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Author(s)	Tanaka, Eri
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ERI TANAKA

RESULTATIVE PREDICATES AS EVENT MEASURES*

1 INTRODUCTION

The notion of measurement is originally applied to the nominal domain, especially to mass nouns. In English, mass nouns are not usually pluralized, rejecting the plural morphology (e.g. **rices*). These nominal predicates become countable when they are associated with a specific measurement scheme, such as *a cup of*, *a glass of*, *three tons of*. Thus an expression like *a cup of rice* is grammatical, being measured in terms of the size of a cup.

The aim of this paper is to apply this notion of measurement to the verbal domain. Exploiting the analogy between mass nouns and a certain class of verbal predicates, I will argue that an aspectual shift in verbal predicates is a manifestation of the measurement in the verbal domain.

The phenomenon that I will deal with in this paper is the so-called resultative construction, which is exemplified in (1):[1]

(1) a. John hammered the metal flat.
b. NP1 V NP2 XP [XP= AP, PP (and NP)]

The hallmark of this construction is that it conveys the meaning where NP1 does something to NP2, and as a result, NP2 becomes XP. (1)a, for example, may be paraphrased as: John hammered the metal and the metal became flat. The XP is usually called a *resultative predicate*, and I follow this tradition.

The resultative construction exemplified in (1)a describes a *telic* situation. The telicity refers to the temporal constitution of a lexical verbal predicate, and it can be attested by the so-called *subinterval property*. (2)a, for example, exhibits the entailment pattern of an atelic event:(2)b entails (2)c.

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[1] It has been well acknowledged that NPs are restricted in the position of the XP in this construction (Simpson 1983).

(2) a. John hammered the metal.
b. John hammered the metal from 1 to 2. =>
c. John hammered the metal from 1:30 to 1:45.

The resultative construction in (1)a, on the other hand, does not allow this entailment, as shown in (3), since it describes a telic event.

(3) a. John hammered the metal flat from 1 to 2. =/=>
b. John hammered the metal flat from 1:30 to 1:45.

Since Bach's (1986) influential work on the classification of verbal predicates, it has been widely assumed that there is a parallelism between the nominal and verbal domains, and atelic events correspond to mass nouns, and telic events to count nouns. The present paper argues that if this parallelism works, then it is also possible to extend it to the measurement system. As indicated above, mass nouns may be shifted to count nouns when associated with measures. It is obvious that the shift from atelic to telic in (2)a and (1)a is initiated by the presence of a resultative predicate. The hypothesis that I will pursue in this paper is that resultative predicates serve as measures in the verbal domain, and I will show that this explains a certain restriction applied to this construction.

The paper is organized as follows: In section 2, I will delineate the issue to be discussed, focusing on the Closed Scale Constraint posed on the resultative construction. In section 3, I will introduce Schwarzschild's (2002) measurement system, which is of a crucial import in analyzing resultative predicates. In section 4, I will discuss how the measurement system is applied to the resultative construction, and how the CSC is derived from that system. Section 5 will be a conclusion.

2 THE CLOSED SCALE CONSTRAINT

2.1 The Closed Scale Constraint

Resultative predicates allow two types of syntactic categories, AP and PP (see footnote 1). They do not, however, freely permit any kind of lexical items that fall into these categories. Observe the following:

(4) a. John hammered the metal {flat/smooth/*soft/*tubular}.
(adapted from Green 1972)
b. The king laughed himself {sick/?slightly nauseous}.
(Napoli 1992: 79)

The restriction has been couched in the semantic terms: resultative predicates have to 'denote an end-point of a scale' (Goldberg 1995), or to 'focus on the endpoint of an

activity' (Napoli 1992). Vanden Wyngaerd (2001: 64) offers the most explicit generalization:

(5) Resultative predicates denote a bounded scale.

The restriction in (5) will be called the *Closed Scale Constraint* (CSC, for short) hereafter. I will use the term "closed" instead of "bounded" in this paper, although it refers to the same notion.

Let us first examine the validity of the CSC. It has been well established in the literature that adjectives may be divided into two categories, *gradable* and *non-gradable* ones (e.g. Cruse 1986, Kennedy 1999). Gradable adjectives are those that accept modifiers such as *very, quite*, and *completely*, and comparatives, while non-gradable ones are those that do not.[2]

(6) a. *very {dead/red/worthless/triangular} [non-gradable]
b. very {long/tall/beautiful/tubular/dirty/soft} [gradable]
c. flatter, straighter, fuller, smoother, cleaner, dryer, wide awake [gradable]

Only gradable adjectives are assumed to have a degree argument in the semantics, and thus license the expressions that are sensitive to it (see Kennedy (1999)).

Gradable adjectives are further classified into subcategories, depending on whether they are modified by *half*, *almost*, or *completely*. The ones that accept these modifiers are called *closed scale adjectives*, and the ones that do not are called *open scale adjectives*:

(7) a. *completely {long/tall/beautiful/tubular/dirty/soft} [open scale]
b. completely {flat/straight/full/smooth/clean/dry/awake} [closed scale]

The CSC above, thus, limits resultative predicates to the ones that have a closed scale. The contrast described in (4)a-b seems to conform to the CSC, except for *sick*, as the following fact indicates:

(8) completely {flat/smooth/*soft/*tubular/*sick}

Vanden Wyngaerd (2001) presents the following data to reinforce the validity of

[2] Suzuki (in press) claims in footnote 4 that *dead* is a gradable adjective based on the observation that *dead* allows *completely* and *half* (*completely dead*, *half dead*). The adjective, however, totally excludes the formation of a comparative, as shown in (i):

(i) *more dead, *deader

Furthermore, *half dead* does not designate a middle point of a *dead-alive* scale, but describes a situation where x is close to death, but is not dead yet. This is evidenced by the fact that on an *empty-full* scale, the half-emptiness entails the half-fullness, as shown in (ii)a, while *half dead* does not entail *half alive*, as shown in (ii)b:

(ii) a. This bottle is half empty. <=> This bottle is half full.
b. John is half dead. =/=> John is half alive.

the CSC:

(9) a. Tom is {very/completely/almost/half} tired.
b. Max is {very/completely/almost/half} hoarse.
c. The pavement is {very/?completely/?almost/half} thin.
d. Charley is {very/completely/almost/half} silly.
(Vanden Wyngaerd 2001: 65)

(10) a. Tom danced himself {completely/almost/half/*very} tired.
b. Max shouted himself {completely/almost/half/*very} hoarse.
c. The joggers ran the pavement {completely/almost/half/*very} thin.
d. Charley laughed himself {completely/almost/half/*very} silly.
(Vanden Wyngaerd 2001: 64)

The data in (10) show that adjectives are coerced to have a closed scale in the context of a resultative predicate. Ono (2005) points out that the same is also true of *sick*. He reports that with a survey on the internet, he has found six resultative examples which include *completely sick*, while only one example that includes *very sick* has been detected.

The restriction is supposed to be applied to PP resultative predicates as well. A PP resultative predicate may be headed by *into*, *to*, *off*, and *out of*, which imply a scale (or path) and the upper limit of the scale is provided by an object NP. Some examples are given below (italics mine):

(11) a. '…*Walk yourself into a comma* and see what your subconscious comes up with.' (Rappaport Hovav and Levin 2001: 773)
b. A fluorescent bar *buzzed into life*. (AP 135)
c. When Carmen came to, his body was still buzzing with the same odd kinetic energy that had *knocked him into unconsciousness*.(WebCorp)

(12) a. I *beat him to a pulp*. (Napoli 1992: 58)
b. And yes, he did keep a box of fairly spicy paperbacks under the checkout desk, loaning them out carefully and making sure they always got back. Even so, each new acquisition of that type was quickly *read to tatters*. (SH 50)

(13) a. Mosquitoes hummed and I *slapped one off my neck*. (BOD 415)
b. I *slapped him out of hysterical*. (Napoli 1992: 57)
c. … Boon had talked a panic-stricken pregnant mother through her first labour-pains, or when he *argued a homosexual clergyman out of suicide*,… (CP 75)

The data so far seem to confirm the CSC as a generalization for resultative predicates. I shall point out, however, that the CSC should be applied to a subset of (so-called) resultative constructions.[3]

It has been acknowledged in the literature that the resultative construction may be divided into (at least) two types, based on the aspectual property of a main verbal

[3] Ono (2005) also argues that the CSC works only for activity-based resultatives.

predicate (Kageyama 1996, Washio 1997). One is dubbed here *activity-based resultatives*, while the other is *accomplishment/achievement-based resultatives*. The relevant semantic characterization to this distinction is the telicity of a verbal predicate.[4] Activity verbs (in the sense of Vendler 1967) are atelic, while accomplishment/achievement verbs are (or can be) telic. Consider the following:

(14) a. The king laughed {*in/for} ten minutes. [activity; atelic]
b. The ice cream froze {in/*for} 30 minutes. [achievement; telic]
c. John painted the wall {in/for} 40 minutes. [ambiguous]

The (in)compatibility with temporal adverbials in (14) suggest that *laugh* denotes an atelic event, while *freeze* describes a telic one (see Dowty 1979). The grammaticality of (14)c indicates that *paint* may be either atelic or telic. Keeping this in mind, let us observe the achievement/accomplishment-based resultatives (the italics mine):

(15) a. John painted the wall *red*.
b. Burns looked at his boots and found them charred *black*.
(Rappaport Hovav and Levin 2001: 785)
c. Her reddish hair was cut *short* and neatly combed. (Cobuild)
d. I froze the ice cream {*a little/very*} *hard*. (Suzuki in press)
e. John painted the wall *very bright*. (Boas 2003)

The data in (15)a-b shows that this type of resultative may accept a non-gradable adjective such as *red* and *black*. (15)c suggests that a gradable open scale adjective (i.e. *short*) may be licensed and (15)d-e indicate that they do not exclude the modification by *a little* or *very*, which is not possible in the examples in (10). The data in (10)-(13), on the other hand, are based on activity verbs, and they obey the CSC. I conclude from these that the CSC should be applied only to the activity-based resultative construction.

The question now is why the grammaticality of activity-based resultatives is affected by the semantics of resultative predicates, while achievement/ accomplishment-based resultatives may permit any kind of resultative predicate. I will argue that the distinction is reduced to the difference in the semantic structure of these events.

2.2 BECOME

One of the mysteries in the formation of activity-based resultatives lies in the 'change-of-state' meaning associated with this construction. The (a) sentences in (16)-(18), for example, can be paraphrased by the sentences that involve *become*, as shown in (b) sentences:

[4] The distinction basically corresponds to the 'weak-strong' dichotomy in Washio (1997) or 'inherent-derived' dichotomy in Kageyama (1996).

(16) a. John hammered the metal flat.
b. The metal became flat as a result of John's hammering.
(17) a. John knocked him unconscious.
b. He became unconscious as a result of John's knocking.
(18) a. I squiggled free.
b. I became free as a result of my squiggling.

The semantics of main verbs themselves do not include the transition interpretation. This is evidenced by the incompatibility with adverbials that require a developmental or transitional structure, such as *completely* and *almost* (Piñón 2005). Compare the examples in (19) and (20):

(19) a. *John hammered the metal *completely*.
b. *John knocked him *completely*.
c. #I *almost* squiggled. [under the intended interpretation]
(20) a. John froze the ice *completely*.
b. John *almost* ate an apple.

In (19), in contrast to (20), the verbs do not have any transitional structure that can be modified by *completely* or *almost*. The resultative construction based on these verbs, on the other hand, allows the modification by these adverbials, which suggests that the construction introduces a transitional interpretation:

(21) a. The metal was completely hammered flat.
b. The assailant was completely knocked unconscious. (WebCorp)
c. I twisted and turned and almost squiggled free. (SH 472)

It is obvious that the adjectives used as resultative predicates do not have a transitional structure either. Even if they accept *completely* (or *almost*), the sentences just denote the maximal degree:

(22) a. The metal is completely flat.
b. John is completely unconscious.
c. I am completely free.

The 'change-of-state' or transitional interpretation of the construction has been attributed to the presence of BECOME-operator in the semantic representation of the construction. Under a decompositional view, the meaning of a verb may be decomposed into a set of primitive semantic schemata, and the semantics of a construction with a complex syntactic structure may be described by the 'composition' of these basic components (see Dowty 1979, Jackendoff 1990, Levin and Rappaport Hovav 1995). A standard representation of the decomposition is given below:

(23) a. x BE-AT z [States]
b. y BECOME [BE-AT x] [Achievements]
c. x ACT-ON y [Activities]
d. [x ACT-ON y] CAUSE [y BECOME [BE-AT z]] [Accomplishments]

The schemata in (23) are assumed to correspond to the Vendler-style aspectual classification. As indicated there, the composition of activities and achievements gives accomplishments. The resultative construction may be viewed as a syntactic manifestation of this lexical-semantic composition, and the origin of the transitional interpretation is traced to the presence of the BECOME component.

In this analysis, the BECOME-operator bears another function: it explains why the resultative construction has a telic interpretation. The state component, which is an argument of the BECOME-operator, defines the final state of one of the participants of an activity. This analysis, however, does not predict the restriction described in the previous section, since the operator poses no semantic constraint to the adjective it takes, and thus any kind of state may serve as a final state, if other factors are well-controlled. Vanden Wyngaerd (2001), thus, argues for the idea where the BECOME-operator analysis is discarded, and he claims that resultative predicates function as *event measures* and the CSC follows from this, because measures are, by definition, 'bounded'. For this implement to work out, we need to assume that an adjectival measure should have a scalar structure that is both lower and upper bounded, as shown in (24):

(24) 0----------1

This line of approach, however, leaves the transition problem unresolved; namely, it does not explain why the resultative construction is associated with a change-of-state interpretation. Furthermore, it is not always possible to assume the scalar structure in (24), and there are some adjectives that cannot have the structure. Kennedy and McNally (2005) show that not all closed scale adjectives have the structure in (24). An important aspect of the structure given above is that it has the two fixed points, which define the minimum (=0) and maximum (=1) degrees respectively. An example of this kind is provided by the *full-empty* scale, where *empty* denotes the minimum degree of the scale and *full* denotes the maximum degree of the scale. A scale with both minimum and maximum degrees is called a *totally closed scale*. It naturally defines the middle point on that scale, which explains the compatibility with *half*:

(25) The glass is *half* {full/empty}.

There are adjectives based on a scale that is closed only on one end. Let us observe the following:

(26) a. The metal is completely {smooth/??rough}.
b. The rope is fully {??bent/straight}.

In these examples, the antonymous pairs display the difference in the compatibility with adverbials that refer to the maximum degree: only one of the pairs accepts the adverbials. The contrast suggests that these adjectives are based on *lower-bounded* and *upper-bounded* scales respectively, and the other ends of the scales remain open. It is natural that they do not tolerate the modification by *half* (e.g. ??*half smooth/rough*, ??*half straight/bent*), for the scales cannot define the 'middle' point. The scale structures that they are based on may be represented as in (27):

(27) a. 0---------1---------- [lower-bounded]
b. ----------0----------1 [upper-bounded]

Since these adjectives do not define two values, they cannot determine an interval either. Vanden Wyngaerd's (2001) theory, then, would fail to explain the fact that upper/lower-closed adjectives, such as *dry*, *smooth*, and *thin*, can be used in the resultative construction:

(28) a. Having drunk the teapot dry….
(Levin and Rappaport Hovav 1995: 37)
b. Max pats the bag smooth. (Rappaport Hovav and Levin 2001: 767)
c. The joggers ran the pavement thin. (Napoli 1992: 79)

It seems that the parallelism between resultative predicates and path locatives (i.e. *to/into X*) underlies the proposal offered by Vanden Wyngaerd (2001). A path locative encodes the goal and presupposes the source. The source may be explicitly realized as *from X*:

(29) John walked/ran/swam from here to the (other side of the) shore.

The resultative construction, on the other hand, never explicitly expresses the source:

(30) a. *I kicked him from consciousness to unconsciousness.
b. *I melted the butter from a solid entity to a liquid.

The resultative predicates, whether they are adjectives or prepositional phrases, do not include the transitional interpretation, and thus they fail to encode the 'source'.

I resolve this problem by positing the BECOME-operator, as in the traditional analyses, and assume that it licenses the transitional meaning as well as defining an interval on a scale. I assume that the BECOME-operator is present at the level of syntax as a phonetically null (lexical) predicate. The structures I posit here are basically the same as the ones proposed in Bowers (1997) and Doetjes (1997):

(31) a. John $[_{vP}$ $[_{v'}$ hammer $[_{VP}$ the metal$_i$ $[_{V'}$ t $[_{RP}$ PRO$_i$ $[_{R'}$ BECOME $[_{AP/PP}$ flat]]]]]]] [transitive-based]
b. The king $[_{vP}$ $[_{v'}$ laugh $[_{VP}$ himself$_i$ $[_{V'}$ t $[_{RP}$ t$_i$ $[_{R'}$ BECOME $[_{AP/PP}$ silly]]]]]] [unergative-based]

The BECOME operator is regarded as the head of a Result Phrase (=RP), which takes an AP/PP as its complement. Transitive-based resultatives are assumed to have a control structure, while unergative-based resultatives are assumed to have an E(xceptional) C(ase) M(arking) structure.

Although I do not agree with Vanden Wyngaerd's proposal in that he rejects the BECOME-operator analysis, I agree with him in that resultative predicates function as event measures for the main verbs. I would like to show how the measurement thesis is implemented along with the BECOME-operator analysis in the succeeding sections.

3 THE MEASUREMENT THEORY

3.1 Schwarzschild's (2002) Measurement Theory

In this section, I shall introduce the measurement theory proposed by Schwarzschild (2002), which I assume in this paper.

Measure expressions such as *two kilograms* and *three centimeters* may occur in nominal modification positions, as shown in (32) and (33):

(32) a. two kilograms of meat
b. three centimeters of tube

(33) a. (a) two kilogram baby
b. (a) three centimeter tube

The construction in (32) has been called *pseudopartitives* in the literature (Selkirk 1977, Jackendoff 1977), and the one in (33) will be called *compounds*, following Schwarzschild (2002).

Schwarzschild (2002) observes that the distributions of pseudopartitives and compounds are sensitive to the mass-count distinction in modified NPs. Consider the following examples (Schwarzschild 2002: 228):

(34) a. two hours of work; *two hour work
b. *two hours of job; (a) two hour job

(35) a. two liters of oil; *two liter oil
b. *two liter of tank; (a) two liter tank

In (34)-(35), (a)-examples include mass nouns, while (b)-examples include singular count nouns. Mass nouns and singular count nouns differ in that the former denotes entities that have a *part* that can be described by the same nominal predicate (cf. Link (1983)). Take *water* for example. If x is *water*, and y is a part of x, then y is also *water*. A singular count noun, such as *an apple*, does not have this property: If x is *an apple*, and y is a part of x, then y cannot be *an apple*. The part-of relation is also observed in bare plural count nouns: If x is *apples*, and y is a part of x, then y can be *apples*.

These nouns also license pseudopartitives:

(36) a. two bags of beans
b. three kilograms of apples

Note that once a mass or (bare) plural noun is measured by a measure phrase in a pseudopartitive construction, the measured nominal does not show the part-of relation described above. If x is *two liters of oil* and y is a part of x, then y cannot be *two liters of oil*. Thus, the measured mass noun has the same semantic property as a singular count noun with respect to the part-of relation.

Some measure expressions are not allowed in pseudopartitives, even if a modified NP is mass:

(37) a. *two degrees Celsius of water (cf. two liters of water)
b. (some) two degree Celsius water

Schwarzschild (2002) argues that the contrast observed in (32)-(33) and the ungrammaticality of (37)a are attributed to the *monotonicity constraint* on a measure function associated with a pseudopartitive construction.[5] The constraint is defined below:

(38) A measure function μ is monotonic relative to domain I iff:
For individuals x, y ∈ I:
If x < y, then μ(x) < μ(y), where < is a proper part-of relation.

Pseudopartitives must include a monotonic measure function, while compounds require non-monotonic one. The first part of the constraint restricts the domain of a monotonic measure function to the one that has a proper part-of relation in its denotation. Thus the contrast in (32)-(33) follows. The second part of the constraint requires that a measure function preserve the proper part-of relation in the domain. This ensures that temperature is not monotonic to *water*: Given that x and y are *water*, and x is a part of y, then that the temperature of x is lower than the temperature of y does not hold. Volume, on the other hand, is monotonic to *water*: If x and y are *water*, and x is a part of y, then the volume of x should be less than the volume of y.

The semantics of a monotonic measure phrase (e.g. *two liters of*) is represented as follows: [[denotation]]

(39) a. [[mp]] = λP.λx. P(x) & mp (μ(x)) & μ is monotonic to P
b. [[two liters of water]] = λx. water (x) & two-liters (μ(x)) & μ is monotonic to *water*. μ: volume

The impact of Schwarzschild's (2002) theory of measurement lies in the idea that a measure phrase is treated as a predicate of a (scalar) interval, which is a result of the application of a measure function μ to a nominal individual.

[5] The same restriction is captured by extensiveness of measure function in Krifka (1989, 1998).

Krifka (1989, 1998) captures the monotonicity in terms of the notion of *extensiveness* of a measure function, and he identifies a measure expression in a measure phrase (i.e. *liter* in *two liters of water*) with a measure function:

(40) [[two liters of water]]= λx. water (x) & liter (x) = two

An extensive measure function is defined as a function that preserves a sum operation: If x and y are water, and x and y do not overlap, then *liter* (x) + *liter* (y) equals *liter* (x + y). Thus, *liter* is an extensive measure function. It is clear that *degree Celsius* does not follow this pattern: If x and y are *water* and they do not overlap, then degree C (x) + degree C (y) does not equal degree C (x + y).

Schwarzschild's analysis, where a measure phrase is treated as a scalar predicate, is superior to Krifka's in that it explains the following contrast:

(41) a. two inches of cable
b. (a) two inch cable

In (41)a, what is measured by the measure phrase is the length of a cable, while the measure phrase in (41)b specifies the length of the diameter of a cable. (41)a may be represented as shown in (42)a and (42)b in Schwarzshild's and Krifka's system, respectively:

(42) a. [[two inches of cable]] = λx. cable (x) & two inches (μ (x)) & μ is monotonic to *cable*. μ: length
b. [[two inches of cable]] = λx. cable (x) & inch (x) = 2

Notice that only in Schwarzshild's system can be the difference between the two interpretations of (41) handled. The compound in (41)b, which requires a non-monotonic measure function, may have the following representation:

(43) [[two inch cable]] = λx. cable (x) & two inches (μ (x)) & μ is not monotonic to *cable*. μ: diameter

(43) is crucially different from (42)a in that the measure function is not monotonic to *cable*, which leads to the interpretation where what is measured is not the length of a cable but the diameter of a cable. Krifka's analysis, on the other hand, predicts that (41)b has the same semantics as (42)b, and it cannot explain why in some cases *inch* serves as an extensive measure function (i.e., as in (41)a), while in other cases it does not (as in (41)b).

3.2 The Monotonicity in the Event Domain

Measure phrases may also modify verbal predicate, as shown by *walk two kilometers*, *dance a lot*. In this section, I will show that the monotonicity constraint defined above

may be applied to the adverbial measure phrases.

I assume that a verbal predicate denotes a set of *events*, following the event semantic view (Davidson 1967, Parsons 1990). Under this view, *walk*, for example, has the following semantic representation:

(44) [[walk]] = λe. walk (e)

Krifka (1998) argues that an adverbial measure phrase, such as *two kilometer*, is based on an extensive measure function (i.e. *kilometer*) for events. Under the measurement system just described above, an extensive measure function is superseded by a monotonic measure function. The example in (45)a would have the following semantic composition:

(45) a. John walked two kilometers.
b. [[two kilometers]] = λP.λe. P(e) & two-kilometers (μ (e)) & μ is monotonic to P.
c. [[walk two kilometers]] = λe. walk (e) & two-kilometers (μ (e)) & μ is monotonic to *walk*.
d. [[*Agent* [walk two kilometers]]] = λx. λe. Agent (e) = x & walk (e) & two-kilometers (μ (e)) & μ is monotonic to *walk*.
[Event Identification in Kratzer (1996: 122)][6]
e. [[John walk two kilometers]] = λe. Agent (e) = j & walk (e) & two-kilometers (μ (e)) & μ is monotonic to *walk*.
f. [[John walked two kilometers]] = ∃e. Agent (e) = j & walk (e) & two-kilometers (μ (e)) & μ is monotonic to *walk*.
[Existential Closure over events]

Let us now examine whether a measure function involved in an adverbial measure phrase is monotonic to events. The monotonicity in the event domain will be defined as follows:[7]

(46) A measure function μ is monotonic to domain E iff:
For individuals e, e' in E:
If e is a proper part of e', then μ(e) < μ (e').

As in the case of the monotonicity in the individual (=nominal) domain, the constraint requires a part-of relation in the event domain. In the individual domain,

[6] The definition of Kratzer's (1996) Event Identification is given below:
(i) If [[f]] and [[g]] are of type <d, <e, t>>, and <e, t>, respectively (,where d is the type of individuals, e is the type of events, and t is the type of truth values) then:
[[f]] ([[g]]) = λx. λe. f (x)(e) & g (e).

[7] Nakanishi (2004) exploits a more fine-grained definition for the monotonicity in the event domain, following Krifka's (1998) suggestion that the primary (direct) argument of an extensive measure function should be individuals. In (45)a, for example, the measured entity is not an event, but a path of that walking event: the measure phrase refers to the distance of a path along which John walked. Since the relation between a walking event and its path is captured by homomorphism (i.e. the structure in a path is preserved in the event), the measure phrase indirectly measures the event.

the denotations of mass and bare plural NPs have a part-of relation in their domain, while singular count NPs do not. The parallelism between nouns and verbs in Bach (1986) shows that mass/bare plural NPs correspond to atelic verbal predicates, and singular count NPs to telic verbal predicates. As I noted in section 1, an atelic predicate such as *hammer the metal* has a part that can be applied to the same predicate. Thus, if e and e' are *hammer the metal*, and e < e' then *hammer the metal* (e). A telic predicate, such as *arrive at the station*, does not have a part-of relation. If e and e' are *arrive at the station* and e < e', then *arrive at the station* (e) cannot hold.

The fact that a telic predicate lacks a part-of relation correlates with the compatibility with a measure phrase:

(47) a. *John arrived *two meters*.
b. *John arrived *a lot*.

The correlation is expected under the monotonicity constraint: Since a telic event does not have a part-of relation, the first condition in (46) is violated.

There is a class of verbal predicates that show ambiguous status with respect to the telicity: semelfactives (e.g. *cough, kick, knock, sniff*; see Smith 1993). These verbs denote a single telic event, as in *John knocked (on) the door once*, while at the same time, they may also denote an iterative event. Under the iterative event interpretation, the semelfactive verb is interpreted to be an activity, as evidenced by *John knocked (on) the door for five minutes*. Semelfactive verbs allow a measure phrase, as shown in (48):

(48) a. John kicked him a lot.
b. John knocked on the door a lot.

The monotonicity constraint predicts the grammaticality in (48). The iterative interpretation of a semelfactive verb corresponds to bare plurals in the nominal domain in that it describes a plural event that has a part-of relation in its denotation.

An adverbial measure phrase also obeys the second condition of the monotonicity. Let us observe the following:

(49) a. John walked a lot.
b. John walked a long distance.
c. John walked for a long time.

A lot does not specify the measurement scheme. (49)a may be ambiguous between the interpretations in (49)b-c, both of which are monotonic to *walk*. If e and e' are walking events and e <e' then the distance in e should be shorter than the distance in e'. The same is also applied to the temporal interpretation in (49)c.

In the event domain, an adverbial measure phrase seems to observe the monotonicity condition. Nakanishi (2004) argues that based on the analysis of split (or *floating*) quantifiers, a measure function involved in the event measurement is a monotonic one, and there is no equivalent to compounds in the event domain. I also posit here that a measure function related to an event has to obey the monotonicity

constraint in the event domain.

To sum up: In this section, I introduced the measurement system that utilizes a measure function μ. In the measurement system, a measure phrase is treated as a scalar predicate, which is applied to the result of the function application to an entity in the domain. The monotonicity constraint was also introduced, and I showed that the constraint is applied both in the nominal and verbal domains.

4 RESULTATIVE PREDICATES AS EVENT MEASURES

Let us now return to the analysis of resultative predicates. In section 2, I showed that only activity-based resultatives are sensitive to the CSC, and the constraint is not relevant for achievement/accomplishment-based resultatives. In this section, I will show that this asymmetry regarding the CSC is explained by analyzing resultative predicates as a kind of measure phrases that measures an event.

4.1 The Semantics of BECOME AP/PP

Recall that in section 2.2 I posited the BECOME-operator as the head of Resultative Phrase (=RP). The structures that I posit are repeated here as (50):

(50) a. $[_{vP}\ [_{v'}\ V\ [_{VP}\ DP_i\ [_{V'}\ t\ [_{RP}\ PRO_i\ [_{R'}\ \underline{\text{BECOME}}\quad \text{AP/PP}]]]]]]$
[transitive-based]

b. $[_{vP}\ [_{v'}\ V\ [_{VP}\ DP_i\ [_{V'}\ t\ [_{RP}\ t_i\ [_{R'}\ \underline{\text{BECOME}}\ \text{AP/PP}]]]]]]$
[unergative-based]

Dowty (1979) postulates the BECOME as a sentential operator that takes a proposition ϕ. [BECOME ϕ] defines a transition from ¬ϕ to ϕ. Since RP is not a sentential projection, the direct application of the formulation is not viable. Furthermore, the BECOME-operator may take an AP or PP that has the degree semantics. Thus, I would like to reformulate the definition of the BECOME with respect to degrees.

Kennedy (1999) argues that a gradable adjective denotes a measure function that takes an individual and returns a degree (or scalar interval) on a scale that is defined by the adjective. A gradable adjective is further headed by a phonologically null Degree head, which defines the *degree of standard*:

(51) a. $[\![\ \text{AP}\ ]\!] = \lambda x.\ \delta_{AP}\ (x)$
b. $[\![\ [_{DegP}\ \text{Deg AP}]\ ]\!] = \lambda d.\ \lambda x.\ \delta_{AP}\ (x) \geq d.$

The degree of standard is a degree on which the truth value of a gradable adjective is dependent. The value may be either supplied by a context (as in *John is tall (for an*

eight-years-old boy).) or a degree numeral (as in *John is 180 centimeters tall*.) In the former, the standard degree is existentially closed:

(52) a. John is tall.
b. $[\![[_{DegP} \text{ Deg tall }]]\!] = \exists d.\ \lambda x.\ \delta_{tall}\ (x) \geq d.$
c. $[\![\text{John is tall }]\!] = \exists d.\ \delta_{AP}\ (j) \geq d.$

I assume that PPs, such as *to death*, *(in)to unconsciousness*, also have a degree semantics:

(53) a. $[\![\text{PP }]\!] = \lambda x.\ \delta_{PP}\ (x)$
b. $[\![\text{Deg PP }]\!] = \lambda d.\ \lambda x.\ \delta_{PP}\ (x) = d.$

I follow Dowty (1979) in that the BECOME defines a *not-P to P* transition. I propose that the negation of a gradable adjective can be defined as follows (I will use AP_{deg}/PP_{deg} for the abbreviations of $[_{DegP}\ [_{Deg'}\ \text{Deg}\ [_{AP/PP}\ A]]]$):

(54) a. $[\![\text{not } AP_{deg}]\!] = \lambda d.\lambda x.\delta_{AP}\ (x) < d.$
b. $[\![\text{not } PP_{deg}]\!] = \lambda d.\lambda x.\delta_{PP}\ (x) < d.$

The negation of a gradable adjective can be defined by a reverse relation between the standard degree and the degree of the adjectival/prepositional subject. The BECOME operator defines an interval that both includes *not tall* and *tall* degrees. This is diagrammatically represented in (55):

(55) a. *tall* => ----0---------- ds--------d'--------> [height]
b. *not tall* => ----0------d----ds---------------->
c. BECOME *tall* => ----0-----==========---------->

The definition of the BECOME-operator is given below (G is a variable for gradable adjectives):

(56) a. $[\![\text{BECOME }]\!] = \lambda G.\lambda I.\lambda x.\exists ds.\exists d.\exists d'.\ G(x)(ds)\ \&\ d < ds\ \&\ d' \geq ds\ \&\ d, d' \in I.$
b. $[\![\text{tall}_{deg}]\!] = \lambda d.\lambda x.\ \delta_{tall}\ (x) \geq d.$
c. $[\![\text{BECOME tall}_{deg}]\!] = \lambda I.\lambda x.\exists ds.\exists d.\exists d'.\ \delta_{tall}\ (x) \geq ds\ \&\ d < ds\ \&\ d' \geq ds\ \&\ d, d' \in I.$

A resultative phrase (=RP) consists of the BECOME, AP/PP and a (monotonic) measure function μ. It is further composed with a main verbal predicate. I assume μ has the following semantics:

(57) a. $[\![\mu]\!] = \lambda Q.\lambda P.\lambda e.\ P(e)\ \&\ Q\ (\mu(e)).$
b. $[\![\mu + \text{BECOME tall}_{deg}]\!] = \lambda x.\lambda P.\lambda e.\ P(e)\ \&\ \exists ds.\exists d.\exists d'.\ \delta_{tall}\ (x) \geq ds\ \&\ d < ds\ \&\ d' \geq ds\ \&\ d, d' \in \mu\ (e)$

4.2 The Monotonicity Constraint and to death *vs.* dead

In the last section, I presented an analysis where an interval defined by an RP is related to a main verbal event via a measure function μ. I shall show in this section that the measure function is monotonic to the event described by a main verbal predicate, as in the case of adverbial measure phrases.

Let us first observe the contrast exhibited by *to death* and *dead*:[8]

(58) a. He laughed himself {to death/*dead}. (Verspoor 1997: 119)
b. He ate himself {to death/*dead}.
c. They went for the throat or the genitals, and the smallest scratch from their long black claws could poison a man {to death/*dead}. (adapted from the data in BNC)

In these examples, *dead*, a non-gradable adjective, is not allowed as a resultative predicates. In contrast, in the following, *to death* and *dead* may alternate:

(59) a. Two of them were shot {to death/dead}.
b. I beat John {to death/dead}. (adapted from Simpson 1983:147)
c. John was stung {to death/dead} by the bees.

In section 2.1, we observed that *dead* is a non-gradable adjective (see also footnote 2), while *to death* includes the degree semantics due to the semantics of *to*. The monotonicity constraint on event measurement in (46), repeated as (60), requires that a measure function preserve the part-of relation in the event domain.

(60) A measure function μ is monotonic to domain E iff:
For individuals e, e' in E:
If e is a proper part of e', then $\mu(e) < \mu(e')$.

The verbs in (58) all fall into the category of atelic events, which suggests that they have a part-of relation. Since *dead* has no degree semantics, *BECOME dead* does not define an interval. As I defined above, μ(e) is crucially dependent on the semantics of a BECOME component, and thus μ(e) cannot have a part, resulting in a violation of the monotonicity.

How is the data in (59), then, explained under the measurement analysis?[9] Wechsler (2005: 256) observes the similar contrast, noting that *batter* is a durative (i.e., atelic) while *shoot* may be either a durative or a punctual (i.e. telic):

(61) a. The rabbits had apparently been battered {*dead/to death}.
b. He and a confederate shot the miller {dead/to death}.

[8]Examples (58)a-b have non-literal, emphatic interpretations, which are not intended here. The first person pronoun would coerce the emphatic interpretation, as shown in (i):
(i) I laughed/ate myself to death. [i.e. I laughed/ate too much.]
[9]Vanden Wyngaerd (2001) faces the same problem, but he has not provided a satisfactory solution.

Verbs such as *shoot*, *beat*, and *knock* are so-called semelfactives, and these verbs may be ambiguous between atelic and telic interpretations (section 3.1). This suggests that they may be either mass or count. The monotonicity constraint requires events to be mass, and since *to death*, and not *dead*, functions as a measure for a mass event, it is predicted that when an event is coerced to be a singular count (= a single telic event), then it does not allow *to death*. This prediction seems to be borne out, as (62) shows (cf. Goldberg and Jackendoff 2005):

(62) a. *I shot him to death with only a single shot.
b. I shot him dead with only a single shot.

The following examples further validate the prediction. (63)a and (63)b differ in that what is beaten (a person, a rat) could be killed by a single blow of a bat or a broom. An instrument such as a bat is not enough to kill a man by beating with only a single blow, while a broom may be enough to kill a rat by beating:

(63) a. I beat him {to death/??dead} with a bat.
b. I beat the rat {to death/dead} with a broom.

The verb, *sting,* in example (59)c, is not usually ambiguous between atelic and telic, when used in a transitive verb (in a literal sense). In (64), the use of progressive in *sting* results in an anomaly, while *beat* does not:

(64) a. ?The bee is stinging him.
b. He is beating the rat.

Since Wechsler's (2005) explanation attributes the contrast to the distinction between atelic vs. telic, the example in (59)c may not be predicted. The measurement theory coupled with the monotonicity constraint, on the other hand, states that what matters is whether the event in question has a part-of relation or not. It predicts that a non-semelfactive telic event may also show the same contrast when the context requires that there be several stinging events. Consider the following:

(65) a. ?? John was stung to death by the bee.
b. John was stung dead by the bee.
(66) a. John was stung to death by a lot of bees.
b. ?? John was stung dead by a lot of bees.

In (65), the stinging event is understood to happen only once, while (66) may have plural stinging events, due to the presence of a lot of bees. The results are explained by the monotonicity constraint, because only plural events have a part-of relation, and thus can be measured by *to death*, not *dead*.

Before moving to the next section, I would like to note another approach to the contrast between *to death* and *dead*. It is called the 'temporal gap' approach here, which is offered by Kageyama (2000). The approach attributes the contrast to the

presence of a temporal gap between an event described by a main verb and a result state. Kageyama (2000: 176) notes that when *to death* is used, there may be a temporal gap between the time at which a main verb event occurs and the time at which the individual involved actually dies. Under this approach, (67)a is not consonant with *dead* because one cannot kill someone at once by stabbing. Rather, the stabbed person will be dead after bleeding a lot. (67)b, on the other hand, one may be able to kill someone at once by shooting, when he got the bullet in a right point.

(67) a. John stabbed him {to death/*dead}.
b. John was shot {to death/dead}.

The approach is, unfortunately, hard to test. The resultative construction does not permit two different temporal adverbials to be distributed over the main clause and the resultative phrase (e.g. **On Monday, John sang himself hoarse on Tuesday*.). Furthermore, it cannot, it seems, explain the contrast in (65) and (66), because one could easily imagine that a lot of bees, rather than one bee, can kill a person at once. The prediction that this approach would make is opposite to the fact. I conclude, thus, that the measurement under the monotonicity constraint approach is superior to the temporal gap approach advocated by Kageyama (2000).

4.3 The CSC and the Monotonicity Constraint

Recall that the requirement of the monotonicity constraint is two-hold: (i) events must have a part-of relation in their domain, and (ii) the part-of relation is preserved by the measurement. In section 2.1, I pointed out that the CSC holds only for activity-based resultative constructions. This naturally follows from the assumption that for an event to be measured, it has to have a part-of relation in its domain. In this section, I will show that the CSC follows from the second constraint in the monotonicity constraint.

Let us first recall what the CSC phenomenon is. The examples are repeated in (68):

(68) a. John hammered the metal {flat/smooth/*soft/*tubular}.
b. The king laughed himself {sick/?slightly nauseous}.

Recall also that the semantics of a resultative phrase is crucially dependent on that of an AP/PP:

(69) $[\![\mu + \text{BECOME AP}_{deg}]\!] = \lambda x.\lambda P.\lambda e.\ P(e) \ \&\ \exists ds.\exists d.\exists d'.\ \underline{\delta_{AP}(x) \geq ds}\ \&\ d < ds\ \&\ d' \geq ds\ \&\ d, d' \in \mu(e)$

The truth condition of a gradable adjective must refer to the degree of standard (ds). According to Kennedy and McNally (2005), degrees of standard for gradable adjectives may be *absolute* or *relative*, and the distinction hinges on whether the

adjectives are closed or open.

Take *tall* for example. Assume that John is 1.5 meters tall. Under this circumstance, (70)a may be judged to be false, while (70)b will be true:

(70) a. John is tall.
b. John is tall for an eight-year-old boy.

(70)a possibly refers to the degree of standard with respect to the heights of people in general, while (70)b is evaluated with respect to the heights of ten-year-old boys. The degree of standard may shift *relative* to the contextually relevant set.

The adjectives in (71), on the other hand, which exemplify the *absolute* standard adjective, do not change the fullness/emptiness according to the contexts. (71)a will be true when the content of the glass reaches the *maximum* on a fullness scale, and (71)b will be true when it reaches the maximum on a emptiness scale:

(71) a. The glass is full.
b. The glass is empty.

These adjectives are called *maximum standard adjectives* in Kennedy and McNally (2005) and have the following semantics:

(72) $[\![\text{full}]\!] = \lambda x.\exists d.\ \text{MAX}(S_{\text{full}}) = d \ \&\ \text{full}(x) = d.$

MAX is the function that returns the maximum degree on an AP scale ($=S_{AP}$).

Adjectives such as *awake* and *wet* are *minimum standard adjectives*. These adjectives differ from maximum standard adjectives in that they have the minimum degree of an AP-scale as the standard. In (73)a-b, *awake* and *wet* are minimum standard adjectives, while *asleep* and *dry* are not:

(73) a. John is {awake/asleep}.
b. The towel is {wet/dry}.

The proposition that John is awake will be true as soon as John leaves the zero-degree of awake-ness (= the maximum degree of *asleep*). In the same way, the towel may be evaluated to be wet as soon as it leaves the zero-degree dryness. The semantics of minimum standard adjectives is represented as follows:

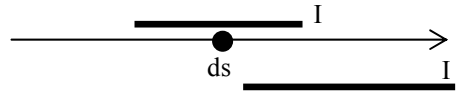
(74) $[\![\text{awake}]\!] = \lambda x.\exists d.\ \text{MIN}(S_{\text{awake}}) = d \ \&\ \text{awake}(x) \geq d.$
[MIN is the function that returns the minimum degree on a scale]

Open scale adjectives have relative standards, while closed scale adjectives have maximum or minimum standards. The semantics of the BECOME-operator defined above crucially refers to the negation, and the negation is crucially dependent on the degree of standard. The negation of an open scale adjective is defined as before: namely, the ordering between the AP-degree of the subject and the degree of standard is reversed. The negation of a maximum standard adjective denotes all the degrees on

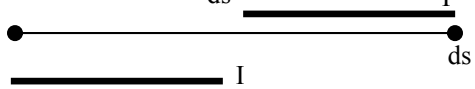
an AP-scale, except for the maximum degree. The negation of a minimum standard adjective, on the other hand, is defined as being equivalent to the minimum degree on that scale. The semantics of the BECOME component of these adjectives are given below:

(75) a. [[BECOME tall]] = λI. λx. ∃d. tall (x) ≥ d & ∃d', d". d' < d & d" ≥ d & d', d" ∈ I.
b. [[BECOME full]] = λI. λx. ∃d. MAX (S_{full}) =d & full(x) = d & ∃d'. d' < d & d', d∈ I.
c. [[BECOME awake]] = λI. λx. ∃d. MIN (S_{awake}) =d & awake(x) ≥ d & ∃d'. d' > d & d', d∈ I.

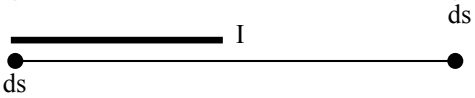
For ease of reference, the diagrammatical representations of the intervals defined above are provided below:

(76) a.


(=(75)a)

b.


(=(75)b)

c.


(=(75)c)

These characterizations reveal that there is a crucial difference between (76)a and (76)b-c. A transition interval defined by an open scale adjective is not incremental with respect to AP-ness, since the degrees on the left hand side of the degree of standard cannot be described to be *AP*. The transitions in (76)b-c, on the other hand, is incremental with respect to AP-ness. Any subinterval may have less AP-ness than a larger interval. Vanden Wyngaerd (2001) calls the transitions defined by open scale adjectives, which correspond to (76)a here, *property transitions*, and the transitions defined by closed scale adjectives *value transitions*.

It is now clear why the CSC must hold: Only the transitions defined by closed scale adjectives obey the monotonicity. Let us examine first whether a BECOME interval defined by a closed scale adjective obeys the monotonicity. Assume e, e' such that e' < e. For the corresponding degree intervals, say, I and I', I' < I necessarily holds.

Let us next consider the cases where open scale adjectives are used. If e' < e, then the corresponding I' and I may not preserve a part-of relation in an event. This is because, in the case of open scale adjectives, there may be two intervals that cannot be compared. Assume that, for example, I is an interval from d1to d2 such that d1, d2 <ds and I' is an interval from d3 to d4 such that d3 < ds and d4 > ds. Assume further that e' < e, and μ(e') = I' and μ (e)= I. Then, I cannot have a greater degree than I', because I' designates an interval that belong to degrees that have no AP-ness. Therefore, the intervals defined by open scale adjectives do not observe the monotonicity constraint, which explains why the CSC must hold for the resultative construction.

Minimum standard adjectives comprise two types: One type is exemplified by

awake and *open*, and the other is by *rough* and *wet*. The former is used in the resultative constructions, while the latter is not. The latter class of adjectives, *rough* and *wet*, has upper-bound and lower-bound scales respectively:

(77) a. The metal is completely {smooth/??rough}.
b. The towel is completely {dry/??wet}.

Awake and *open*, on the other hand, denote a totally closed scale adjectives. In the BECOME interval described in (76)c, it is obvious from the discussion that the monotonicity constraint is observed: for any e and e', such that e <e', then the intervals which correspond to them, I and I', must be in a part-of relation. I propose that in the case of *rough* and *wet*, although they are also minimum standard adjectives, the structure they induce is similar to an open scale adjective. The intuition is that when you say the towel is wet, for example, the single drop of water does not suffice to say that the towel is wet in a usual situation. The same situation may be judged to be true, when you conduct a scientific experiment. The open-scale-ness is also attested by the following:

(78) a. John is tall *for an eight-year-old boy.*
b. His hands are rough *for his age*.
c. #John is awake *for his age*.

Recall that an open scale gradable adjective, such as *tall*, can accompany the expression that indicates the comparison class in question. In the same way, *rough* may be used with this kind of expression, as shown in (78)b. The comparison class cannot be supplied for adjectives like *awake*, as shown in (78)c. These considerations suggest that *rough* and *wet* are associated with open scales, and as such, they need a relative degree of standard. This yields, as we have shown above, the violation of the monotonicity constraint.

To summarize: I have clarified the semantics of resultative phrases in this section. I have proposed that resultative phrases which incorporate the BECOME-operator function as event measurement for an event described by a main verbal predicate. The crucial mechanism that determines the acceptability of the construction is the monotonicity constraint on the measurement. This proposal enables us to explain (i) the distributional behavior of *to death* and *dead*, and (ii) why the CSC must hold for activity-based resultatives.

5 CONCLUSION

This paper has dealt with the semantics of the resultative construction in English, focusing on the restriction to resultative predicates (= the CSC). It has revealed that the CSC is applied only to a subset of (so-called) resultatives, and the constraint is not a constraint specific to the construction, rather, it is derived by a general requirement for measurement.

The measurement thesis put forth in this paper has two advantages over other approaches. One is that it naturally explains the telicity alternation pertaining to this construction. Resultative constructions have been known to describe a telic event, even though a main verb denotes an atelic event. The aspectual shift has been explained by a lexical decomposition (or composition) approach, which is unable to explain and predict the CSC, while our approach here, which is crucially dependent on Bach's thesis that the atelic-telic distinction is equivalent to the mass-count distinction in the nominal domain, can explain the shift via a measurement over the event domain. The explanation is an extension of an independently developed theory for measurement in the nominal domain, and needs no apparatus specific to the aspectual shift.

The other advantage is that it would explain the presence of non-literal sense of resultative predicates. The degree associated with verbs does not only concern the 'quantity' of verbs, but the 'property' of verbs. In a sentence such as *He likes her a lot*, the degree adverb, *a lot*, refers to the degree how much he is fond of her. Resultative predicates also often induce a non-literal, emphatic interpretation, as in *I ate myself to death*. If the thesis that a resultative phrase functions as a measure is on the right track, then this non-literal interpretation, I believe, could be analyzed along the same lines as the degree adverb.

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Eri Tanaka
eri-tana@eec.ehime-u.ac.jp