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Scale Structures of Numeral Additive Particles: The Case of the Japanese Particles *Moo* and *Ato*[*]

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1. Introduction

In Japanese, the numerical additive meaning is expressed by the particle *ato* or *moo* plus a numeral classifier/measure phrase. Observe the following example:[1]

(1) Taro-wa e-o [{moo /ato} 1-mai] kak-u-daroo.
Taro-TOP picture-ACC more.ADD/more.ADD 1-CL.sheet write-NON.PST-will
'Taro will draw one more picture.'

In (1), both *moo* and *ato* trigger a 'prior time' presupposition (e.g., Greenberg 2009a) that the event of drawing a picture occurred prior to the time of utterance. However, there is a slight difference in meaning between *moo* and *ato*. While (1) with *ato* implies that 'the next picture will be the final picture,' the sentence with *moo* does not have such an implication of 'finality.'

Furthermore, *ato* and *moo* are also different in their distribution patterns. While *moo* can occur naturally with a stative predicate, *ato* cannot:

(2) (A person said that the rod is 90 cm long, and the speaker replies.)
Kono sao-wa {moo /*ato} 10-senchi nagai-desu.
this rod-TOP more.ADD/more.ADD 10-centimeter long-PRED-POLITE
'This rod is 10 centimeters longer.'

(2) with *moo* implies additive comparison. Here, *moo* makes reference to a contextually determined degree (i.e., 90 cm) and adds 10 cm to it. In this context, *ato* cannot be used.

How can we analyze the meanings of *ato* and *moo*? Why is it that *ato* cannot co-occur with a stative predicate? In this paper, I investigate the meanings and distribution patterns of the numerical additive particles *ato* and *moo* and argue that there are two kinds of numerical additivity in Japanese: endpoint-oriented additivity and non-endpoint-

oriented additivity. *Moo* is non-endpoint-oriented in that it simply adds a given degree to an existing/contextually salient degree, whereas *ato* is (future) endpoint-oriented in that it signals that adding the given degree to an existing/contextually determined degree reaches a future endpoint.

I then argue that the difference between non-endpoint and endpoint-oriented measurements is reflected in their distribution patterns. If a numerical additive particle co-occurs with an eventive verb, as in (1), additivity can be both non-endpoint-oriented and endpoint-oriented, and sentences with *moo* and *ato* are both natural. However, if a numerical additive particle co-occurs with a stative predicate, as in (2), usually only non-endpoint-oriented additive particle *moo* is possible. This is because the state is not dynamic and does not involve future development. It will be shown that this is a natural consequence of the idea that event verbs have an event argument, while (gradable) stative predicates do not (e.g., Katz 2003, 2008; Kratzer 1995; Maienborn 2005).

However, if we embed *ato* in a conditional clause (or a modal sentence with a future-oriented meaning), it is possible to use *ato* with a stative predicate:

(3) Moshi kono sao-ga {ato/moo} 30-senchi naga-katta-ra, ka-ttei-ta.
if this rod-NOM more.ADD 30-centimeters long-PST-COND buy-PERF-PST
'If this rod were 30 centimeters longer, I would have bought it.'

I argue that *ato*'s requirement of endpoint-oriented measurement is satisfied via the semantics of conditionals and modals, which are future-oriented.

The theoretical implication of this paper is that the interpretations and distributions of Japanese additive particles are sensitive to the meanings of the predicates with which they co-occur, and there is also a rich interaction between the additive particles and the meaning of the sentence outside the domain of a predicate.

The remainder of this paper is organized as follows: Section 2 introduces the basic background of the additive particles. Section 3 considers the meaning of additive particles with eventive predicates, and Section 4 considers the meaning of additive particles with stative predicates. Section 5 discusses the case in which *ato* plus a stative predicate becomes natural when embedded in a conditional clause or a modal operator and provides an explanation. Section 6 briefly discusses the case in which the future-oriented property of *ato* is interpreted as the future as seen from the past. Section 7 investigates the semantic distinction between additive comparison and differential measurement in Japanese, and argues that their semantics are different. Section 8 presents theoretical implications.

2. Basic background on *ato* and *moo*

Before analyzing the meanings of numerical additive morphemes in Japanese, let us first consider the basic properties of *ato* and *moo*. In Section 2.1, I examine the syntactic properties of additive morphemes in Japanese, and in Section 2.2, I consider the distribution patterns of *ato* and *moo* from a cross-linguistic perspective.

2.1. Syntactic properties of the additive morphemes ato and moo

It is well known that Japanese measure phrases/classifiers can appear in various syntactic environments:

(4) a. [Gakusei san-nin]-ga ie-ni ku-ru. (non-split, nominal)
[student three-CL]-NOM home-to come-NON.PST
'Three students will come to my home.'
b. [San-nin-no gakusei]-ga ie-ni ku-ru. (non-split, genitive)
[three-CL-GEN student]-NOM home-to come-NON.PST
'Three students will come to my home.'
c. Gakusei-ga ie-ni san-nin ku-ru. (split)
student-NOM home-to three-CL come-NON.PST
'Three students will come to my home.'

(4a) is a 'non-split nominal' type, (4b) a 'non-split genitive' type, and (4c) a split type. In (4a) and (4b), the numeral and its host NP are in the same nominal projection. By contrast, in (4c), the numeral and its host NP are not adjacent. Such a quantifier has traditionally been called a 'floating quantifier' (see, e.g., Kuroda 1980; Miyagawa 1989; Fukushima 1993; Takami 1998; Nakanishi 2007, among many others).

What is important here is that the additive particles can only appear in the 'split measure phrase' construction (i.e., the floating type):

(5) a. Non-split NP type
*[Gakusei {moo /ato} san-nin]-ga ie-ni ku-ru.
[student more.ADD/more.ADD three-CL]-NOM home-to come-NON.PST
'Intended: Three more students will come to my home.'
b. Non-split genitive type
*[{Moo /ato} san-nin-no gakusei]-ga ie-ni ku-ru.
[more.ADD/more.ADD three-CL-GEN student]-NOM home-to come-NON.PST
'Three students will come to my home.'

c. Split type

Gakusei-ga	ie-ni	{moo	/ato}	san-nin	ku-ru.
student-NOM	home-to	more.ADD	/more.ADD	three-CL	come-NON.PST

'Three more students will come to my home.'

Thus, we can say that *ato* and *moo* are predicative.[2]

2.2. Ato and moo are not regular comparative morphemes

It has been pointed out in the literature that the English *more* can have either an additive or a comparative meaning (Greenberg 2009a, b; Thomas 2010). For example, (6) has a regular comparative meaning:

(6) Mary is more intelligent than Danny.

In contrast, Greenberg (2009a) observes that (7) is ambiguous between a regular comparative reading (where today John interviewed more than three students) and an additive reading (where John interviewed additional students [perhaps one or two]):

(7) Yesterday Danny interviewed three students. Today he interviewed more (students).
(Greenberg 2009a)

Greenberg (2009b) notes that languages like Modern Hebrew use different lexical items for additive and comparative meanings, that is, *yoter* for the comparative and *od* for the additive.

(8)

Etmol	Dani	ri'ayen	SloSa	studentim.
yesterday	Danny	interviewed	three	students
Ha-yom	hu	ri'ayen	yoter/od.	
today	he	interviewed	more (*yoter/od*).	

'Yesterday John interviewed three students. Today he interviewed $\text{more}_{\text{comparative}}$ /$\text{more}_{\text{additive}}$.' (Greenberg 2009b)

The Japanese additive particles *ato* and *moo* are similar to the Hebrew additive particle *od* in that they cannot be used as comparative morphemes:

(9) a. Tokyo-wa Sapporo-yori atatakai.
Tokyo-TOP Sapporo-than warm
'It is warmer in Tokyo than in Sapporo.'
b. *Tokyo-wa Sapporo-yori {ato /moo} atatakai.
Tokyo-TOP Sapporo-than more.ADD/more.ADD warm
'Intended: It is warmer in Tokyo than in Sapporo.'

2.3. The Puzzles

In Section 1, we observed some asymmetries in the interpretations and distributions of *moo* and *ato*:

(10) a. Taro-wa e-o [{moo /ato} 1-mai] kak-u-daroo.
Taro-TOP picture-ACC more.ADD/more.ADD 1-CL.sheet write-NON.PST-will
'Taro will draw one more picture.'
Assertion: Taro will draw one picture.
Presupposition: Taro drew at least one picture before the time of utterance.
(with *ato*: the next picture will be the final one.)
b. Kono sao-wa {moo /*ato} 10-senchi nagai.
this rod-TOP more.ADD/more.ADD 10-centimeter long
'This rod is 10 centimeters longer.'

The asymmetries to be observed here are as follows: (i) *moo* in (10a) and *ato* in (10a) are different in terms of a 'finality' meaning; (ii) (10a) has an event-based additive meaning, where (10b) with *moo* has a comparison-based additive meaning; and (iii) *ato* cannot be used with an adjectival predicate.

In the following sections, I separately investigate the meaning of additive particles with eventive and stative predicates and attempt to explain the above observations in a principled manner. It will be shown that the interpretations and distributions of *ato* and *moo* are sensitive to the lexical semantics of the predicates with which they co-occur.

3. The meanings of additive particles with eventive predicates

Let us first consider the meanings of additive particles with eventive predicates. We have observed that both *ato* and *moo* have a prior time presupposition (Greenberg 2009a). The meanings created by adverbs are presuppositions (rather than entailments) because they systematically escape the scope of modal operators, questions, or conditionals:

(11) Taro-wa biiru-o {moo /ato} 1-pai nom-u-tsumori-da.
Taro-TOP beer-ACC more.ADD/more.ADD 1-CL.glass drink-NON.PST-plan-PRED
'Taro is going to drink one more glass of beer.'
Assertion: Taro is going to drink one glass of beer.
Presupposition: Taro drank at least one glass of beer before the time of utterance.

(12) Biiru-o {moo /ato} 1-pai itadake-masu-ka?
beer-ACC more.ADD/more.ADD 1-CL.glass give.me.POLITE-PRED.POLITE-Q
'Can you give me one more glass of beer?'
(Presupposition: I received at least one glass of beer before the time of utterance.)

(13) Biiru-o {moo /ato} 1-pai tanome-ba,
beer-ACC more.ADD/more.ADD 1-CL.glass order-if
waribiki ken-ga mora-e-ru.
discount card-NOM receive-can-NON.PST
'If we order one more glass of beer, we can get a discount card.'
(Presupposition: We ordered at least one glass of beer before the time of utterance.)

In the above examples, the meanings of *moo* and *ato* project beyond the scope of the modal operator, question operator, and conditionals.[3]

3.1. Endpoint-oriented vs. non-endpoint-oriented additivity

Although both *moo* and *ato* in (11)-(13) trigger a 'prior time' presupposition (Greenberg 2009a), they are different in terms of scale structures. While (11)-(13) with *ato* presuppose that 'the next glass will be the final glass,' the sentences with *moo* do not have such an implication of 'finality.'

The evidence for the assertion that *ato* has an endpoint-oriented presupposition is that it would be odd for the speaker to drink another glass of beer if they have already uttered (11) with *ato*. Note that the finality presupposition does not mean that the speaker will never drink beer again in their life. Instead, it is an endpoint of an ongoing event.

We can analyze the assertion and presupposition of (14) with *moo* as in (15):

(14) Taro-wa e-o {moo /ato} 1-mai kak-u-daroo.
Taro-TOP picture-ACC more.ADD/more.ADD 1-CL.sheet write-NON.PST-will
'Taro will draw one more picture.'
Assertion: Taro will draw one picture.
Presupposition: Taro drew at least one picture before the time of utterance.

(15) Semantics/pragmatics of (14) with *moo*

a. Assertion: $\exists e_1 \exists t_1[t_1 > \text{now}, \text{draw}(e_1), \text{agent}(e_1) = \text{Taro}, \text{theme}(e_1) = \text{picture}, \#\text{sheet of picture} = 1, \tau(e_1) \subset t_1]$

b. Presupposition: $\exists e_2 \exists t_2[t_2 < \text{now}, \text{draw}(e_2), \text{agent}(e_2) = \text{Taro}, \text{theme}(e_2) = \text{picture}, \#\text{sheet of picture} \geq 1, \tau(e_2) \subset t_2]$

Approximately, the assertion states that at some future time t_1, there will be a drawing event (e_1) whose agent is 'Taro' and whose theme is a picture and the number of pictures is one. Regarding the relation between event and time, it states that the running time of e_1 (i.e. $\tau(e_1)$) is included in t_1 (where t_1 is a time interval).[4] On the other hand, the presupposition states that at some past time t_2 there was a drawing event (e_2) whose agent was 'Taro' and whose theme was a picture and the number of pictures was at least one. Here, the running time of e_2 is included in t_2. Adding the asserted eventuality (e_1) to the presupposed eventuality (e_2) results in a more developed 'larger' eventuality (Greenberg 2009b). See also Thomas (2009) for the analysis of the 'incremental' reading in Mbyá comparatives.

In contrast, (16) shows the assertion and presupposition of (14) with *ato*. The presupposition in (16) is that adding the asserted eventuality (e_1) to the presupposed eventuality (e_2) pushes events toward an unrealized endpoint (culmination).[5]

(16) Semantics/pragmatics of (14) with *ato*

a. Assertion: $\exists e_1 \exists t_1[t_1 > \text{now}, \text{draw}(e_1), \text{agent}(e_1) = \text{Taro}, \text{theme}(e_1) = \text{picture}, \#(\text{picture}) = 1, \tau(e_1) \subset t_1]$

b. Presupposition: $\exists e_2 \exists t_2[t_2 < \text{now}, \text{draw}(e_2), \text{agent}(e_2) = \text{Taro}, \text{theme}(e_2) = \text{picture}, \#(\text{picture}) \geq 1, \tau(e_2) \subset t_2, (e_2 + e_1) = \text{future endpoint}]$

This presupposition naturally explains why a sentence with *ato* cannot take a past tense verb. (17) is odd because adding the past event (the at-issue event) to a previous event cannot yield a 'future' endpoint.

(17) (Watashi-wa) biiru-o {moo /??ato} 1-pai nomi-mashi-ta.
I-TOP beer-ACC more.ADD/more.ADD 1-glass drink-POLITE-PST
At-issue: I drank one glass of beer.
Presupposition: I drank at least one glass of beer before the at-issue time.

Note that the sentence is still odd even if we posit a reference time in the past and express additivity relative to that point as in (18):[6]

(18) Arekara watashi-wa biiru-o {moo /?ato} 1-pai non-da.
after.that I-TOP beer-ACC more.ADD/more.ADD 1-glass drink-PST
'After that I drank one more glass of beer.'
Presupposition: I drank at least one glass of beer before the at-issue time.

Based on the above empirical facts, it is safe to assume that *ato* is a future-oriented endpoint additive particle, whereas *moo* is a neutral additive particle.

3.2. Compositional semantics of the additive particles (eventive type)

Let us now consider how the entailment and presupposition of sentences with additive particles can be analyzed in a compositional manner. Before considering this issue, it is necessary to consider the meaning of the same sentences without additive particles, that is, the split measure phrase construction.

Nakanishi (2007) observes the following seeming paradox regarding the split measure phrase construction: 'The measure function in split MP constructions clearly applies to a VP, but at the same time, it seems to apply to a NP as well':

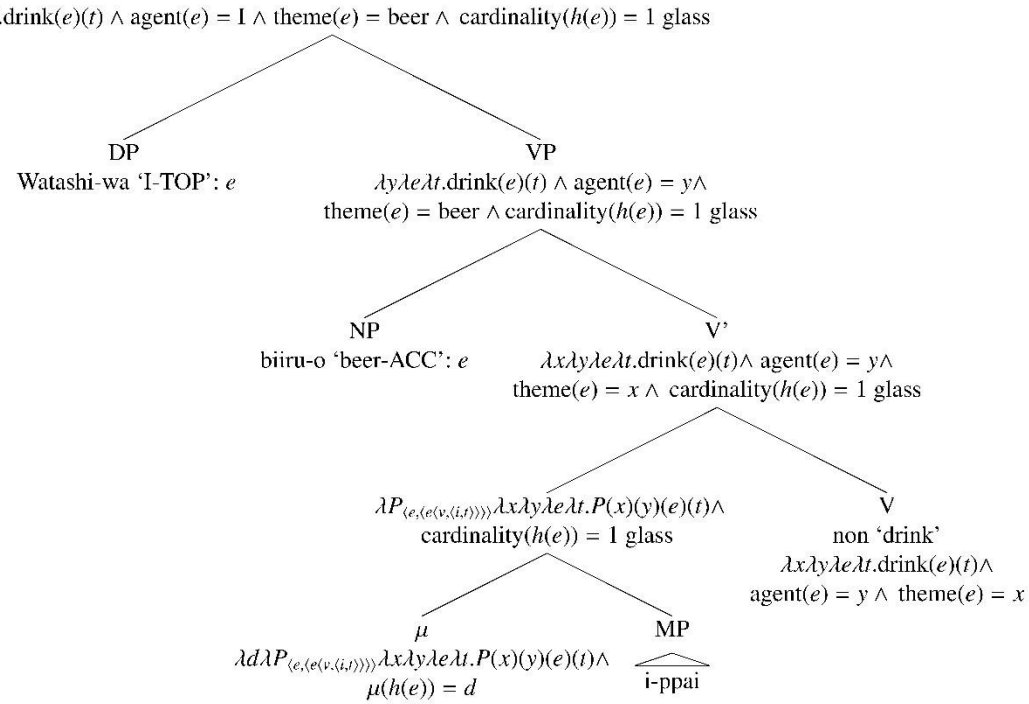
(19) (Watashi-wa) biiru-o [1-pai non-da.]
I-TOP beer-ACC 1-glass drink-PST
'I drank one glass of beer.'

In other words, the split MP construction involves measuring events and individuals. To resolve this dilemma, Nakanishi (2007) cites Krifka (1989, 1998) in proposing a mechanism that maps events to individuals (i.e., homomorphism *h* from events to individuals).[7] The measure function in (20) indirectly measures eventualities by measuring the range of a homomorphism from events to individuals.[8]

(20) $[\![\mu_{VP}]\!] = \lambda d\lambda P_{<e,<e<v,<i,t>>>>}\lambda x\lambda y\lambda e\lambda t.P(x)(y)(e)(t) \wedge \mu(h(e)) = d$
(Based on Nakanishi 2007: 163)

(21) illustrates the logical structure of (19).

(21)



Regarding the semantics of tense, following Ogihara (2020), I assume the meaning of past and future tense operators as follows (I have omitted the information of world for the sake of simplicity):

(22) a. $[\![\text{PRES}]\!]^C = \lambda f \lambda e \lambda t \lambda t_1.\ t = t_1 \wedge f(e)(t)$

(Based on Ogihara 2020:107, slightly modified)

b. $[\![\text{PAST}]\!]^C = \lambda f \lambda e \lambda t \lambda t_1.\ t < t_1 \wedge f(e)(t)$

(Based on Ogihara 2020:107, slightly modified)

c. $[\![\text{FUTURE}]\!]^C = \lambda f \lambda e \lambda t \lambda t_1.\ t_1 < t \wedge f(e)(t)$

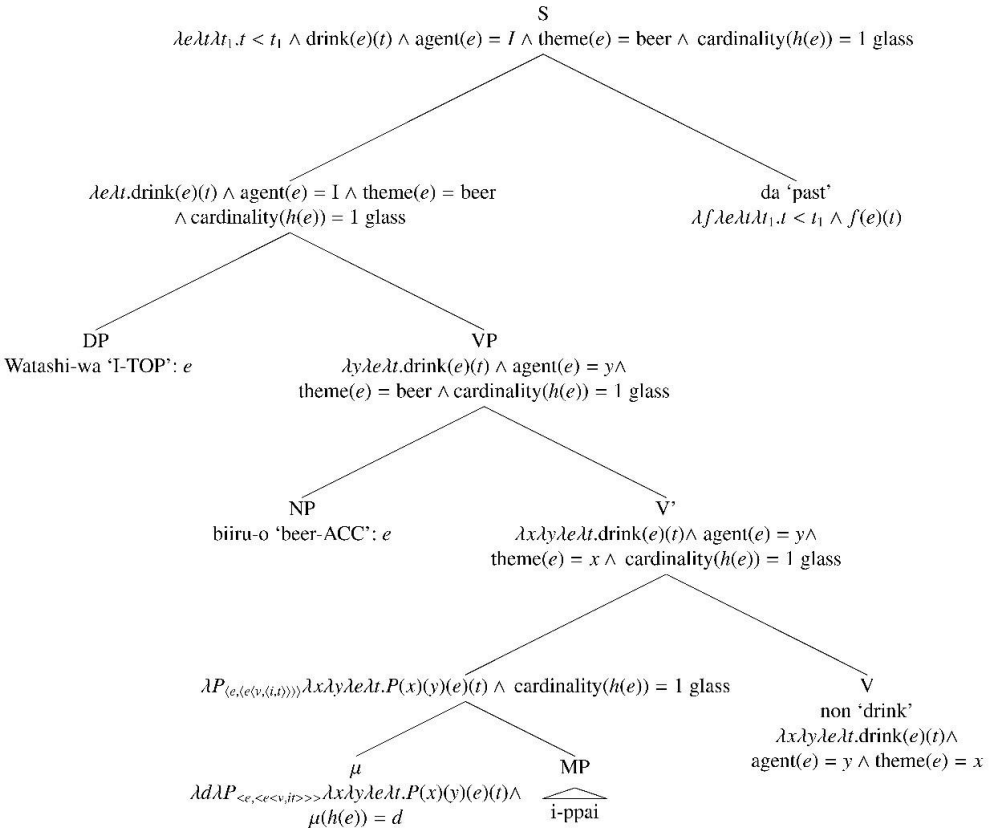
Furthermore, following Ogihara (2020), I assume that at the matrix level the given tense information is relativized according to the current time (c_T) based on Truth Definition (23) (again, I have ignored the information of world):

(23) Truth Definition

A matrix sentence S is true in the context c iff there is an event e and a time t_2 such that $[\![\text{matrix clause}]\!]^C(e)(t_2)(c_T) = 1$ (Based on Ogihara 2020:107)

The following (24) illustrates the logical structure of (19):

(24)



(25) A matrix sentence S is true in the context c if there is an event e and a time t_2 such that $[\![t_2 < c_T \wedge \text{drink}(e)(t_2) \wedge \text{agent}(e) = \text{I} \wedge \text{theme}(e) = \text{beer} \wedge \text{cardinality}(h(e)) = 1 \text{ glass}]\!]^C = 1$

Note that we assume here that the verb *nom-u* 'drink' does not have a degree argument. Thus the measure phrase is not directly combined with the verb.[9] The logical structure roughly states that there was a drinking eventuality whose agent is I whose theme is beer, and the cardinality of a glass of beer is one.

Now let us consider the meaning of the previously cited sentence with *moo*/*ato*:

(26) (Watashi-wa) biiru-o {moo /ato} [1-pai nom-u-daroo.]
I-TOP beer-ACC more.ADD/more.ADD 1-glass drink-NON.PST-will
At-issue: I will drink one glass of beer.
Presupposition: I drank at least one glass of beer before the time of utterance.

Based on Greenberg's (2009a, b) idea of event-based additive presupposition, I propose that *moo* and *ato* have the following meanings:

(27) $[\![\text{moo}_{event}]\!] = \lambda d\lambda P_{<e,<e<v,<i,t>>>>}\lambda x\lambda y\lambda e\lambda t$: $\underline{\exists d'\exists e'\exists t'[t' < t \wedge t' < \text{now} \wedge P(x)(y)(e')(t') \wedge \mu(h(e')) = d']}$. $P(x)(y)(e)(t) \wedge \mu(h(e)) = d$

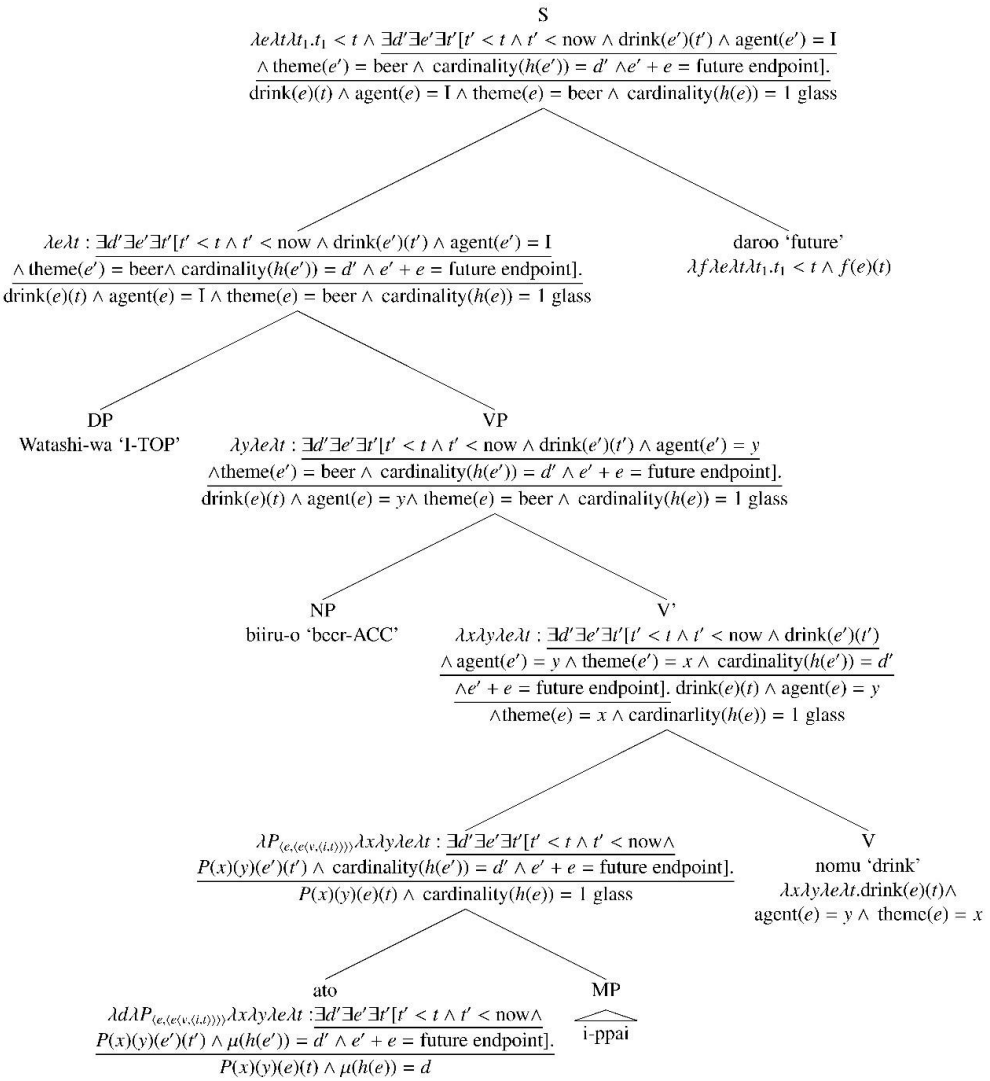
(where the underlined part is a presupposition)

(28) $[\![\text{ato}_{event}]\!] = \lambda d\lambda P_{<e,<e<v,<i,t>>>>}\lambda x\lambda y\lambda e\lambda t$: $\underline{\exists d'\exists e'\exists t'[t' < t \wedge t' < \text{now} \wedge P(x)(y)(e')(t') \wedge \mu(h(e')) = d' \wedge e' + e = \text{future endpoint}]}$. $P(x)(y)(e)(t) \wedge \mu(h(e)) = d$

(where the underlined part is a presupposition)

Ato and *moo* as similar to $[\![\mu_{VP}]\!]$, except that they have presuppositions. The following (29) and (30) show the logical structure and Truth Definition of (26) with *ato*.

(29)



(30) Truth Definition

A matrix sentence S is true in the context c iff there is an event e and a time t_2 such that $[\![c_T < t_2 \wedge \underline{\exists d' \exists e' \exists t' [t' < t_2 \wedge t' < \text{now} \wedge \text{drink}(e')(t') \wedge \text{agent}(e') = \text{I} \wedge \text{theme}(e') = \text{beer} \wedge \text{cardinality}(h(e')) = d' \wedge e' + e = \text{future endpoint}]}$. drink($e$) ($t_2$) $\wedge$ agent(e) = I $\wedge$ theme(e) = beer $\wedge$ cardinality(h(e)) = 1 glass$]\!]^C$ = 1

The presupposition in the structure indicates that there was a drinking eventuality *e'* whose agent is I and whose theme is beer and the cardinality of a glass of beer is at least one, and adding the asserted eventuality (*e*) to the presupposed eventuality (*e'*) reaches a future endpoint. Based on this presupposition, the speaker asserts that there was a drinking eventuality whose agent is I, whose theme is beer, and the cardinality of a glass of beer is one.

4. Additive particles with stative predicates

4.1. The status of the meaning of moo with stative predicates

Let us now consider cases in which numeral additive particles occur with stative predicates. As observed in Section 1, *ato* cannot appear if the sentence predicate is stative (although *moo* can appear in such cases):

(31) Kono sao-wa [{moo /*ato} 5-do] magat-teiru.
this rod-TOP more.ADD/more.ADD 5-degree bend-STATE
'This rod is 5 degrees more bent.' (additive comparison reading)
(Individual comparison reading: This rod is 5 degrees bent than a contextually determined rod.)
(Self-comparison reading: This rod is 5 degrees more bent than previously measured.)

(32) Taro-wa roshiago-no tango-o moo 3-ko shit-teiru.
Taro-TOP Russian-GEN word-ACC more.ADD 3-CL know-STATE
'Taro knows 3 more Russian words.'
(Individual comparison reading: Taro knows three more Russian words than a contextually determined individual, for example, Hanako.)
(Self-comparison reading: Taro knows three more Russian words than the contextually determined number that Taro is assumed to know.)

Unlike the eventive *moo*, the stative *moo* does not represent an addition of an event to a previous event. Rather, *moo* with a stative predicate adds a degree to a contextually determined degree and expresses a comparative meaning. Note that the above sentences seem to have two types of comparative additive reading: individual-comparison and self-comparison. In the individual-comparison reading, the contextually determined degree is that of another individual. In the self-comparison reading, a comparison is made with the same individual. In either case, a contextually determined degree must exist.

We can now answer the following questions shown in (33):

(33) a. Why can *moo* not trigger a prior time presupposition in a stative predicate?
b. Why can *ato* not appear in statives?

Regarding first question, *moo* cannot trigger a prior time presupposition in the case of stative predicates because stative predicates are like mass terms; they do not involve change and are not dynamic (see, e.g., Rothstein 1999, 2004). Thus, the only way to express additivity *moo* with stative predicates is to posit another 'contextual' standard and make a contrast between the target (= the subject) and the standard (i.e., comparison-based additivity). I believe that the difference between event-based additivity interpretation (which triggers a prior time presupposition) and comparison-based additive interpretation is a natural consequence of the idea that event verbs have an event argument, whereas (gradable) stative predicates do not (Katz 2008, see also Kratzer 1995; Katz 2003; Maienborn 2005).

As for the second question, *ato* cannot arise in stative predicates because *ato* requires a future endpoint. It does not make sense to use *ato* in stative predicates because the result of adding degrees to an existing degree corresponds to the current situation, not the future situation.

4.2. The meaning of the additivity with a stative predicate

Let us now consider the meaning of additive *moo* with a stative predicate in a more theoretical fashion, based on the following example:

(34) Kono sao-wa [{moo /*ato} 5-do] magat-teiru.
this rod-TOP more.ADD/more.ADD 5-degree bend-STATE
'This rod is 5 degrees more bent (than a contextually determined degree).'

I propose that when *moo* co-occurs with a stative predicate, it denotes a comparison like additive meaning as in (35):

(35) $[\![\text{moo}_{add.state}]\!] = \lambda d \lambda g_{<d,<e,t>>} \lambda x \lambda t.\ \exists d_1 [d_1 = \text{a contextually determined degree} \wedge max\{d' | g(d')(x)(t)\} = d_1 + d]$

In prose, *moo* takes a degree *d*, a gradable predicate *g*, an individual *x*, and a time *t* and denotes that there is some degree d_1 such that d_1 is a contextually determined degree, and the maximal degree of *x* with respect to *g* at *t* is $d_1 + d$. Here, d_1 can be a contextually salient individual or the contextually salient degree of the target itself. In either case, *moo* adds degree to a contextually determined degree.

Crucially, unlike event-based additivity, there is no prior-time presupposition in *moo* occurring with a stative predicate. As for the semantics of stative predicates (gradable predicates), I assume that they express the relation between degrees and the individual (see e.g., Creswell 1977; von Stechow 1984), and that this relation is relativized according to the passage of time (Kennedy & Levin 2008). Thus, the denotation of *magat-teiru* can be represented as follows:

(36) $[\![\text{magat-tei}]\!] = \lambda d \lambda x \lambda t.\text{bent}(x)(t) = d$

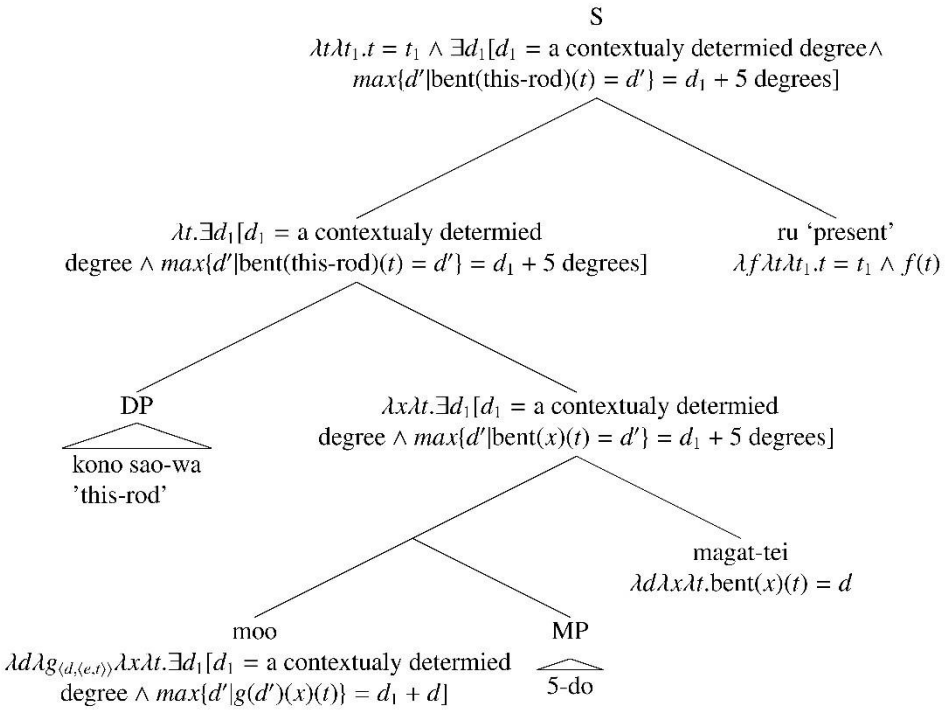
Regarding tense, since there is no event variable in the semantics of a stative predicate, we need to modify the semantics of tense operators slightly accordingly, as shown in:

(37) Tense operators (without an event variable)
a. $[\![\text{PRES}]\!]^C = \lambda f \lambda t \lambda t_1.\ t = t_1 \wedge f(t)$
b. $[\![\text{PAST}]\!]^C = \lambda f \lambda t \lambda t_1.\ t < t_1 \wedge f(t)$
c. $[\![\text{FUTURE}]\!]^C = \lambda f \lambda t \lambda t_1.\ t_1 < t \wedge f(t)$

(38) Truth Definition (without event variables)
A matrix sentence S is true in the context *c* iff there is an event *e* and a time t_2 such that $[\![\text{matrix clause}]\!]^C (t_2)(c_T) = 1$

The following figure shows the logical structure of (34):

(39)



(40) Truth Definition (without event variables)

A matrix sentence S is true in the context *c* iff there is an event *e* and a time t_2 such that $[\![t_2 = c_T \wedge \exists d_1[d_1$ = a contextually determined degree $\wedge$ *max*{*d'*|bent(this rod)(t_2) = *d'*} = d_1 + 5 degrees]$]\!]^C$ = 1.

Then what about the case of the stative verb like *shit-teiru* 'know'?

(41) Taro-wa roshiago-no tango-o moo 3-ko shit-teiru.
Taro-TOP Russian-GEN word-ACC more.ADD 3-CL know-STATE
'Taro knows 3 more Russian words.'

The crucial point here is that stative verbs like *shit-teiru* 'know' are also gradable (see Katz 2008 for a discussion of the semantics of the gradable verb *know*). This is corroborated by the fact that degree adverbs can be combined with predicates:

(42) Taro-wa nigongo-nitsuite yoku shit-teiru.
Taro-TOP Japanese.language-about well know-STATE
'Taro knows about Japanese well.'

Thus, in principle, we can analyze the meaning of sentence (41), similar to gradable adjectives. We can posit the following denotations for the transitive gradable predicate

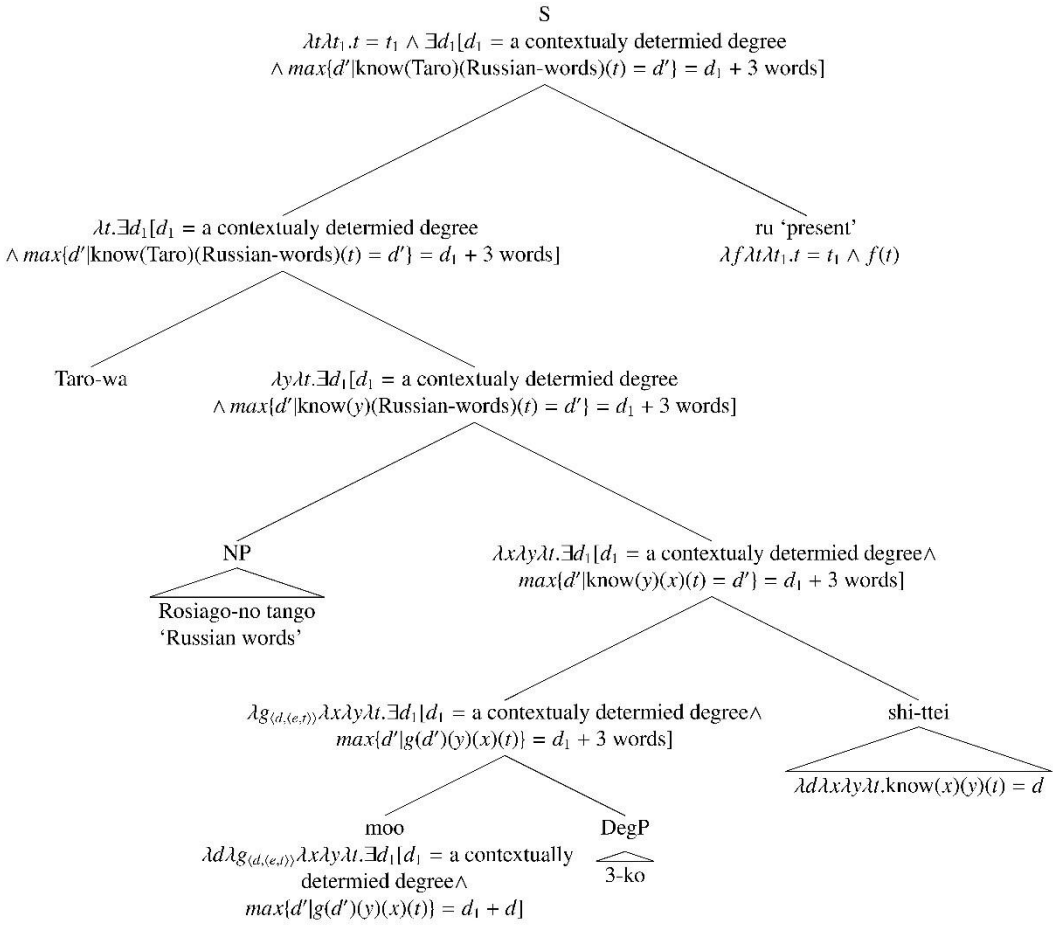
shi-tei 'know' and a slightly modified lexical entry for *moo* that is adjusted to the meaning of the transitive gradable predicate:

(43) $[\![\text{shi-ttei}]\!] = \lambda d\lambda x\lambda y\lambda t.\text{know}(x)(y)(t) = d$

(44) $[\![\text{moo}_{add.state2}]\!] = \lambda d\lambda g_{<d,<e,t>>}\lambda x\lambda y\lambda t.\ \exists d_1[d_1 = \text{a contextually determined degree} \wedge max\{d'|g(d')(y)(x)(t)\} = d_1 + d]$

The only difference between $moo_{add.state}$ in (35) and $moo_{add.state2}$ in (44) is that the latter has an additional individual argument. The following figure illustrates the logical structure of (41):

(45)



If we apply Truth Definition to (45), we obtain the following truth condition:

(46) Truth Definition (without event variables)

A matrix sentence S is true in the context *c* iff there is an event *e* and a time t_2 such that $[\![t_2 = c_T \wedge \exists d_1[d_1 =$ a contextually determined degree $\wedge$ *max*$\{d' |$know(Taro)(Russian words)$(t_2) = d'\} = d_1 +$ 3 words$]]\!]^C = 1$.

5. Conditional and modal resques the stative sentence with *ato*

Thus far, we have observed that *ato* cannot appear in stative sentences. However, if *ato* is embedded in a conditional clause, then *ato* can co-occur with a stative predicate, as in (47):

(47) a. Moshi kono sao-ga {ato /moo} 30-senchi naga-katta-ra,
if this rod-NOM more.ADD/more.ADD 30-centimeters long-PST-COND
ka-ttei-ta.
buy-PERF-PST
'If this rod were 30 centimeters longer, I would have bought it.'

b. Moshi Taro-ga roshiago-no tango-o ato 3-ko
if Taro-NOM Russian-GEN word-ACC more.ADD 3-CL
shit-tei-tara shiken-ni gookaku-si-tei-ta-daroo.
know-STATE-COND exam-to pass-do-PERF-PST-will
'If Taro knew 3 more Russian words, he would have passed the exam.'

Intuitively, *ato* can be used in (47) because we can posit a future/hypothetical endpoint that triggers an event in the main clause. For example, the speaker in (47a) knows the required length of the rod (e.g., 2 meters), and they are saying that adding 20 centimeters to the presupposed existing degree would enable it to reach the targeted 'point.'

Furthermore, *ato* can co-occur with stative predicates in the following environment, as well:

(48) {Ato /moo} 10-senchi nagai boo-ga hitsuyoo-da.
more.ADD/more.ADD 10-centimeter long stick-NOM necessary-PRED
'We need 10 centimeters longer stick.'

In (48) *ato 10-senchi nagai* modifies the noun *boo*. Here, the sentence is natural because the predicate *hitsuyoo-da* forces the speaker/hearer to posit an endpoint/expected degree.

Based on the discussion above, we can say that a sentence with *ato* plus a stative predicate becomes natural if an external linguistic material/context provides an endpoint.

(49) $[\![\text{ato}_{add.state}]\!] = \lambda d \lambda g_{<d,<e,t>>} \lambda x \lambda t. \exists d_1 [d_1 = \text{a contextually determined degree} \wedge max\{d' | g(d')(x)(t)\} = d_1 + d \wedge d_1 + d = \text{future endpoint}]$

6. Future in the past

Thus far, we have assumed that *ato* is endpoint oriented and that the endpoint is in the future. An important point is that the future can be the future as seen from the past:

(50) Taro-wa kenkoojou-no riyuu-de ninki-o ato 1-nen
Taro-TOP health-GEN reason-with term-ACC more.ADD 1-year
nokoshi-ta tokoro-de sooki taishoku-shi-ta.
leave-PST place-with early retirement-do-PST
'Taro took early retirement with one year left in his term for health reasons.'

(51) Taro-wa ato i-pai biiru-o nomi-tai-to omot-ta.
Taro-TOP more.ADD 1-CL.glass beer-ACC drink-want-that think-PST
'Taro thought that he wants to drink one more (final) glass of beer.'

This suggests that tense information in the semantics of *ato* should be analyzed in the context of the relative tense.[10]

7. Comparison with Japanese differential measurement

The meaning of comparative additivity is semantically similar to that of differential measurement. Sawada & Grano (2011) argue that interpretations of measure phrases in Japanese are sensitive to the scale structures of gradable predicates. When a measure phrase combines directly with an 'open-scale' adjective like *long*, it has a differential interpretation with a contextually determined standard:

(52) Kono sao-wa 5-senchi nagai. (open scale adjective)
this rod-TOP 5-centimeter long
'This rod is 5 centimeters longer.'
NOT: 'This rod is 5 centimeters long.'

On the other hand, when a measure phrase combines directly with a lower closed scale adjective like *magat-teiru* 'bent', it has a direct measurement interpretation:

(53) Kono sao-wa 5-do magat-teiru. (lower closed scale adjective)
this rod-TOP 5-degree bend-STATE
'This rod is 5 degrees bent.'
NOT: 'This rod is 5 degrees more bent.'

Note that the meaning of (52) is analogous to that of (54):

(54) (A person said that the rod is 30 cm long and the speaker replies.)
Kono sao-wa moo 5-senchi nagai. (open scale adjective)
this rod-TOP more.ADD 5-centimeter long
'This rod is 2 meters taller.'

Is there a semantic difference between (52) and (54)? My answer is yes. (54) expresses an additive comparison, whereas (52) expresses only a differential comparison. The following dialogue demonstrates this difference.

(55) Salesman: This rod is 30 cm long.
a. Customer: Moo 5-senchi nagai sao-o kudasai.
more.ADD 5-centimeter long rod-ACC please.give.me
'Please give me a rod that is 5 cm longer.'
b. Customer': #5-senchi nagai sao-o kudasai.
5-centimeter long rod-ACC please.give.me
'Please give me a rod that is 5 cm longer.'

In this context, (55a) is felicitous, and (55b) is infelicitous. (55b) is not natural because it does not express an 'additive' meaning. (55a) indicates that the (maximal) length of this rod minus the maximal length of a contextually determined standard is 5 cm. Thus, it is differential and not additive. (See Sawada & Grano (2011) for a detailed discussion of the formal analyses of differential measure phrases.)

8. Conclusions

This paper investigated the meaning of the Japanese numerical additive particles *ato* and *moo*. I argued that the interpretations of the Japanese additive particles *ato* and *moo* are sensitive to the distinction between states and events. That is, there is a systematic split: if a numerical additive particle co-occurs with an eventive predicate, we obtain the meaning of event-based additivity; if a numerical additive particle co-occurs with a stative predicate, we can interpret it as comparison-based additivity. I showed that this split can naturally be explained if we consider that eventive predicates have an event argument, whereas stative predicates (state verbs/gradable adjectives) lack such an argument (e.g., Katz 2008).

In this paper, I have also argued that the 'distribution' of the additive particles is sensitive to the event/state distinction. *Ato* has a (future-oriented) endpoint-additive meaning, whereas *moo* does not. We observed that *ato* could not appear in simple stative sentences. I explain this fact based on the theory that statives do not assume an 'incremental process' (i.e., they are not dynamic). I have also argued that a sentence with *ato* plus a stative predicate becomes natural if it is embedded in a conditional clause or modal operator, which allows *ato* to refer to a future endpoint.

Significantly, the distributions and interpretations of *ato* and *moo* are sensitive to the predicates with which they co-occur. Japanese numerical additive particles are, therefore, an important diagnostic tool for the fundamental distinction between states and events, and by studying them, we can improve our understanding of the role of scalarity in pragmatics. It has been claimed that endpoint/endpoint (bound/unbound) plays an important role in understanding the semantics of verbs and adjectives. In this paper, I have shown that this distinction also exists regarding the lexical semantics of additive particles.

Notes

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1 *Moo/ato* can also combine with an adverb of minimal degree such as *sukoshi* 'a little'. Note also that *moo* can be used to express the aspectual meaning 'already.' In this paper, we will not focus on this aspectual use of *moo*.

2 Note that the following sentence sounds natural, even though it looks like a case of the non-split genitive type:

(i) [Moo hito-ri-no gakusei]-wa nihonjin-da. (non-split, genitive type)
another one-CL-GEN student-TOP Japanese-PRED
'Another student is Japanese.'

However, *moo hito-ri* (i) is interpreted as 'another person' and is lexically different from ordinary additive expressions. The fact that the sentence becomes bad if we use other numerals supports this fact:

(ii) *[Moo san-nin-no gakusei]-wa nihonjin-da.
more.ADD three-CL-GEN student-TOP Japanese-PRED
'lit. Another 3 students are Japanese.'

[3] Note that neither *ato* nor *moo* can appear in negation:

(i) ??Taro-wa e-o [{moo /ato} 1-mai] kaka-nai-daroo.
Taro-TOP picture-ACC more.ADD/more.ADD 1-CL.sheet write-NEG-will
'Taro will not draw one more picture.'

The same observation can be made with regard to the stative type of *moo*. This suggests that *moo* and *ato* are positive polarity items.

[4] τ is a function that maps an event to its "run time" (see Krifka 1992).

[5] Note that there is a constraint that the agent of the presupposition and the agent of the assertion must be the same person in the use of *ato* and *moo*. Interestingly, the English additive *more* does not seem to have such a constraint (Greenberg 2009a).

[6] Note that if *ato* is embedded inside a clause, it can co-occur in a past sentence. In that case, future is interpreted as future in the past. We will discuss this point in Section 6.

[7] Nakanishi (2007) places the monotonicity constraint on the presupposition of μ. I have omitted this presupposition.

[8] In terms of type, *e* is a type for individuals, *v* is a type for events, *i* is a type for times, and *t* is a type for truth values.

[9] Another approach is to consider that degree argument is part of the lexical meaning of verbs (e.g., Kennedy & Levin 2008; Piñón 2008).

[10] In these examples the embedded event is non-veridical from the perspective of the current time, and this might be an important factor for licensing *ato*. I would like to leave this point for future study.

References

Cresswell, Maxwell John. 1977. The semantics of degree. In Barbara H. Partee (ed.), *Montague grammar*, 261–292. New York: Academic Press.

Fukushima, Kazuhiko. 1993. Model theoretic semantics for Japanese floating quantifiers and their scope properties. *Journal of East Asian Linguistics* 2, 213–228.

Greenberg, Yael. 2009a. Event-based additivity in English and Modern Hebrew. Ms. Bar-Ilan University.

Greenberg, Yael. 2009b. Additivity with events. *Proceedings of Israel Association for Theoretical Linguistics* 25, 1–15.

Katz, Graham. 2003. Event arguments, adverb selection and the Stative Adverb Gap. In Ewald Lang, Claudia Maienborn and Cathrine Fabricius-Hansen (eds.), *Modifying adjuncts*, 455–474. Mouton de Gruyter.

Katz, Graham. 2008. Manner modification of state verbs. In Louise McNally and Christopher Kennedy (eds.), *Adjectives and adverbs*, 220–248. Oxford: Oxford University Press.

Kennedy, Christopher and Beth Levin. 2008. Measure of change: The adjectival core of degree achievements. In Louise McNally and Christopher Kennedy (eds.), *Adjectives and adverbs*, 156–182. Oxford: Oxford University Press.

Kratzer, Angelika. 1995. Stage-level and individual-level predicates. In Gregory N. Carlson and Francis Jeffry Pelletier (eds.), *The generic book*, 125–175. Chicago: University of Chicago.

Krifka, Manfred. 1989. Nominal reference, temporal constitution and quantification in event semantics. In Renate Bartsch, Johan van Benthem and Peter van Emde Boas (eds.), *Semantics and contextual expression*, 75–115. Dordrecht: Foris.

Krifka, Manfred. 1992. Thematic relations as links between nominal reference and temporal constitution. In Ivan A. Sag and Anna Szabolcsi (eds.), *Lexical matters*, 29–53. Stanford: CSLI Publications.

Krifka, Manfred. 1998. The origins of telicity. In Susan Rothstein (ed.), *Events and grammar*, 197–235. Dordrecht: Kluwer.

Kuroda, Sige-Yuki. 1980. Bunkoozoo-no hikaku [The comparison of grammatical structure]. In Tetsuya Kunihiro (ed.), *Nichi-eigo hikaku-kooza 2: Bunpoo* [*Japanese-English comparison courses 2: Grammar*], 23–61. Tokyo: Taishukan.

Maienborn, Claudia. 2005. On the limits of the Davidsonian approach: The case of copula sentences. *Theoretical Linguistics* 31, 275–316.

Miyagawa, Shigeru. 1989. *Structure and case marking in Japanese*. San Diego, CA: Academic Press.

Nakanishi, Kimiko. 2007. *Formal properties of measurement constructions*. Berlin: Mouton de Gruyter.

Ogihara, Toshiyuki. 2020. Aspect and thematic roles. *Journal of Semantics* 37, 83–115.

Piñón, Christopher. 2008. Aspectual composition with degrees. In Louise McNally and Christopher Kennedy (eds.), *Adjectives and adverbs*, 183–219. Oxford: Oxford University Press.

Rothstein, Susan. 1999. Fine-grained structure in the eventuality domain: The semantics of predicative adjective phrases and *be*. *Natural Language Semantics* 7, 347–420.

Rothstein, Susan. 2004. *Structuring events: A study in the semantics of lexical aspect*. Oxford: Blackwell Publishing.

Sawada, Osamu and Thomas Grano. 2011. Scale structure, coercion, and the interpretation of measure phrases in Japanese. *Natural Language Semantics* 19, 191–226.

von Stechow, Arnim. 1984. Comparing semantic theories of comparison. *Journal of Semantics* 3, 1–77.

Takami, Ken-ichi. 1998. Nihongo-ni suuryooshi yuuri-ni tsuite: Kinooron teki bunseki [On quantifier float in Japanese: A functional analysis]. *Gengo* 27, 99–107.

Thomas, Guillaume. 2009. Comparison across domains in Mbyá. *Proceedings of WSCLA* 14, 197–207.

Thomas, Guillaume. 2010. Incremental *more*. *Proceedings of Semantics and Linguistic Theory* 20, 233–250.