)$, or

- $\mathbf{stnd}(\mathcal{M}, \mathbf{MAX}(\mathcal{M}))$.

Otherwise,

- if **MIN**($\mathcal{M}$) is well-defined, then for any degree $d > \mathbf{min}(\mathcal{M})$, $\mathbf{stnd}(\mathcal{M}, d)$;

- if **MAX**($\mathcal{M}$) is well-defined, then $\mathbf{stnd}(\mathcal{M}, \mathbf{MAX}(\mathcal{M}))$.

Otherwise, for any $d \geq d'$ where d' is the contextual threshold of $\mathcal{M}$-ness, $\mathbf{stnd}(\mathcal{M})(d)$.

The definition may look somewhat complicated, but the underlying idea is simple: the endpoints of the scale 'stand out' (cf. Kennedy (2007)), and, as such, if there are endpoints, they are are always candidates for the standard. Thus, in the case of fully closed scales, either the maximal or the minimal endpoint is chosen as the standard of comparison for determining the truth of the sentence. If there is only one endpoint, then the standard is fixed to that endpoint. Finally, if the scale does not come with any endpoint, the standard value is simply fixed to the vague contextual threshold.

MAX and **MIN** are functions that take a measure function as an argument and return the maximum and minimum values on the scale associated with that measure function (if there are any). The definitions of these functions are straightforward (here, **image** is a function that takes a function as an argument and returns the image of that function):

(18) a. $d = \mathbf{MIN}(\mathcal{M})$ iff $d \in \mathbf{image}(\mathcal{M}) \wedge \neg \exists d'[d' \in \mathbf{image}(\mathcal{M}) \wedge d' < d]$

b. $d = \mathbf{MAX}(\mathcal{M})$ iff $d \in \mathbf{image}(\mathcal{M}) \wedge \neg \exists d'[d' \in \mathbf{image}(\mathcal{M}) \wedge d' > d]$

Given the definition of standard in (17), the ambiguity of (13) (and the lack thereof for (14)) then follows straightforwardly. The crucial assumption is that the scale for the measure function for verbs like *straighten* has *both* a maximum and a minimum endpoint. The maximum endpoint is the one corresponding to the lexically specified endpoint for the underlying adjective (which designates the state of there being no bend) and the minimum endpoint is the derived endpoint designating the initial degree. It is independently known

that, in the adjectival domain, for predicates with both a maximum and a minimum endpoint, both of these endpoints are possible candidates for the standard for truth evaluation (Kennedy and McNally 2005; Kennedy 2007). Assuming the null hypothesis that the same principle for standard setting is operative in the verbal domain as well, we have an explanation for the observed ambiguity. If the standard is set to the minimum endpoint (corresponding to the initial degree), we obtain a differential (or atelic) interpretation which is true just in case the final degree is larger than the initial degree (i.e., if there was some positive change in degree in the relevant interval). If, on the other hand, the standard is set to the maximum endpoint, the sentence is true just in case the maximum endpoint is reached by the end of the relevant interval. This results in a telic reading which, for (13a), says that the rod became completely straight. With verbs like *lengthen* in (14), the scale associated with the measure function has only a minimum endpoint designating the initial degree. Thus, it follows that such sentences have only the atelic, differential interpretation.

3.2 Measure functions for motion verbs

I now extend the scale-based analysis of verb meaning to motion verbs. It should be noted at the outset that, unlike degree achievements (for which the underlying gradable adjectives makes the relevance of the notion of scale relatively uncontroversial), motivations for a scalar analysis may not be so obvious initially. However, I believe that exploring this possibility is worthwhile and I will argue below that the main advantage of adopting a scale-based approach is that it offers a principled and unified account of aspectual composition across different domains that is otherwise not easily available in other approaches (or, at the very least, a detailed compositional analysis of the same or similar set of data as analyzed below has not yet been offered in other approaches).

Of the two types of motion verbs in Japanese, a scale-based approach is perhaps easier to motivate for directional motion verbs, given that their meanings are more closely tied to the notion of path than manner of motion verbs. I assume that the directional motion verb *noboru* 'ascend' is of type $\langle \mathrm{e}, \mu \rangle$ lexically and denotes a verbal measure function of type μ by

combining with a goal argument:[12]

(19) $[\![\text{noboru}]\!] = \lambda y \lambda x \lambda t.\mathbf{ascend}(y)(x)(t)$

(21) illustrates an analysis for a simple sentence (20) containing a directional motion verb.

(20) Ken-ga   santyoo-ni   nobot-ta.
      Ken-NOM mountaintop-DAT ascend-PAST

      'Ken climbed to the mountaintop.'

(21) $\exists t.t < \mathbf{now} \wedge \mathbf{stnd}(\mathbf{ascend}(\mathbf{mt\text{-}top}), \mathbf{ascend}(\mathbf{mt\text{-}top})(\mathbf{k})(t))$

$\lambda P \exists t.t < \mathbf{now}$ $\lambda t.\mathbf{stnd}(\mathbf{ascend}(\mathbf{mt\text{-}top}), \mathbf{ascend}(\mathbf{mt\text{-}top})(\mathbf{k})(t))$
$\wedge P(t)$

$\mathbf{k}$ $\lambda x \lambda t.\mathbf{stnd}(\mathbf{ascend}(\mathbf{mt\text{-}top}), \mathbf{ascend}(\mathbf{mt\text{-}top})(x)(t))$
Ken-ga
'Ken' $\lambda \mathcal{M} \lambda x \lambda t.$ $\lambda x \lambda t.\mathbf{ascend}(\mathbf{mt\text{-}top})(x)(t)$
         $\mathbf{stnd}(\mathcal{M}, \mathcal{M}(x)(t))$
         pos_v $\mathbf{mt\text{-}top}$ $\lambda y \lambda x \lambda t.\mathbf{ascend}(y)(x)(t)$
                    santyoo-ni   nobot-ta
                    'mountaintop-DAT'   'ascend-PAST'

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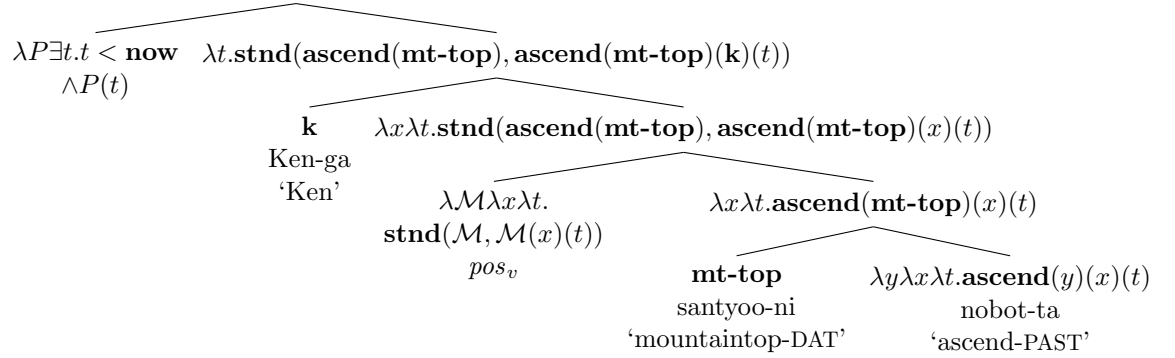
[12]It should be noted that not all -*ni*-marked phrases for the verb *noboru* denote goals. For example, while both (ia) and (ib) are grammatical, unlike (ia), in (ib) the -*ni*-marked phrase simply designates the location (and hence it lacks the entailment present in (ia) that the top of the mountain is reached).

(i)   a. Taroo-ga santyoo-ni   nobot-ta.
          Taro-NOM mountaintop-DAT ascend-PAST
          'Taro climbed to the mountaintop.'

      b. Taroo-ga Fujisan-ni   nobot-ta.
          Taro-NOM Mt. Fuji-DAT ascend-PAST
          'Taro climbed Mt. Fuji.'

This explains why the former but not the latter is compatible with the lexical compound verb *nobori-tumeru*, which requires the -*ni*-marked phrase to designate a specific goal point:

(ii) a. Taroo-ga santyoo-ni   nobori-tume-ta.
          Taro-NOM mountaintop-DAT ascend-complete-PAST
          'Taro climbed to the mountaintop.'

      b.??Taroo-ga Fujisan-ni   nobori-tume-ta.
          Taro-NOM Mt. Fuji-DAT ascend-complete-PAST
          intended: 'Taro climbed Mt. Fuji completely.'

By combining with some goal argument, (19) returns a measure function (recall from above that measure functions are functions of type $\mu = \langle e, \langle i, d \rangle \rangle$). In (21), the measure function $\lambda x \lambda t.\textbf{ascend}(\textbf{mt-top})(x)(t)$ measures how much upward movement x has undergone over the course of t, with the mountaintop designating the goal of that upward-directed motion. How exactly we define the mapping between degrees on the scale and the actual length that the degree models is not crucial, but for the sake of concreteness, I assume that degrees are real numbers corresponding to the values on the metric system (i.e. degree 1 corresponds to one meter). Thus, for example, if the height difference of Ken at the initial and final points of t is 30 meters, then $\textbf{ascend}(\textbf{mt-top})(\textbf{k})(t) = 30$.

Manner of motion verbs, by contrast, are basically activity verbs and modelling their lexical meanings by means of scales does not seem plausible (it is unclear what scale would be involved and what the degrees on that scale would represent). I will thus treat them simply as non-scalar one-place predicates (relativized for a temporal interval parameter) of type $\langle e, \langle i, t \rangle \rangle$. Thus, $\textbf{walk}(\textbf{j})(t)$ is true just in case John walked at the interval t.[13]

As noted in section 2, there is an important difference between manner of motion verbs and other more prototypical activity verbs which makes the former a subtype of motion verbs. Unlike prototypical activity verbs, manner of motion verbs denote activities that necessarily entail change of location (cf. the contrast between (4a) and (4b)). I assume that this entailment associated with manner of motion verbs invokes a derived measure function that measures the length of path that tracks the change of location resulting from the named activity. This measure function derivation operation (of type $\langle \langle e, \langle i, t \rangle \rangle, \mu \rangle$) can be formalized as a lexical rule that takes the original lexical entry of a manner of motion verb and returns a derived entry like (22):

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[13]Here, I will not address the issue of exactly under what conditions an activity predicate is judged true (how many steps does John need to minimally make, how much of the total interval t does he have to be engaged in walking, etc.?). Activity predicates are inherently vague, and though important for a complete understanding of their meanings, this issue is largely orthogonal to aspectual composition, which is the main topic of the present paper.

(22)　**path** ($[\![\text{aruku}]\!]$) $= \lambda x \lambda t.\textbf{path}(\textbf{walk})(x)(t)$

I assume that the underlying scale for the measure function **path**(**walk**) is open-ended on both ends. Length is measured from the zero point and there is no point in talking about minus length, but just like the vague adjective *tall* is by assumption associated with a totally open scale (despite the fact that minus length doesn't make sense for tallness either), I assume that the vague verbal predicate *aruku* is associated with an open scale. Also, I keep assuming that the degrees that the measure function return correspond to numerical values on the metric system. Thus, if Ken has walked 30 meters over the course of t, then **path**(**walk**)(**k**)(t) = 30.

The measure function derivation operation introduced here is similar to aspectual coercion operations recognized by some authors (see, e.g., De Swart (1998) for aspectual coercion, and also Iwamoto (2008) for a general approach to aspectual composition in Japanese which relies on coercion and unification; I return to this point at the end of this section). But unlike the more general notion of aspectual coercion (which often heavily depends on contextual factors and world knowledge), the measure function derivation operation that I assume here is strictly based on *uncancellable* entailments that arise (but are distinct) from the lexically-encoded meaning of the verb. From this, it immediately follows that deriving a change of location measure function out of the lexical meaning of a genuine activity verb like *odoru* 'dance' is not an option, even though there is nothing incoherent about the notion of moving along a path in a dancing manner. Also, by applying the **path** operator to the lexically encoded activity meaning of the manner of motion verb, the derived measure function is still not compatible with a goal argument. Like the measure function for open scale degree achievements (such as *lengthen*), the measure function in (22) does not have a maximum endpoint and hence is not compatible with goal phrases indicating definite endpoints.[14]

It may seem somewhat strange to talk about uncancellable entailment that is *distinct* from lexically encoded meaning (is there any such thing to begin with?). But note that if sentence

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[14]One might wonder at this point why English manner verbs (not just manner of motion verbs) freely combine with goal phrases. See section 5 below for some discussion on this cross-linguistic difference.

S expresses some proposition P as its main assertion and additionally has a presupposition Q, and, if, furthermore, P and Q together entail some proposition R, then R is just as uncancellable as P in a felicitous utterance of S, but it does not necessarily have to be part of the *lexically encoded* meaning of (the components of) S. Rather, in this case, R has the status of what one might call a DERIVED ENTAILMENT (Kubota 2012), that is, an entailment that arises from an interaction between the narrower sense of entailment (corresponding to the lexically encoded meaning) and presupposition. The change of location meaning of manner of motion verbs has exactly the status of such a derived entailment. The verb expresses as its lexical meaning only the manner of motion. But it is shared knowledge of competent speakers of Japanese that if the event named by the verb takes place, it inevitably leads to an (at least relative) change of location. Thus, an uncancellable entailment of change of location arises from the lexically encoded meaning of the verb (together with its presupposition), but the change of location entailment itself is not part of the lexically encoded meaning. Note that I am not suggesting here that all change of state meanings should be treated as derived entailments. Which meaning component should be directly encoded as the lexical meaning and which component as a presupposition should be determined for each verb based on a careful examination of its properties.[15]

There are at least two pieces of evidence for the availability of this measure function derivation operation for manner of motion verbs. The first comes from the interpretation of the compound verb V-*sugiru* 'V excessively/over-V' (Yumoto 1997; Nakanishi 2007), which expresses excessive meanings.

(23)   a.   *odori-sugiru*: 'dance too much' (i.e. too much physical activity involved)

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[15]This also means that there can be cross-linguistic differences in this respect. Recall from above that English manner of motion verbs do not entail even relative change of location. Thus, the manner meanings encoded in English and Japanese manner of motion verbs are presumably different in some subtle way such that the former are associated with more abstract and 'pure' manner meanings which do not invoke a derived change of location entailment.

b. *nobori-sugiru*: 'ascend too much' (i.e. ascend to a too high position)

c. *aruki-sugiru*: 'walk too much', ambiguous between:

    i. too much physical activity involved

    ii. too much distance moved

Setting aside the interpretation which entails excessiveness of the number of distinct events (which is available regardless of the verb type), the three types of verbs contrast with one another in the interpretation of this compound verb. As shown in (23), with activity verbs, the excessiveness expressed by *sugiru* pertains to how much the named activity has been carried out. By contrast, with the directional motion verb *noboru* 'ascend', the excessiveness is interpreted in terms of the distance of movement. On the present scale-based approach, this contrast can be naturally captured by assuming that the verb *sugiru* is a verbal measure function intensifier which targets the degree argument associated with the verb (see Nakanishi (2007) for further support for an analysis along these lines). Crucially, with manner of motion verbs, *sugiru* exhibits an ambiguity between the 'excessive activity' interpretation and the 'excessive change of location' interpretation. This ambiguity follows straightforwardly by assuming that a derived change of location measure function is available for these verbs.

A similar pattern is observed with the degree question with *dore-kurai* 'how much'.

(24)   a. *Dore-kurai odot-ta?* 'How much did you dance?'

        (asking about the length of time involved)

    b. *Dore-kurai nobot-ta?* 'How much did you go up?

        (asking about the length of time / the length of physical path involved)

    c. *Dore-kurai arui-ta?* 'How much did you walk?'

        (asking about the length of time / the length of physical path involved)

In addition to the duration interpretation available for all three sentence, this degree question can be interpreted as asking for the physical distance moved with directional motion verbs. Manner of motion verbs pattern like directional motion verbs in allowing for this interpretation

as well. This ambiguity, again, suggests that a derived change of location meaning is available for them.

The analysis of manner of motion verbs via the notion of derived entailment (mediated by the **path** operator introduced above) is clearly related to approaches to aspectual composition that mediate aspectual mismatch (broadly construed) via the notion of COERCION (De Swart 1998). In particular, Iwamoto (2008) proposes an analysis of motion verbs in Japanese in which composition with path phrases is mediated by general principles of conceptual structure unification, assuming a unification-based grammatical architecture (of the sort standardly assumed in HPSG (Pollard and Sag 1994) and LFG (Bresnan 1982)). There is a close connection between the availability of the **path** operator for manner of motion verbs in the present account and the unifiability of the conceptual structures of such verbs and path phrases in Iwamoto's (2008) account. The notion of derived entailment introduced above, however, is much more restricted than the notion of coercion that Iwamoto's unification mechanism relies on, the latter of which encompasses various sorts of inferences that are heavily dependent on world knowledge. I stick to the more conservative entailment-based account here since it suffices to capture the properties of motion verbs in Japanese. Given that an entailment-based account is more specific than a general coercion-based account, other things being equal, it should be relatively straightforward to subsume the former under the latter should the latter turn out to be more adequate in view of a wider range of facts pertaining to aspectual composition in natural language. The main challenge for a general coercion-based approach is how to precisely articulate the notion of coercion so that it does not overgenerate (see Iwamoto (2008) for some initial attempts at addressing this hairy issue). In section 4.1, I offer a more specific comparison between the present approach and Iwamoto's (2008).

3.3   Scale composition

To account for aspectual composition, we need some way of combining the scales contributed by the verb and by other expressions such as path phrases. There are several options conceivable at this point. One possibility would be to introduce the notion of events and specify the

relationship between the measure function contributed by the verb and the one contributed by the path phrase via an event variable associated with the verb. An analysis along these lines would have a close affinity to the familiar mereological approach by Krifka (1989, 1992) with the notions of 'mapping to objects' and 'mapping to events'.

However, in what follows, I will choose to cast my analysis somewhat differently, by eschewing the use of event variables. For one thing, I'd like to resist the temptation of overloading the ontology, which already contains the notion of scale as a primitive. In fact, one of the initial motivations of the scale-based approach to aspectual composition is that we can capture the key intuitions behind event-based approaches by making the notion of scales play (more or less) the same role that events play in event-based approaches. If we overload the ontology carelessly by reintroducing events as primitives, a large part of the initial appeal of the scale-based approach as a (potential) *alternative* to an event-based approach threatens to be lost (or obscured). Another reason to shy away from introducing the notion of events (which is related to the above point) is that once we introduce events and literally 'merge' the measure functions contributed by different components of the sentence into a single measure function associated with the event variable, the 'degrees' that such a measure function are supposed to measure inevitably become highly abstract, without any measurable or otherwise directly observable property in the real world that they correspond to. It is unclear whether any advantages gained by making such a move outweighs its costs.

Thus, instead of overloading the ontology, I will take a simpler and more direct (albeit perhaps less elegant) alternative. I simply model a composite measure function $\mathcal{M}_1 + \mathcal{M}_2$ consisting of original measure functions $\mathcal{M}_1$ and $\mathcal{M}_2$ as a function that takes an object and an interval as arguments and returns a pair of degrees each corresponding to the outputs of the original measure functions. Thus, formally $\mathcal{M}_1 + \mathcal{M}_2$ is defined as follows:[16]

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[16]Pedersen (2015) also makes use of the notion of composite measure functions in his analysis of degree achievements and the repetitive/restitutive ambiguity of *again* (e.g. *The river widened again*), but in a somewhat different way. In Pedersen's approach, a composite measure function (for degree achievements) returns

(25) $[\mathcal{M}_1 + \mathcal{M}_2] = \lambda x \lambda t. \ \langle \mathcal{M}_1(x)(t), \mathcal{M}_2(x)(t) \rangle$

Note that the formal definition in (25) does not by itself impose any constraint on the two measure functions being composed. To capture the intuition that a composite measure function measure the progress of one and the same event from different perspectives, I assume that linguistically well-formed composite measure functions obey some structure identity conditions which minimally include the following two:[17]

(26)   If $\mathcal{M}_1$ and $\mathcal{M}_2$ have minimum (maximum) endpoints, then $\mathcal{M}_1 + \mathcal{M}_2$ is well-defined only if the following condition holds:

$$\forall t \forall x [\mathcal{M}_1(x)(t) = \mathbf{min}(\mathcal{M}_1) \quad \leftrightarrow \quad \mathcal{M}_2(x)(t) = \mathbf{min}(\mathcal{M}_2)] \ \wedge$$
$$[\mathcal{M}_1(x)(t) = \mathbf{max}(\mathcal{M}_1) \quad \leftrightarrow \quad \mathcal{M}_2(x)(t) = \mathbf{max}(\mathcal{M}_2)]$$

(27) $\mathcal{M}_1 + \mathcal{M}_2$ is well-defined only if the following condition holds:

$$\forall t \forall x [\mathcal{M}_2(x)(t) > 0 \rightarrow \mathcal{M}_1(x)(t) > 0]$$

(26) essentially says that $\mathcal{M}_1 + \mathcal{M}_2$ is well-defined only if the minimum (maximum) endpoints of $\mathcal{M}_1$ and $\mathcal{M}_2$ are aligned with each other. (27) says that $\mathcal{M}_2$ is 'dependent' on $\mathcal{M}_1$. The intuition behind this latter condition is that when we are tracking the progress of walking on a path (where the main measure function $\mathcal{M}_1$ is from the verb and the subordinate measure function $\mathcal{M}_2$ is from the path phrase), $\mathcal{M}_2$ should not accidentally keep track of movement on the path which does not result from walking. Note that this means that measure function composition operation is not symmetric: In $\mathcal{M}_1 + \mathcal{M}_2$, $\mathcal{M}_1$ is the main measure function

degrees on the same scale, specifically, the degrees of A-ness (for the degree achievement 'A-*en*') at the initial and final points of the interval that it takes as its argument.

[17] The key guiding intuition here is the idea that there is an upper bound on the complexity of the kinds events that can be 'packaged' into composite but unitary 'event descriptions' in natural language. Various authors working on lexical semantics have proposed conditions on the complexity of event representations in somewhat informal terms; see, for example, Levin and Rappaport Hovav's (1999) 'event coidentification' constraint and Goldberg's (1991) 'unique path' constraint. Obviously, (26) and (27) alone are hardly sufficient to capture this idea formally, but I leave the task of further articulating it for another occasion.

whereas in $\mathcal{M}_2 + \mathcal{M}_1$, $\mathcal{M}_2$ is the main measure function.

The definition of the notion of standard now needs to be extended to composite measure functions. This is fairly straightforward. Following the original intuition behind the notion of standard (Kennedy and McNally 2005; Kennedy 2007), I assume that if one of the two underlying scales has an endpoint, then that endpoint 'stands out' and hence is chosen as the standard of comparison. Otherwise, some contextually determined degree associated with either scale is chosen as the standard:

(28) For a composite measure function $\mathcal{M}$, $\mathbf{stnd}(\mathcal{M}, \langle d_1, d_2 \rangle)$ just in case:

    a. if $\pi_1(\mathcal{M})$ has either a maximum or a minimum endpoint, then $\mathbf{stnd}(\pi_1(\mathcal{M}), d_1)$.

    b. if $\pi_2(\mathcal{M})$ has either a maximum or a minimum endpoint, then $\mathbf{stnd}(\pi_2(\mathcal{M}), d_2)$.

    c. otherwise, either $\mathbf{stnd}(\pi_1(\mathcal{M}), d_1)$ or $\mathbf{stnd}(\pi_2(\mathcal{M}), d_2)$.

3.4 Accounting for aspectual composition

With the assumptions introduced above, we are now ready to account for the data from section 2. For the sake of explicitness, I make some assumptions about the syntax-semantics interface, listed in (i)–(iv), but it should be noted that my analysis does not depend on any specific syntactic theory and no operation other than function application and lambda abstraction is needed for semantic composition. Thus, syntactic node labels are largely irrelevant, and I omit them entirely in the trees given below.

  (i) Motion verbs either lexically denote (i.e., in the case of directional motion verbs) or have derived meanings (i.e., in the case of manner of motion verbs) as (verbal) measure functions of type $\boldsymbol{\mu}$ $(= \langle \mathsf{e}, \langle \mathsf{i}, \mathsf{d} \rangle \rangle)$.

  (ii) Path phrases are syntactically treated as adjuncts, and semantically denote verbal measure function modifiers of type $\langle \boldsymbol{\mu}, \boldsymbol{\mu} \rangle$ such that they take a (possibly simplex) measure function and returns a composite measure function as output.[18,19]

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[18] I do not make a distinction between simplex and complex measure functions typewise.

[19] This assumption may receive some support from the fact that path phrases are unlike subcategorized direct

(iii) Degree modifiers are of type $\langle \mu, \langle e, \langle i, t \rangle \rangle \rangle$, the same type as the verbal *pos* operator.

(iv) Measure phrases denote degrees of type d and are arguments of the *Meas* operator of type $\langle d, \langle \mu, \langle e, \langle i, t \rangle \rangle \rangle \rangle$ (which is of the same type as the *pos* operator except that it takes a degree as an additional argument).

(iii) and (iv) are compatible with standard assumptions about measure phrases and degree modifiers in the semantics of gradable adjectives (cf., e.g., Kennedy and McNally 2005).

I start with composition with path phrases. A path phrase denotes a measure function modifier of type $\langle \mu, \mu \rangle$ that takes a verbal measure function as an argument and composes it with a measure function that it lexically contributes (which measures the progress of motion along some physical path it names), returning the composite measure function as an output. For example, the denotation for the path phrase *sono yamamiti-o* 'that trail' is given in (29):

(29) ⟦sono yamamiti-o⟧ $= \lambda \mathcal{M}.\ \mathcal{M}+\textbf{move}(\textbf{the-trail})$

The measure function contributed by the path phrase $\textbf{move}(\textbf{the-trail})$ $(= \lambda x \lambda t.\textbf{move}(\textbf{the-trail})(x)(t))$ tracks the change of location of an entity x over the course of the interval t along the physical path corresponding to the trail. I assume that there is an empty operator that converts a path (qua object of type e) to a measure function when the linguistic expression in question appears as a path phrase in the sentence.

Note that, even though the physical path itself has endpoints, the movement of x along this path does not have to start from either endpoint of the path. Thus, the minimum endpoint of the measure function $\lambda x \lambda t.\textbf{move}(\textbf{the-trail})(x)(t)$ simply corresponds to the point on the path at which x starts its movement at the beginning of the interval t. Assuming that there is a one-to-one correspondence between the structure of the abstract path tracking x's movement

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objects in not obeying the double-*o* constraint, as noted by Matsumoto (1996a) (citing Poser (1983)):
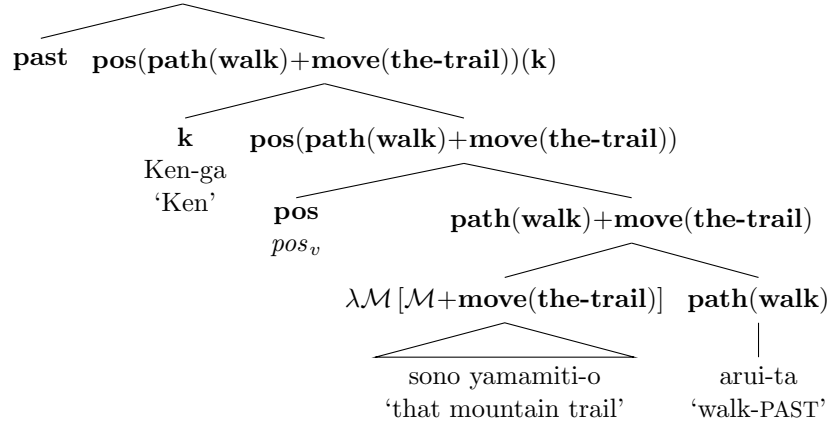
(i)   (?)Kare-wa yoru-no   haiuei-o   kuruma-o tobasu.
        he-TOP   night-GEN highway-ACC car-ACC   fly
      'He drives his car fast on the highway at night.'

and the structure of the physical path, there is no backtracking in the movement of x on the trail and the two endpoints of the physical path are identified as the minimum and maximum endpoints of the measure function. If we instead assume that the change of location simply takes place along the physical path (not necessarily starting from either endpoint of the path), backtracking is possible and there is no inherent endpoint for the change of location and hence the measure function does not have a maximum endpoint. I assume that the **move** function is underspecified as to this correspondence between the structure of the physical path and the abstract path tracking the object's movement.

With manner of motion verbs such as *aruku* 'walk', the verb originally denotes an activity type meaning (of type $\langle \mathsf{e}, \langle \mathsf{i}, \mathsf{t} \rangle \rangle$), which cannot be directly combined with the measure function provided by the path phrase in (29). However, as discussed above, manner of motion verbs have derived entailments of change of location that are lacking in genuine activity verbs. Due to this entailment, the meaning of the verb can be converted to a measure function of type $\langle \mathsf{e}, \langle \mathsf{i}, \mathsf{d} \rangle \rangle$), and can then be given as an argument to the measure function modifier (29) denoted by the path phrase. (7a) can then be analyzed as in (30) (here, **pos** $=$ $\lambda \mathcal{M} \lambda x \lambda t.\mathbf{stnd}(\mathcal{M}, \mathcal{M}(x)(t))$ and **past** $= \lambda P \exists t.t < \mathbf{now} \wedge P(t)$).[20]

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[20]For expository ease, I assume that tense (which is a bound morpheme on the verb) is interpreted at the S level (but nothing in the present proposal hinges on this assumption). Note in particular that the existential closure of tense at the S level does not necessarily mean that the tense scopes over other operators in the sentence (for example, when the subject of the sentence is a universal quantifier, the other scoping relation can be obtained easily by quantifying-in the quantifier after the existential closure for tense takes place).

(30) $\mathbf{past(pos(path(walk)+move(the\text{-}trail)))(k))}$

$\mathbf{past}$ $\mathbf{pos(path(walk)+move(the\text{-}trail)))(k)}$

$\mathbf{k}$ $\mathbf{pos(path(walk)+move(the\text{-}trail)))}$
Ken-ga
'Ken' $\mathbf{pos}$ $\mathbf{path(walk)+move(the\text{-}trail)}$
              pos_v

          $\lambda\mathcal{M}\,[\mathcal{M}+\mathbf{move(the\text{-}trail)}]$ $\mathbf{path(walk)}$

              sono yamamiti-o   arui-ta
              'that mountain trail'   'walk-PAST'

(31) $\mathbf{past(pos(path(walk)+move(the\text{-}trail)))(k))}$

$= \exists t.t < \mathbf{now} \wedge \mathbf{stnd(path(walk)+move(the\text{-}trail)}, [\mathbf{path(walk)+move(the\text{-}trail)}](\mathbf{k})(t))$
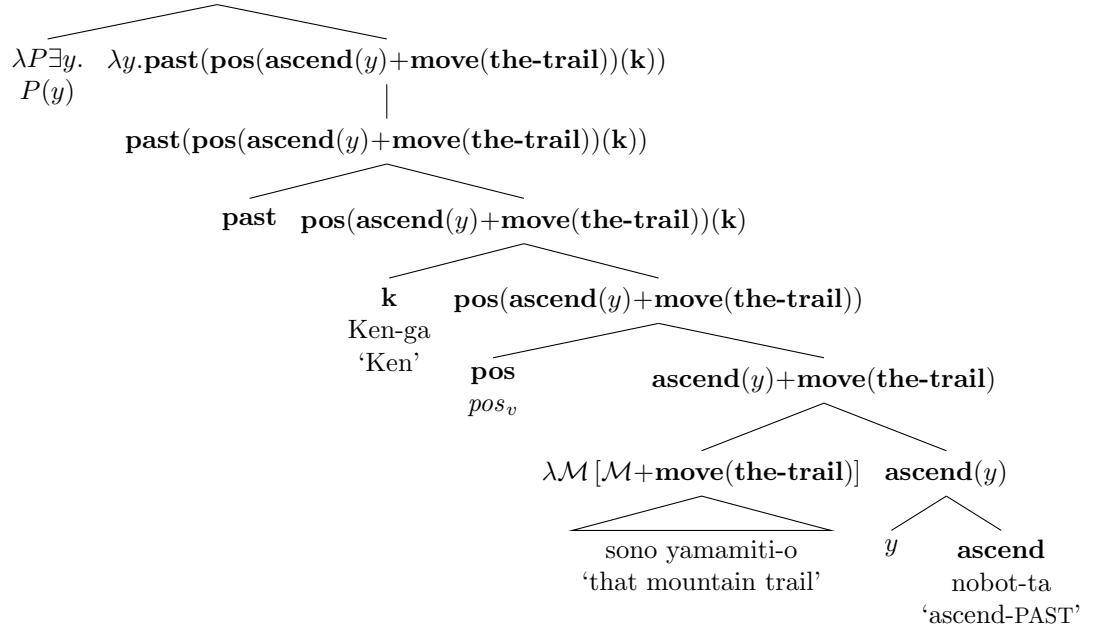
The composite measure function **path(walk)+move(the-trail)** consists of an open-ended measure function of the verb and a fully-closed measure function contributed by the path phrase (assuming that the latter is isomorphic to the physical path). According to the definition of standard evaluation for composite measure functions in (28) in section 3.3, when one of the component measure functions has an endpoint, that endpoint is chosen as the standard. Thus, the structure of the measure function from the path phrase is relevant here, and, just as in the case of degree achievements, variable telicity immediately follows: if the standard is set to the minimum endpoint, the sentence exhibits an atelic, differential interpretation which only entails that part of the path was moved on (which in turn pragmatically implicates that the endpoint wasn't reached); if, on the other hand, the standard is set to the maximum endpoint, a telic interpretation results which entails that the whole path was moved on. This prediction is indeed borne out, as we have already seen. (32) (= (7a)) is aspectually ambiguous, and the two readings can be disambiguated by the 'in' vs. 'for' adverbials.

(32) Ken-wa   sono yamamiti-o   **san-zikan(-de)** arui-ta.
      Ken-TOP that mountain.trail-ACC three-hour-in   walk-PAST
      'Ken walked that mountain trail in/for three hours.'

Note also that the atelic reading does not necessarily entail that the starting point of walking corresponds to one of the endpoints of the path. By dropping the strict isomorphic correspondence condition on the abstract path encoded in the measure function **move(the-trail)** and the physical path, the starting point of the motion can be any point on the physical path.

Turning now to directional motion verbs, since the verbs themselves lexically denote measure functions, they are already compatible with the measure functions of path phrases. But there is one minor technical point that needs to be worked out. That is, the semantic type of a directional motion verb is $\langle e, \mu \rangle$ (where the first argument is the goal argument), and it does not match the semantic type of the argument of the measure function modifier denoted by the path phrase (which is of type $\langle \mu, \mu \rangle$). I assume that the goal argument, if not overtly expressed, is simply existentially bound at the sentence level. With this assumption, the analysis goes as in (33), with the final translation for the sentence unpacked in (34).

(33) $\exists y.\textbf{past}(\textbf{pos}(\textbf{ascend}(y)+\textbf{move}(\textbf{the-trail}))(\textbf{k}))$

$\lambda P \exists y.$ $\lambda y.\textbf{past}(\textbf{pos}(\textbf{ascend}(y)+\textbf{move}(\textbf{the-trail}))(\textbf{k}))$
$P(y)$

$\textbf{past}(\textbf{pos}(\textbf{ascend}(y)+\textbf{move}(\textbf{the-trail}))(\textbf{k}))$

$\textbf{past}$ $\textbf{pos}(\textbf{ascend}(y)+\textbf{move}(\textbf{the-trail}))(\textbf{k})$

$\textbf{k}$ $\textbf{pos}(\textbf{ascend}(y)+\textbf{move}(\textbf{the-trail}))$
Ken-ga
'Ken' $\textbf{pos}$ $\textbf{ascend}(y)+\textbf{move}(\textbf{the-trail})$
pos_v

$\lambda \mathcal{M}\,[\mathcal{M}+\textbf{move}(\textbf{the-trail})]$ $\textbf{ascend}(y)$

sono yamamiti-o y $\textbf{ascend}$
'that mountain trail'   nobot-ta
'ascend-PAST'

(34) $\exists y.\textbf{past}(\textbf{pos}(\textbf{ascend}(y)+\textbf{move}(\textbf{the-trail}))(\textbf{k}))$

$= \exists y \exists t.t < \textbf{now} \wedge \textbf{stnd}(\textbf{ascend}(y)+\textbf{move}(\textbf{the-trail}), [\textbf{ascend}(y)+\textbf{move}(\textbf{the-trail})](\textbf{k})(t))$

32

Due to the structure identity condition on measure function composition in (26), the maximum endpoints of the original measure functions are aligned with each other. Note that, unlike with manner of motion verbs, directional motion verbs explicitly encode the directionality of movement, and thus is compatible with the measure function from the path phrase only if the latter encodes a monotonic, unidirectional movement (with no backtracking and with the mountaintop identified as the goal). Thus, the endpoint of the measure function for the path phrase that is aligned with the endpoint of the verbal measure function corresponds to the endpoint of the physical path.

As in the case of manner of motion verbs, the standard is determined in reference to the endpoints associated with the component measure functions. And here again, the scale underlying the measure function is fully-closed, from which it again follows that (35) (= (7b)) is ambiguous between telic and atelic readings.

(35)   Ken-wa   sono yamamiti-o   **san-zikan(-de)** nobot-ta.
          Ken-TOP that mountain.trail-ACC three-hour-in   ascend-PAST
          'Ken climbed that mountain trail in/for three hours.'

Before moving on, I would like to address one issue which one might take to be problematic for the present analysis. It has been noted in the literature (Kageyama 1997; Matsumoto 1997) that, for directional motion verbs, specifying both a path phrase and a goal phrase is awkward. This is not predicted by the present analysis. The exact status of the relevant examples seems somewhat unclear. The following example sounds a bit awkward, but it seems to be marginally acceptable on the interpretation in which the goal specified by the goal phrase coincides with the endpoint of the path:

(36) ?Ken-wa   sono yamamiti-o   san-zikan-de santyoo-ni   nobot-ta.
        Ken-TOP that mountain.trail-ACC three-hour-in mountaintop-DAT ascend-PAST
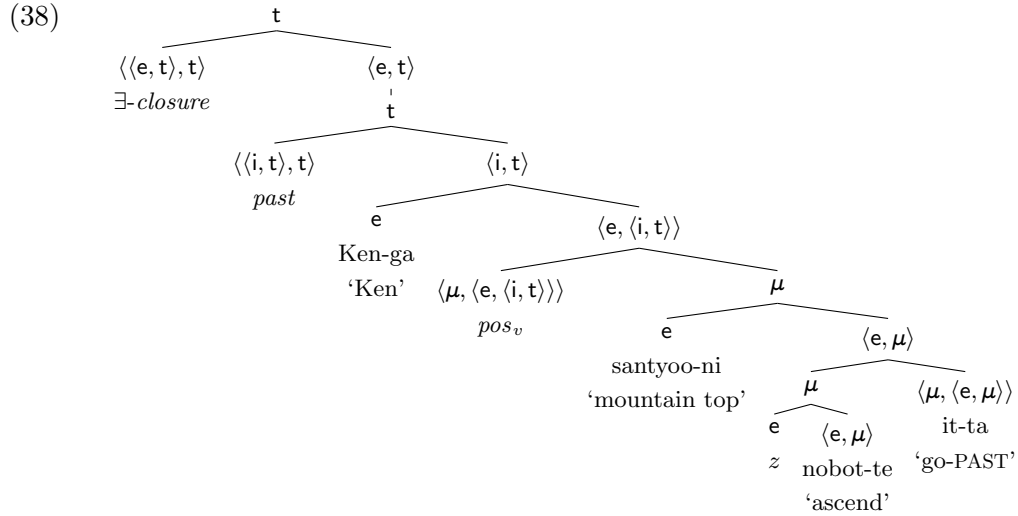   'Ken climbed that mountain trail to the mountaintop in three hours.'

I take the awkwardness of this example to derive from the redundancy of specifying the goal twice, rather than some hard grammatical constraint.

I now turn to directional auxiliaries, which can be analyzed in terms of scale composition in a way analogous to path phrases. Directional auxiliaries are syntactically (auxiliary) verbs, but their semantic function is parallel to path phrases. Thus, I treat them as measure function modifiers. Since a directional auxiliary subcategorizes for its own goal argument, its semantic type is $\langle \mu, \langle e, \mu \rangle \rangle$. The meanings of *iku* and *kuru* can then be specified as in (37) (I ignore the deictic difference between the two, which is irrelevant for the present discussion).

(37) $[\![\text{iku/kuru}]\!] = \lambda \mathcal{M} \lambda y.\ \mathcal{M} + \textbf{move-to}(y)$

The measure function **move-to** here is a change of location measure function, but unlike the measure functions of path phrases, it merely identifies the goal of the directional motion (represented by the goal argument y) instead of fully specifying the path.

For directional motion verbs, the goal argument of the verb is again existentially bound at the S level. With this assumption, the semantic composition goes as in (38) (here and below, I only show the structure of the tree, omitting the step-by-step meaning derivation):

(38)

(39) $[\![(38)]\!] = \lambda P \exists z [P(z)](\lambda z.\textbf{past}(\textbf{pos}(\textbf{iku}(\textbf{ascend}(z))(\textbf{mt-top}))(\textbf{k})))$

 $= \exists z \exists t.t < \textbf{now} \wedge \textbf{stnd}(\textbf{ascend}(z) + \textbf{move-to}(\textbf{mt-top}), [\textbf{ascend}(z) + \textbf{move-to}(\textbf{mt-top})](\textbf{k})(t))$

Here, since the goal argument of the directional motion verb z is simply existentially bound, the maximum endpoints of the original scales are not explicitly identified with each other.

However, since measure function composition requires the endpoints of the input scales to be aligned with each other (if there are any), the goal designated by the *-ni*-marked goal phrase corresponds to the goal lexically encoded in the meaning of the verb, as desired. Since the original measure functions have only maximum endpoints, the derived measure function has only a maximum endpoint. From this, it correctly follows that (39) is invariably telic and that the sentence entails that the goal is reached.

With manner of motion verbs, the **path** function is again exploited to make the meaning of the verb compatible with the measure function contributed by the directional auxiliary. Thus, the complex verb *arui-te iku* denotes the composite measure function in (40).

(40) $[\![\text{arui-te iku}]\!] = \lambda y.[\textbf{path}(\textbf{walk}) + \textbf{move-to}(y)]$

This measure function inherits the maximum endpoint from the measure function of the directional auxiliary (which is only maximally closed) corresponding to the goal that the auxiliary lexically subcategorizes for. Thus, the standard of the composite measure function is set to this endpoint. From this, it follows that manner of motion verbs become telic when they combine with directional auxiliaries, as exemplified by (41):

(41)   Ken-wa   eki-ni   **30-pun*(-de)** arui-te   it-ta/ki-ta.
       Ken-TOP station-DAT 30-minute-in   walk-TE go-PAST/come-PAST
       'Ken walked/ran to the station in 30 minutes.'

To summarize the discussion up to this point, descriptively, both path phrases and directional auxiliaries neutralize the aspectual distinction between manner of motion verbs and directional motion verbs. In the present account, this result follows from an analysis of aspectual composition via the mechanism of measure function composition. In both cases, the structure of the scale for the composite measure function plays a crucial role in determining the telicity of the sentence. But since path phrases and directional auxiliaries themselves have different scale structures, the outcome is different: with path phrases (which contribute fully-closed scales), the variable telicity effect arises, whereas with directional auxiliaries (which contribute only maximally-closed scales), an obligatorily telic interpretation is derived.

The present scale-based analysis moreover extends straightforwardly to cases involving measure phrases and degree modifiers. These expressions can be treated in a way parallel to the treatment of such expressions in the adjectival domain. Following Svenonius and Kennedy (2006), I assume that measure phrases saturate the degree argument slot of the covert *Meas* operator (of type $\langle d, \langle \mu, \langle e, \langle i, t \rangle \rangle \rangle \rangle$) and that degree modifiers are operators of type $\langle \mu, \langle e, \langle i, t \rangle \rangle \rangle$. In other words, the *Meas* operator (with the degree argument slot saturated) and degree modifiers are of the same semantic type as the verbal *pos* operator and serve the same role of turning a measure function into a predicate of individuals. Thus, as in the adjectival domain, they are in complementary distribution.

One technical detail we need to attend to is that, just as the definition of the *pos* operator was extended to composite measure functions, the definition of the *Meas* operator and degree modifiers need to be extended. In general, a measure phrase or a degree modifier can target either the meaning of the verb itself or some other expression (such as the path phrase) as long as the meanings of the modifier and the target of modification are compatible. Taking this point into consideration, the generalized meaning of the *Meas* operator can be defined as in (42), with the definition of the 'part-of' relation $\sqsubseteq$ for measure functions in (43).

(42) $[\![Meas]\!] = \lambda d \lambda \mathcal{M} \lambda x \lambda t. \exists \mathcal{M}' \sqsubseteq \mathcal{M}[\mathcal{M}'(x)(t) = d]$
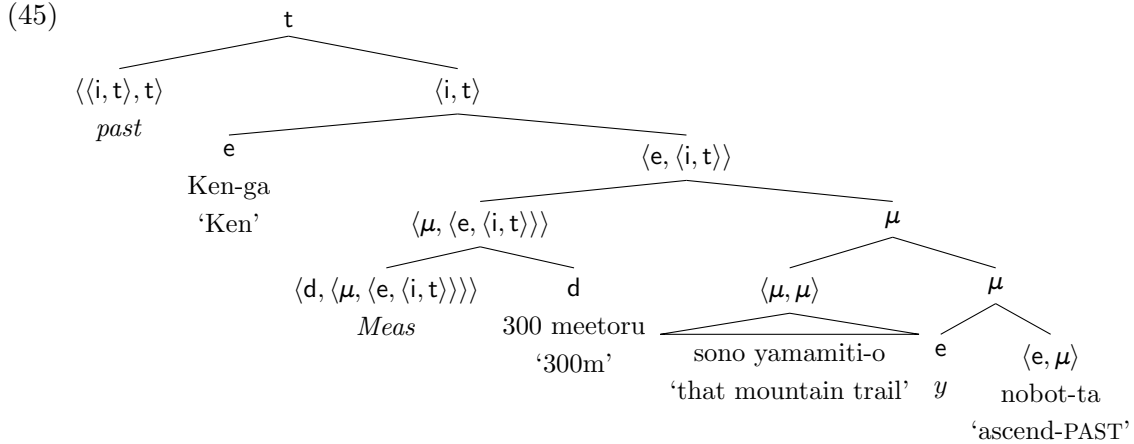
(43)   a. If $\mathcal{M}$ is a non-complex measure function, $\mathcal{M}' \sqsubseteq \mathcal{M}$ iff $\mathcal{M}' = \mathcal{M}$.

   b. If $\mathcal{M}$ is a complex measure function, $\mathcal{M}' \sqsubseteq \mathcal{M}$ iff $\mathcal{M}' \sqsubseteq \pi_1(\mathcal{M})$ or $\mathcal{M}' \sqsubseteq \pi_2(\mathcal{M})$.

As should be clear from the definition in (43), (42) reduces to the standard definition of *Meas* if $\mathcal{M}$ is a non-complex measure function.

(44) can now be analyzed as in (45), with the translation unpacked as in (46).

(44)   Ken-ga   sono yamamiti-o   300-meetoru nobot-ta.
       Ken-NOM that mountain.trail-ACC 300-meter   ascend-PAST
       'Ken ascended the mountain trail 300 meters.'

(45)

t

$\langle\langle i, t\rangle, t\rangle$ $\langle i, t\rangle$
past

e $\langle e, \langle i, t\rangle\rangle$
Ken-ga
'Ken'

$\langle\mu, \langle e, \langle i, t\rangle\rangle\rangle$ μ

$\langle d, \langle\mu, \langle e, \langle i, t\rangle\rangle\rangle\rangle$ d $\langle\mu, \mu\rangle$ μ
Meas   300 meetoru
'300m'

sono yamamiti-o e $\langle e, \mu\rangle$
'that mountain trail' y nobot-ta
'ascend-PAST'

(46) $[\![(45)]\!] = \mathbf{past}(\mathbf{meas}(300)(\mathbf{ascend}(y)+\mathbf{move}(\mathbf{the\text{-}trail}))(\mathbf{k}))$

$= \exists t.\, t < \mathbf{now}.\exists\mathcal{M}' \sqsubseteq (\mathbf{ascend}(y)+\mathbf{move}(\mathbf{the\text{-}trail}))[\mathcal{M}'(\mathbf{k})(t) = 300]$

(46) is ambiguous between two readings, depending on which of the component measure functions the measure phrase targets. If $\mathcal{M}' = \pi_1(\mathcal{M})$, then it means that the length of movement is 300m; if, on the other hand, $\mathcal{M}' = \pi_2(\mathcal{M})$, then it means that the height difference resulting from the change of location is 300m. These correspond to the intuitively available two readings of the sentence.

Degree modifiers are know to be sensitive to scale structure (Kennedy and McNally 2005; Rotstein and Winter 2004), and this is true in the verbal domain as well. In particular, as discussed in detail in Bochnak (2013), the degree modifier *half* requires a fully-closed scale as its target and asserts that the midpoint of the scale is reached. *Hanbun* in Japanese behaves similarly when it combines with the two types of motion verbs. Thus, as shown in (47) and (48), with the lexically encoded open and maximally closed scales, the two types of verbs are both incompatible with *hanbun*, but when the verbs combine with a path phrase and the scale is converted to a fully-closed one, they become compatible with modification by *hanbun*.[21]

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[21]The following example is acceptable in what Bochnak (2013) calls the 'evaluative' reading of *half*, where what the degree modifier targets is the quality scale which measures how close the event in question is to a prototypical event of walking:

(i)   John-wa   hanbun arui-ta.
    John-TOP half   walk-PAST

(47) a.#John-wa **hanbun** arui-ta.
   John-TOP half   walk-PAST
   intended: 'John half walked.'

   b.#John-wa **hanbun** santyoo-ni   nobot-ta.
   John-TOP half   mountain.top-DAT ascend-PAST
   intended: 'John half ascended to the mountain top.'

(48) a. John-wa sono yamamiti-o   **hanbun** arui-ta.
      John-TOP that mountain.trail-ACC half   walk-PAST
      'John walked half of that mountain trail.'

   b. John-wa sono yamamiti-o   **hanbun** nobot-ta.
      John-TOP that mountain.trail-ACC half   ascend-PAST
      'John ascended half of that mountain trail.'

The sensitivity to scale structure exhibited by *hanbun* can be captured in the present analysis by assigning the following meaning to it:

(49) $[\![\text{hanbun}]\!] = \lambda \mathcal{M} \lambda x \lambda t. \exists \mathcal{M}' \sqsubseteq \mathcal{M}. \, \mathcal{M}'(x)(t) = \dfrac{\mathbf{max}(\mathcal{M}') + \mathbf{min}(\mathcal{M}')}{2}$

That is, *hanbun* is well-defined only if at least one of the component measure functions has both the maximum and minimum endpoints, and it simply asserts that the midpoint of the scale is reached.

The analysis for (48a) then goes as in (50).

'John half walked.' (e.g., when he was really supposed to be running)

As Bochnak (2013) discusses, this reading involves an altogether different scalar dimension for which the path or incremental structure of the event is totally irrelevant. Here, I set aside this type of reading. For a more detailed discussion and analysis of this type of reading of *half*, see Bochnak (2013).

(50)
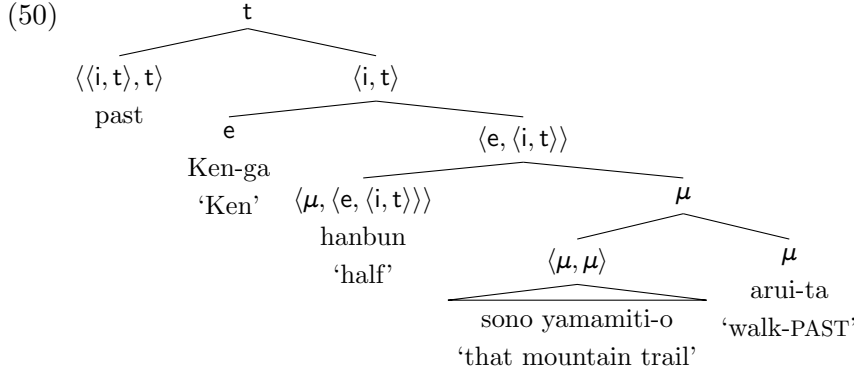
(51) $[\![(50)]\!] = \mathbf{past}(\mathbf{half}(\mathbf{path}(\mathbf{walk})+\mathbf{move}(\mathbf{the\text{-}trail}))(\mathbf{k}))$

$$= \exists t.t < \mathbf{now} \wedge \big[\exists \mathcal{M}' \sqsubseteq \mathcal{M}.\, \mathcal{M}'(\mathbf{k})(t) = \frac{\mathbf{MAX}(\mathcal{M}') + \mathbf{MIN}(\mathcal{M}')}{2}\big]$$

where $\mathcal{M} = \mathbf{path}(\mathbf{walk})+\mathbf{move}(\mathbf{the\text{-}trail})$

Note that the interpretation of *hanbun* is ambiguous depending on which of the two components of the composite measure function it targets. In particular, in the case of (48b), if $\mathcal{M}' = \pi_1(\mathcal{M})$, then the sentence means that the midpoint of the path (in terms of the length of the path) is reached, whereas if $\mathcal{M}' = \pi_2(\mathcal{M})$, the sentence entails that the midpoint in terms of height is reached. (48b) is indeed ambiguous in these two readings.

Incremental modifiers such as *ippo-ippo*, *itidan-itidan* and *ippo-zutu* can be analyzed as measure function modifiers, just like path phrases and directional auxiliaries. The main difference between incremental modifiers and the latter two types of expressions is that instead of imposing endpoints, incremental modifiers impose conditions on the way in which the change measured by the measure function unfolds over time. Specifically, I posit the following lexical entry for *itidan-itidan*, of type $\langle \boldsymbol{\mu}, \boldsymbol{\mu} \rangle$:

(52) $\lambda \mathcal{M}.\mathbf{itidan}(\mathcal{M})$

where for any x and t, $\mathbf{itidan}(\mathcal{M})(x)(t) = \mathcal{M}(x)(t)$ if the following holds:

$$t = \sum_{1 \leq i \leq n} t_i \wedge \forall t_i, t_j [i \neq j \rightarrow t_i \cap t_j = \emptyset] \wedge \exists \mathcal{M}' \sqsubseteq \mathcal{M}.\forall t_i [\mathbf{length}(\mathcal{M}'(x)(t_i)) = \mathbf{one\text{-}step}]$$

otherwise **itidan**$(\mathcal{M})(x)(t)$ is undefined.

The modified measure function is identical to the original measure function (and hence does not change its endpoint-oriented scale structure), but it imposes an additional condition on the temporal interval t over which it is evaluated. That is, t has to consist of subintervals $t_1, \ldots, t_n$ which form a contiguous non-overlapping chain such that at each of these subintervals t_i, the event encoded by $\mathcal{M}$ progresses by the unit corresponding to one step (of the stairs). I omit the analysis of a full sentence since the relevant compositional details are the same as above.

Finally, I sketch briefly how path-denoting adverbial clauses in (11) and (12) may be analyzed via the notion of scale composition. The role that these adverbials play in the sentence is similar to the role of prepositional phrases in English in examples like the following:

(53)   a. The train ran through the tunnel.

           b. John walked over the mountain.

           c. John went across the boarder.

           d. The ball rolled down the slope.

This is consistent with the observation often made in the literature that English has many prepositions specifying the structures of paths whereas corresponding information tends to be expressed by verbs in Japanese (see, e.g., Kageyama et al. (2011)).

Zwarts (2005, 2008) analyzes the compositional semantics of English prepositional phrases in detail by formalizing the notion of path in algebraic terms. Zwarts's notion of path is largely compatible with the notion of scale in the present approach. Thus, for the most part, his analysis of English prepositional phrases can be recast in the present scale-based setup straightforwardly and this gives us a starting point for analyzing the semantics of Japanese path-denoting adverbial clauses. I will only sketch a beginning of this project since incorporating the whole algebra of paths developed by Zwarts in the present scale-based system is beyond the scope of this paper.

Of particular interest to us is that, as noted by Zwarts, such path-denoting prepositional phrases often exhibit variable telicity effects; the facts are largely parallel in Japanese path-denoting adverbial clauses. For example, the prepositions *up* and *down* are similar to degree achievements in that, when combined with motion verbs, they express incremental change of height. As may be expected, when the object of the preposition is definite, we see the familiar variable telicity effect:

(54)   a.   The car went/ran up the hill in/for 30 minutes.

     b.   Kuruma-wa 30-pun(-de)   saka-o   nobot-te   hasit-ta.
        car-TOP   30-minute-in slope-ACC ascend-TE run-PAST
        'The car went up the slope in/for 30 minutes.'

Zwarts (2005) also notes that prepositions such as *over*, *across*, and *through*, while normally entailing that the relevant path has been totally covered, can also induce atelic, partial readings in certain contexts. At least some of the corresponding Japanese path-denoting adverbial clauses seem to be similarly ambiguous (*wataru* 'go across' and *tooru* 'go through' seem to exhibit this ambiguity more readily whereas *yokogiru* 'cross' seems to be unambiguously telic; I currently do not have an explanation for this variability).

(55)   a.   John walked over the hill for/in one hour.

     b.   John-wa   3-pun(-de) hasi-o   watat-te arui-ta.
        John-TOP 3-minute-in bridge-ACC cross-TE walk-PAST
        'John walked over the bridge for/in 3 minutes.'

The patterns of aspectual composition found here can be analyzed by means of scale composition, in a way essentially parallel to the other cases discussed above. For example, for (54b), we can analyze the path-denoting adverbial clause as a measure function modifier in (56) (with y designating the goal of upward movement existentially bound at the top S level, as in the previous examples), which combines with the measure function denoted by the verb to yield the composite measure function in (57).

(56) $\lambda \mathcal{M} \lambda x \lambda t [\mathcal{M} + (\mathbf{ascend}(y) + \mathbf{move}(\mathbf{the\text{-}slope}))]$

(57) $\lambda x \lambda t[\mathbf{path}(\mathbf{run}) + (\mathbf{ascend}(y) + \mathbf{move}(\mathbf{the\text{-}slope}))]$

The measure function from *saka-o* 'the slope' is bounded on both ends, and this scale structure is inherited to the whole composite measure function denoted by the sentence. The variable telicity effect in (55b) is then predicted in the same way as in other examples above. A similar account goes for the other examples in (54) and (55).

Finally, I would like to note that there is a broader range of empirical phenomena for which the present scale-based approach is potentially applicable. In particular, aspectual composition is a domain in which complex factors come into play in inducing the diverse and intricate patterns observed cross-linguistically (for wider cross-linguistic implications, see also the discussion in section 5). For some initial explorations of such cross-linguistic patterns within a scale-based approach, focusing on change of state verbs in Japanese and English, see Kubota (2010).
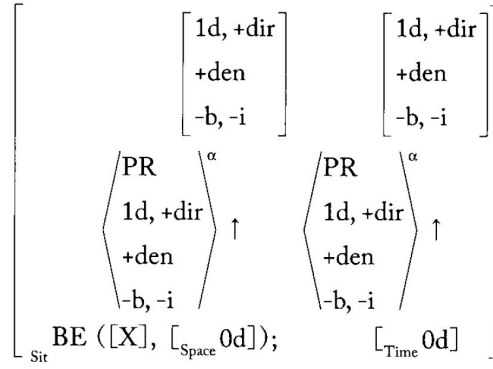
4   Comparison with previous proposals

I now compare the present scale-based analysis of motion verbs with two alternatives in the literature: Iwamoto (2008) and Ueno (2007). Iwamoto (2008) takes aspectual composition to be the main target of explanation, and extends a decomposition-based approach to verb meaning with mechanisms that explicitly represent the (un)boundedness of events and the way they unfold in time. Ueno (2007) primarily focuses on the classification of the two types of motion verbs in Japanese in a more traditional type of decomposition-based approach. While these studies offer many insights, neither of them alone provides a completely successful account of both aspectual composition and classification of motion verbs in Japanese within the larger typology of verb meaning.

4.1   Iwamoto (2008)

In Iwamoto's approach, which extends Jackendoff's (1991; 1996) theory of structure-preserving binding, a manner of motion verb receives the representation in (58):
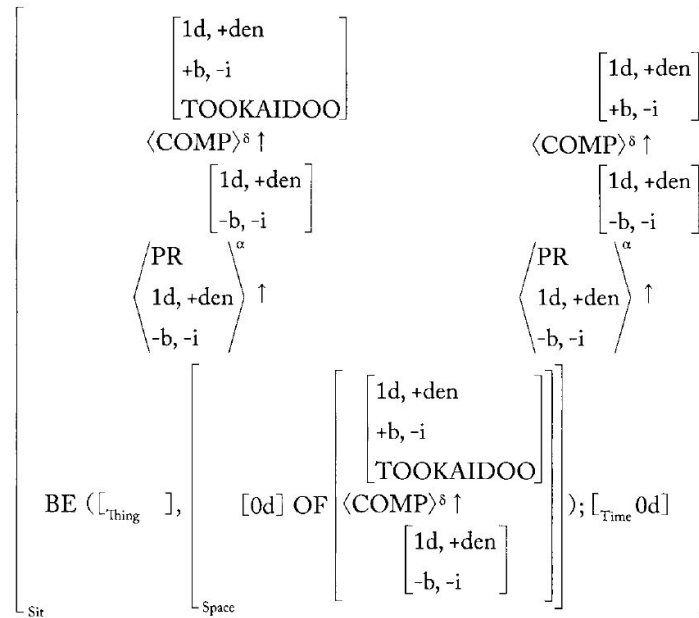
(58)

$$
\left[
\begin{array}{c}
\left\langle
\begin{array}{c}
\begin{bmatrix}
\text{1d, +dir} \\
\text{+den} \\
\text{-b, -i}
\end{bmatrix} \\[2pt]
\text{PR} \\
\text{1d, +dir} \\
\text{+den} \\
\text{-b, -i}
\end{array}
\right\rangle^{\alpha} \uparrow
\quad
\left\langle
\begin{array}{c}
\begin{bmatrix}
\text{1d, +dir} \\
\text{+den} \\
\text{-b, -i}
\end{bmatrix} \\[2pt]
\text{PR} \\
\text{1d, +dir} \\
\text{+den} \\
\text{-b, -i}
\end{array}
\right\rangle^{\alpha} \uparrow \\
\underset{\text{Sit}}{}\; \text{BE} \left([X], [_{\text{Space}} \text{0d}]\right); \quad [_{\text{Time}} \text{0d}]
\end{array}
\right]
$$

The bottom line represents the 'cross-section', to be thought of as an atemporal snapshot of the event, and the upward arrows out of the Space and Time slots represent the 'projections' onto unbounded ($-$b) one dimensional (1d) axes (of space and time). Crucially, the coindexation (or 'binding') of these projections by the superscript α is meant to capture the one-to-one correspondence between the timeline and the position of the theme on its movement trajectory.

When the verb combines with a path phrase, the information contributed by the two are unified. Since the verb encodes an unbounded path and the path phrase encodes a bounded path, there are two possibilities. One is to coerce the representation of the verb via COMP ('composed of'), a function that creates a bounded object out of an unbounded mass:

(59)

$$
\left[
\begin{array}{c}
\left\langle
\begin{array}{c}
\begin{bmatrix}
\text{1d, +den} \\
\text{+b, -i} \\
\text{TOOKAIDOO}
\end{bmatrix} \\
\langle\text{COMP}\rangle^{\delta}\uparrow \\
\begin{bmatrix}
\text{1d, +den} \\
\text{-b, -i}
\end{bmatrix} \\
\text{PR} \\
\text{1d, +den} \\
\text{-b, -i}
\end{array}
\right\rangle^{\alpha}\uparrow
\quad
\left\langle
\begin{array}{c}
\begin{bmatrix}
\text{1d, +den} \\
\text{+b, -i}
\end{bmatrix} \\
\langle\text{COMP}\rangle^{\delta}\uparrow \\
\begin{bmatrix}
\text{1d, +den} \\
\text{-b, -i}
\end{bmatrix} \\
\text{PR} \\
\text{1d, +den} \\
\text{-b, -i}
\end{array}
\right\rangle^{\alpha}\uparrow \\[6pt]
\underset{\text{Sit}}{}\;\text{BE} \left([_{\text{Thing}}\quad],\;\underset{\text{Space}}{\left[[\text{0d}]\ \text{OF}\
\begin{bmatrix}
\langle\text{COMP}\rangle^{\delta}\uparrow \begin{bmatrix}\text{1d, +den}\\ \text{+b, -i}\\ \text{TOOKAIDOO}\end{bmatrix} \\
\begin{bmatrix}\text{1d, +den}\\ \text{-b, -i}\end{bmatrix}
\end{bmatrix}
\right]}\right);\,[_{\text{Time}}\text{0d}]
\end{array}
\right]
$$

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This yields the telic reading, entailing the full 'consumption' of the path. The atelic reading is obtained by applying the GR ('grinder') function to the path phrase first, changing its [+b] specification to [−b], and then unifying it with the original representation of the verb in (58).

While sharing the key idea (due originally to Krifka (1989; 1992)) that the structure of the path determines the shape of the event, there are some nontrivial differences between the present scale-based analysis and Iwamoto's proposal. Due to space considerations, here I focus on one empirical point, which pertains to the treatment of variable telicity with directional motion verbs.[22] Iwamoto treats directional motion verbs on a par with degree achievements and assigns to them lexical representations like (60), which basically encode differential change.

(60)

$$
\left[
\mathrm{BE}([\mathrm{X}]^{\alpha}, \;
\left\langle
\begin{array}{l}
\mathrm{PR} \\
1\mathrm{d},+\mathrm{dir} \\
-\mathrm{den},+\mathrm{b},-\mathrm{i} \\
\mathrm{bdby}^{+}\!\left(
\left[\begin{array}{l}
\left\{\begin{array}{l}\mathrm{FRONT}\\ \mathrm{UP}\\ \mathrm{BELOW}\end{array}\right\}\mathrm{of}([\alpha])]^{\beta} \\
\mathrm{d}(\mathrm{x})
\end{array}\right]
\right)
\end{array}
\right\rangle^{\gamma}_{[\beta]} \uparrow [_{\mathrm{Space}}\, 0\mathrm{d}]); \;
\left\langle
\begin{array}{l}
\mathrm{PR} \\
1\mathrm{d},+\mathrm{dir} \\
-\mathrm{den},+\mathrm{b},-\mathrm{i} \\
\mathrm{bdby}^{+}([\mathrm{t}_{i}])
\end{array}
\right\rangle^{\gamma}_{[0\mathrm{d},\,\mathrm{t}_{i}]} \uparrow [_{\mathrm{Time}}\, 0\mathrm{d}]
\right]
$$

For ordinary degree achievements, the telic reading is obtained by delimiting this differential change by supplying some contextually determined fixed value for d(x), whereas the atelic reading is obtained by a recursive application of what Iwamoto calls 'self-reference change' (basically a repetition of the differential change encoded in (60)). But this account of variable

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[22] Another point of unclarity that remains with Iwamoto's approach pertains to the lexical representation of manner of motion verbs. Note that the representation in (58) alone does not by itself distinguish between different manner of motion verbs such as *aruku* 'walk' and *hasiru* 'run'—the manner meaning is represented nowhere. One might think that this could be done by elaborating the 'cross-section' component of the meaning of the verb, but note the inherent difficulty of this approach: the cross-section only represents an atemporal snapshot of the relevant event, but two different activities (such as walking and running) cannot be distinguished from each other without comparing how they unfold *over time*.

telicity does not carry over to directional motion verbs in any straightforward way. Note that (60) explicitly represents the spatial projection to be bounded (+b). Thus, a path phrase should be able to compose with the verb without the intervention of a coercion operation, yielding only the telic reading. It is then unclear how the atelic reading is obtained. Crucially, the GR function invoked in the case of manner of motion verbs has no role to play here. Being a coercion operator, it is available only if there is a conflict in the two meaning representations being composed (cf. Jackendoff 1991; De Swart 1998).[23] Given the set of assumptions Iwamoto makes, it seems difficult to provide a uniform analysis of variable telicity effects in the presence of path phrases; at the very least, the proposal remains incomplete since no explicit account is offered for how the atelic reading arises in the case of directional motion verbs.

4.2   Ueno (2007)

In contrast to Iwamoto, Ueno mainly focuses on the lexical representations of the two types of motion verbs in Japanese. His central claim is that manner of motion verbs are associated with representations that encode both change of location and manner at the same time.

More specifically, Ueno analyzes manner of motion verbs basically as activity verbs except that they come with an additional meaning specification, along the following lines:

(61) $\begin{bmatrix} \text{MOVE } ([_{Thing} \;\; \alpha \;]) \\ \text{AFF } ([_{Thing} \;\;]^{\alpha}, [\;]) \\ \left[\text{FOR} \left[\text{GO } ([_{Thing} \;\; \alpha \;], [_{Path} \;\;]) \right] \right] \end{bmatrix}$

Here, MOVE represents physical motion not necessarily related to change of location and AFF stands for a two place 'affect' relation between Actor and Patient. These are common to ordinary (non-motion) activity verb. What distinguishes manner of motion verbs from genuine activity verbs is that they additionally specify the GO relation (representing directional motion) embedded under FOR (which represents 'purpose').

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[23]Converting the verb meaning representation to an atelic one via the notion of self-reference change is not an option here. As Iwamoto (2008, 285) explicitly notes, when an overt linguistic expression (here, the path phrase) fixes the value of d(x), that prevents the application of the self-reference change operation.

As it stands, however, (61)—with the main predicate MOVE—is a representation of an activity-type verb. To capture the commonality between manner of motion verbs and directional motion verbs more explicitly, Ueno introduces an operation called 'Clause Inversion', which flips the superordinate/subordinate relation between the MOVE and GO predicates in (61). By applying Clause Inversion to (61), we obtain (62):

(62)
$$\begin{bmatrix} \text{GO} ([_{Thing}\ \alpha\ ], [_{Path}\ \ ]\ ) \\ \text{AFF} ([_{Thing}\ \ ]^{\alpha}, [\ ]\ ) \\ \text{BY} \begin{bmatrix} \text{MOVE} ([_{Thing}\ \alpha\ ]) \end{bmatrix} \end{bmatrix}$$

In short, Ueno's proposal captures the dual status of manner of motion verbs by explicitly representing both manner and change of location meanings in the lexical representation of these verbs. Note that this directly goes against Levin and Rappaport Hovav's (2013) manner/result complementarity hypothesis.[24] This is somewhat worrisome since once one admits lexical representations of the form in (61)/(62), it is unclear what limits the complexity allowed in the lexical representations of verbs in natural language. In fact, this turns out to be precisely the source of the theoretical and empirical problems for Ueno's analysis.

The theoretical problem is that, in addition to the manner/result complementarity, Ueno's analysis violates another otherwise robust generalization governing the organization of the lexicon, namely, Koontz-Garboden's (2007) principle of MONOTONICITY. This principle essentially says that no destructive operation is possible in word formation processes (including zero derivation), and can be thought of as a word-level counterpart of the principle of compositionality. Clause Inversion violates the monotonicity principle since it destructively rewrites a complex meaning representation.

Introducing such a powerful operation may be justified if it is the only viable analysis of the data at hand. However, Ueno's analysis turns out to be empirically inadequate as well. The problem comes from the patterns of directional auxiliaries from section 2. Specifically, once

---

[24]But note that the viability of manner/result complementarity itself is still controversial. See Beavers and Koontz-Garboden (2012) and Husband (2011) for some recent discussion.

one admits complex representations like (61)/(62) that simultaneously encode an activity-type meaning and a (directional) motion meaning for *simplex* verbs, there is in principle no reason why such representations cannot be assigned to more complex, derived linguistic expressions such as *moete-iku (in the intended sense of 'go (while) burning' in (6c)). The representation in (62) seems exactly right for such a composite verb, but then, it remains mysterious why this structure cannot be assigned as the representation for such complex verbs.

Before moving on, I would like to clarify one key difference between Ueno's proposal and my own. In a sense, the **path** operator I have posited in my analysis is similar to Ueno's Clause Inversion operation in that it changes a 'manner'-type meaning to a 'change-of-location' type meaning. But note crucially that my analysis fully conforms to both the principle of monotonicity and the manner/result complementarity. The **path** operator yields a derived measure function by merely relying on the (derived) lexical entailment of the input verb meaning, without destructively modifying its internal structure. Thus, it conforms to the principle of monotonicity. Moreover, in my analysis, the 'manner'-type meaning and the 'result'-type meaning are never simultaneously present in any lexical representation (whether basic or derived), thus observing the manner/result complementarity too. This way, neither the conceptual nor the empirical problem of the sort discussed above arises in my analysis, and it captures the apparently problematic status of manner of motion verbs in a conceptually natural way.

5   Conclusion

I would like to conclude the paper by discussing some typological implications of the present scale-based approach. The lexicalization patterns of motion verbs have often been discussed in relation to Talmy's (1985; 2000) typological distinction between VERB-FRAMED and SATELLITE-FRAMED languages (cf. Kageyama (1997); Matsumoto (1997); Ueno (2007); Kitahara (2009) for some recent discussions on Japanese). In Talmy's typology, Japanese is classified as a verb-framed language, in which the notion of path is primarily encoded in

the verb rather than in a satellite (such as particles and pre-/postpositional phrases). In particular, it does not allow for the pattern exhibited by *run to the station* in English (a typical satellite-framed language), where the verb encodes the manner of motion and the path is expressed by the satellite. The typological distinction is taken to extend to other constructions as well, most notably the resultative construction: it has been observed in the literature (Kageyama 1996; Washio 1997) that the so-called strong resultatives (Washio 1997) in which an activity-type verb that does not entail any change of state on the object combines with a result phrase (as in *hammer the metal flat* in English) is impossible in Japanese.[25] This is naturally expected given that change of location and change of state are closely related notions. That is, here again, the satellite-framed pattern of English (in which a purely manner-denoting verb combines with a 'path'-denoting satellite) contrasts with the verb-framed pattern of Japanese (in which a verb that is not associated with a 'path'-oriented meaning fails to license resultatives).

The facts about resultatives are actually somewhat subtler than this. In particular, as noted by Washio (1997), the set of verbs that license resultatives in Japanese is larger than the set of change of state verbs. While activity verbs such as *tataku* 'hammer' and *hikizuru* 'drag' do not license resultatives, in addition to (unequivocally) change of state verbs such as *kooru* 'freeze' and *kogeru* 'burn' in (63), there is a set of verbs (many of which are surface-contact verbs) that lexically do not entail any definite change of state but which nevertheless license resultatives, including *migaku* 'polish', *huku* 'wipe' and *haku* 'sweep' in (64):[26]

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[25]Note also in this connection that English allows for this type of meaning composition in motion constructions too. As discussed in Isono (2013), even purely activity-type verbs that do not express any notion of change of location such as verbs of sound emission and light emission can combine with path phrases:

(i)   a. The cart rumbled down the street.

       b. A shooting star flashed across the sky.

[26]Washio (1997) provides evidence that these verbs are aspectually atelic (unlike genuine change of state

(63) a. Ike-ga   **katikati-ni** koot-ta.
          pond-NOM solid   freeze-PAST
          'The pond froze solid.'

       b. Zaimoku-ga **makkuro-ni** koge-ta.
          timber-NOM black   burn
          'The timber burned black.'

(64) a. John-ga   kutu-o   **pikapika-ni** migai-ta.
          John-NOM shoe-ACC shiny   polish-PAST
          'John polished the shoes shiny.'

       b. John-ga   teeburu-o **kireini** hui-ta.
          John-NOM table-ACC clean   wipe-PAST
          intended: 'John wiped the table cleanly.'

       c. John-ga   yuka-o   **tiri hitotu naku**   hai-ta.
          John-NOM floor-ACC without a speck of dust sweep-PAST
          intended: 'John swept the floor without a speck of dust.'

Washio (1997, 10) notes that although these latter verbs do not necessarily entail any change of state, they nonetheless 'imply that if the states of the patients do change, then they would change in certain fixed directions', in other words, that they 'have a "disposition" toward certain states'. In what follows, I call this class of verbs 'implicit change of state verbs'.[27]

The intermediate nature of implicit change of state verbs is somewhat reminiscent of the status of manner of motion verbs. In both cases, the verb is lexically an activity predicate

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verbs, which are telic) and should be classified as activity verbs rather than accomplishments. Kageyama (1996) claims that *kireini* in (64b) is a manner adverb rather than a result phrase, but his argument is based on a dubious assessment of data where he takes other result phrases such as *pikapika-ni* in (64a) to be incompatible with this class of verbs.

[27]The notion of implicit change here seems to be closely related to the notion of sublexical modality, a notion proposed by Koenig and Davis (2001) in a quite different empirical domain (argument linking). In particular, it seems possible to formalize Washio's notion of 'disposition' toward certain fixed states as an inherently modal notion instantiating Koenig and Davis's (2001) 'energetic modals', whose modal bases consist of worlds 'in which the actions or situations denoted by the verb achieve the goals that motivate those actions or the inherent consequences which result from the occurrence of the situation' (Koenig and Davis 2001, 89).

which is aspectually atelic, but at the same time the notion of change is implicitly present as a derived entailment (albeit as a modalized one in the case of implicit change of state verbs).

The above observations suggest a somewhat different characterization of the parallel between resultatives and motion constructions in Japanese than Talmy's original binary classification of language types. In particular, the fact that verbs exhibiting the intermediate status and which are aspectually not prototypical change of location/state verbs similarly undergo composition with path/result-oriented expressions (i.e. path phrases for manner of motion verbs and result phrases for implicit change of state verbs) is intriguing. Ideally, an analysis of resultatives in Japanese should capture this parallel in some theoretically principled way. Such an analysis in fact suggests itself quite naturally within the present scale-based setup. Specifically, the close parallel between motion constructions and resultatives can be captured by assuming that, just like motion constructions, resultatives in Japanese involve the operation of scale composition as the key mechanism of meaning composition. This indeed seems exactly the right analysis for change of state verbs like *kooru* 'freeze' and *kogeru* 'burn'. With change of state verbs, both the verb and the result phrase denote changes of state. The composite measure function that results from scale composition then measures the progress of change of state from two different perspectives simultaneously.[28]

The fact that implicit change of state verbs license resultatives can then be accounted for in terms of derived measure functions in a way parallel to the treatment of manner of motion verbs. Here again, what triggers the derived change of state measure function is the derived entailment of the verb. Specifically, due to the modalized entailment of 'change toward a certain fixed state', the activity-type meaning lexically specified for the verb can be converted to a change of state measure function that measures the progress of the resultant change.

---

[28]See Uegaki (2014) for a recent scale-based analysis of resultatives in Japanese. While I believe that the approach I have speculated on here shares the basic analytic intuition with Uegaki's proposal, there are certain technical assumptions that he makes which makes the comparison of the two not totally straightforward. A careful investigation of the semantics of resultatives is left for future work.

Note crucially that, by taking the modal component into account, the derived entailment of change is an uncancellable entailment: in Koenig and Davis's (2001) terms, the consequent change inevitably takes place in all worlds that are in the modal base of the 'energetic' modal lexically encoded in the verb. The derived measure function is then composed with the measure function of the result phrase to yield a composite measure function.

There are a number of details that need to be spelled out in order to work this out as an adequate analysis of resultatives, including the issues of how to represent verb meanings with modal components in a scale-based setup and at which step of meaning composition an implicit change is turned into an actually entailed change (which seems to be necessary in order to ensure that composing the derived verbal measure function with that of the result phrase yields a coherent composite measure function). I have to leave these issues for future work. The point here is that, if this line of analysis is generally on the right track, it offers an attractively simple explanation for the parallel between motion constructions and resultatives in Japanese.[29] The perspective offered in such an approach is more refined than the original Talmian classification, and is also in line with the recent rethinking on the Talmian typology (see, e.g., Beavers et al. (2010)) that attempts to account for the typological variation observed across languages from more general principles pertaining to the organization of the lexicon and the set of morpho-syntactic resources available in specific languages. On the view that I have argued for here, the essentially verb-framed nature of Japanese derives from the fact

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[29]Kageyama (1996, 1997) proposes to account for the typological pattern of Japanese in terms of available options for composing the 'Lexical Conceptual Structure' representations of verb meanings, which has a certain similarity to the present proposal. In a nutshell, Kageyama's proposal is that the verb-framed pattern of Japanese derives from the fact that it lacks the operation of freely composing process-type representations of activity verbs with result-denoting representations of the satellites to yield accomplishment-type meaning representations. The underlying intuition that the verb itself has to encode the notion of change in order to combine with path/result-denoting satellites is similar to the present proposal. However, in implementing this idea in a decomposition-based setup, Kageyama requires that verbs that can appear in resultatives are uniformly change of state verbs, an assumption that Washio (1997) convincingly argues is problematic.

that verbs themselves must (at least implicitly) encode a change-type measure function in their lexical meanings in order to license path phrases or result phrases. This retains the key insight of the Talmian classification, but at the same time, it naturally accommodates the fact that classes of verbs exhibiting intermediate properties exist both in the domain of motion verbs and in the domain of verbs licensing resultatives, a fact which arguably goes beyond the coarse binary classification of language types entailed by the original Talmian typology.

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