Distributive Numerals in Tlingit: Pluractionality and Distributivity

1. Basic Phenomenon and Key Claims

Tlingit possesses a numeral series that is aptly described by the labels 'distributive numeral', 'anti-quantifier', 'distance distributive', or 'dependent indefinites' (Gil 1982, Choe 1987, Farkas 1997, Matthewson 2000, Zimmermann 2002, Oh 2005, Balusu 2006, Henderson 2011).

(1) **Distributive Numerals in Tlingit**

a. Unmarked Numerals

Ax	kaa	yátx'i	**nás'k**	xáat	has aawashaat.
my	male	children	**three**	fish	they.caught

My sons caught three fish.

b. Distributive Numeral

Ax	kaa	yátx'i	**nás'gigáa**	xáat	has aawashaat.
my	male	children	**three.DIST**	fish	they.caught

(i) *My sons caught three fish each.*
(ii) *My sons caught three fish each time / caught fish in threes.*

- Sentence (1a) containing an unmarked numeral receives about the same range of interpretations as its English translation (*i.e.*, collective and cumulative). [1]

- Sentence (1b) containing a distributive numeral receives a different range of construals, one that is approximated by the English translations it is paired with.
    - Under either of the construals in (1b), there is 'distribution' of 'three fish' over some plurality:
        - A plurality of sons (1bi)
        - A plurality of catching events (1bii)

(2) **Key Analytic Claims**

- Tlingit sentences like (1b) are not truly ambiguous. Rather, they can be assigned a single meaning that covers both the scenarios suggested by the English translations in (1bi) and (1bii).
- Under this semantics, the distributive numeral has a meaning akin to 'pluractional adverbials' like *piece by piece* or *two by two* in English.
- This semantics predicts a number of facts concerning the interpretation of various sentences containing distributive numerals, both in Tlingit and in other languages (*e.g.* Korean and Kaqchikel)
- This semantics can extended in an interesting way to 'binominal each' in English

[1] However, as we will note below, (1a) strongly resists a 'distributive' interpretation, though this is perhaps akin to its English translation as well.

2. Basic Morphology and Syntax of Distributive Numerals

Formation of Tlingit distributive numeral:

- Suffix *–gaa* to the base of the unmarked numeral.
- The suffix bears a tone opposite to that of the immediately preceding syllable.
- For the numerals 1-3, the numeral root undergoes certain additional phonological changes

(3) **Distributive Numeral Series in Tlingit (1 – 10)**

a. Unmarked Numerals		b. Distributive Numerals	
tléix’	*one*	tlék’gaa	*one by one, one each*
déix	*two*	dáxgaa	*in twos, two each*
nás’k	*three*	nás’gigáa	*in threes, three each*
dax’oon	*four*	dax’oongáa	*in fours, four each*
keijín	*five*	keijíngaa	*in fives, five each*
tleidooshú	*six*	tleidooshúgaa	*in sixes, six each*
daxadooshú	*seven*	daxadooshúgaa	*in sevens, seven each*
nas’gadooshú	*eight*	nas’gadooshúgaa	*in eights, eight each*
gooshúk	*nine*	gooshúkgaa	*in nines, nine each*
jinkaat	*ten*	jinkaatgáa	*in tens, ten each*

Note: For numerals modifying animate Ns, the ‘animate classifier/agreement’ suffix - *náx* occurs to the right of *gaa*.

(4) **Distributive Animate Numeral Series in Tlingit (1 – 10)**

a. Unmarked Animate Numerals		b. Distributive AnimateNumerals	
tléinánx	*one*	tlék’gaanánx	*one by one, one each*
dáxnánx	*two*	dáxgaanánx	*in twos, two each*
nás’ginánx	*three*	nás’gigáanánx	*in threes, three each*
dax’ooninánx	*four*	dax’oongáanánx	*in fours, four each*
keijíninánx	*five*	keijíngaanánx	*in fives, five each*
tleidooshúnánx	*six*	tleidooshúgaanánx	*in sixes, six each*
daxadooshúnánx	*seven*	daxadooshúgaanánx	*in sevens, seven each*
nas’gadooshúnánx	*eight*	nas’gadooshúgaanánx	*in eights, eight each*
gooshúgunánx	*nine*	gooshúkgaanánx	*in nines, nine each*
jinkaadinánx	*ten*	jinkaatgáanánx	*in tens, ten each*

In natural texts, these distributive numerals often appear to function as adverbs translatable into English as pluractional adverbs like *two by two, two at a time, in twos* (Leer *et al.* 2001: 26).

(4) **Distributive Numerals as Adverbial Modifiers in Tlingit**

Tlék’gaa	áwé	anax	daak	has aawal’éx.
one.DIST	FOC	through.it	out	they.danced

One by one, they danced out. (Edwards 2009: 260)

(5) **Distributive Numerals as Adnominal Modifiers in Tlingit**

- As is well-known, many languages also allow distributive numerals to function as adnominal modifiers (Gil 1982, Choe 1987, Matthewson 2000, Zimmermann 2002, Oh 2005, Balusu 2006, Henderson 2011).

- Similarly, in Tlingit it is common to find distributive numerals in positions where they could conceivably be nominal modifiers (*e.g.* (1a) vs. (1b))

- Unfortunately, given the freedom of word-order in Tlingit, there are rather few positive tests for the constituency of NPs.
  - But there is some evidence that distributive numerals in Tlingit *can* function as adnominal modifiers.

a. Arguments for Optional Adnominal Status
- They clearly sometimes form an intonational unit with the NP in speech.
- Moreover, as illustrated by (5b) it is possible for the elliptical answer to a *wh*-question to consist of a distributive numeral followed by a noun.
- Generally, such elliptical answers can only be constituents. As shown in (5c), such an answer cannot consist of a manner adverb followed by a noun.

b. Distributive Numerals as Adnominal Modifiers in Tlingit

(i) *Question Prompt:*

Daa	sáwé	has aawashaat	yá i kaa yátx'i?
what	Q.FOC	they.caught	these your male children

What did you sons catch?

(ii) *Possible Elliptical Answers*

1.	nás'k	xáat	2.	nás'gigáa	xáat
	three	fish		three.DIST	fish
	Three fish.			*Three fish each.*	

c. Elliptical Answers Must be Constituents in Tlingit

(i) Basic Sentence:

Tláakw	útlxi	xwaaxáa
quickly	boiled.fish	I.ate

I ate the boiled fish quickly.

(ii) *Question Prompt:*

Daa	sáwé	yeexáa?
what	Q.FOC	you.ate

What did you eat?

(iii) *Impossible Elliptical Answer:*

* Tláakw	útlxi
quickly	boiled.fish

Another argument for (optionally) adnominal distributive numerals in Tlingit can be based upon the facts below.

(6) **Distributive Numerals and Demonstratives in Tlingit**

The ill-formedness of (6a,b) demonstrates that distributive numerals in Tlingit cannot directly modify NPs marked with demonstratives, a frequently encountered pattern across languages (Zimmermann 2002, Oh 2005).

a. * Ax shaa yátx'i dáxgaa wé keitl has aawashúch.
my female children two.DIST those dog they.bathed

b. * Ax shaa yátx'i wé dáxgaa keitl has aawashúch.
my female children those two.DIST dog they.bathed

(7) **Distributive Numerals as Adverbial Modifiers in Tlingit**

Given the facts in (6), it follows that in well-formed sentences like the following, the distributive numeral must be base-generated as an *adverb*; it could not simply be a 'floated' adnominal modifier.

Ax shaa yátx'i dáxgaa has aawashúch wé keitl
my female children two.DIST they.bathed those dog
My daughters bathed those dogs two at a time.

(8) **Distributive Numerals as Adnominal Modifiers in Tlingit**

Given the facts in (6), it follows that in well-formed sentences like the following, the distributive numeral must be *adnominal*. If it could be parsed as an adverb, then we would wrongly predict the acceptability of (6a).

Ax shaa yátx'i dáxgaa keitl has aawashúch.
my female children two.DIST dog they.bathed
My daughters bathed two dogs each.

(9) **Principle Conclusions, To Be Employed in Subsequent Arguments**

a. As noted in (8), in a structure of the form 'Subj. Distributive-Numeral Obj. Verb", the distributive numeral *must* be adnominal, and cannot be adjoined to VP.

b. In a structure of the form "(NP) Distributive-Numeral … Demonstrative NP", the distributive numeral *must* be adverbial, and cannot be a 'floated' adnominal modifier of the demonstratively-marked NP.

Thus, distributive numerals in Tlingit can be both adnominal and adverbial modifiers…

(10) **Side Question**

a. Question:
Why are sentences like (6a) ill-formed under an 'adverbial' parse of the distributive numeral? Why isn't a structure of the form 'Subject Adverb Object V' possible?

b. Answer:
Speakers have a strong preference to avoid 'front heavy' sentences. If there is more than one major phrase in the sentence, speakers prefer for at least one to be post-posed after the verb (Leer 1991: 24).

(11) **Distributive Suffix is Specific to Numerals**

The suffix *–gaa* has only been reported to occur on numerals. I haven't checked other cardinality expressions (*e.g. shayadihein* 'many'), but it definitely cannot appear on arbitrary NPs.

a.	Ax	kaa	yátx'i	**nás'gigáa**	xáat	has aawashaat.
	my	male	children	**three.DIST**	fish	they.caught

Each of my sons caught three fish.
(≈ *My sons caught three fish each*)

b.	* Ax	kaa	yátx'i	**xáatgáa**	has aawashaat.
	my	male	children	**fish.DIST**	they.caught

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3. Basic Facts Regarding the Semantics of Distributive Numerals

(12) **Methodological Note**

- The semantics of Tlingit distributive numerals were explored using truth/felicity-judgment tasks (Matthewson 2004).
- Speakers were asked to translate English sentences paired with particular 'scenarios', as well as to judge the 'correctness' (broadly speaking) of constructed Tlingit sentences relative to those 'scenarios'.
- The scenarios were described to speakers in English, but that linguistic description was accompanied by a pictorial representation.

(13) **Collective Readings are Incompatible With Distributive Numerals**

Scenario: Linda, Anne and Sue together bathed Sparky and Spot (at the same time).

a. Unmarked Numeral
Wé shaax'wsáani **déix** keitl has aawashúch.
those girls **two** dog they.bathed
The girls washed two dogs.
Judgment: True in scenario above (offered as translation of English sentence)

b. Distributive Numeral
Wé shaax'wsáani **dáxgaa** keitl has aawashúch.
those girls **two.DIST** dog they.bathed
Judgment: Not true in scenario above

(14) **Cumulative Readings are Incompatible With Distributive Numerals**

Scenario: My sons Tom and Ben went fishing. Tom caught two fish. Ben caught one.

a. Unmarked Numeral
Ax kaa yátx'i **nás'k** xáat has aawashaat.
my male children **three** fish they.caught
My sons caught three fish.
Judgment: True in scenario above (offered as translation of English sentence)

b. Distributive Numeral
Ax kaa yátx'i **nás'gigáa** xáat has aawashaat.
my male children **three.DIST** fish they.caught
My sons caught three fish each / My sons caught fish three at a time.
Judgment: Not true in scenario above

(15) **Distributive Readings Virtually *Require* Distributive Numerals**

Scenario: My sons Tom and Ben went fishing. Tom caught three fish, and Ben did too.

a. Unmarked Numeral
Ax kaa yátx'i **nás'k** xáat has aawashaat.
my male children **three** fish they.caught
My sons caught three fish.
Judgment: Not true / only marginally true in scenario above.

b. Distributive Numeral
Ax kaa yátx'i **nás'gigáa** xáat has aawashaat.
my male children **three.DIST** fish they.caught
My sons caught three fish each / My sons caught fish three at a time.
Judgment: True and appropriate in scenario above

(16) **Terminology: Distributive Share (DIST-SHARE) and Distributive Key (DIST-KEY)**

a. Distributive Key
If the truth-conditions of a sentence can modeled through the use of a distributive operator ([$\lambda P_{<et>}$: [λx_e : $\forall y$. y < x & atom(y) → P(y)]]), then the *distributive key* of that sentence is the material that would form the restrictor of the operator.

b. Distributive Share
If the truth-conditions of a sentence can modeled through the use of a distributive operator ([$\lambda P_{<et>}$: [λx_e : $\forall y$. y < x & atom(y) → P(y)]]), then the *distributive share* of that sentence is the material that would form the scope of the operator.

c. Illustration

(i) The boys bought three sausages each.

1. Distributive Key = the boys
(≈ $\forall y$. y < **the.boy** & atom(y) → y bought three sausages)

2. Distributive Share = bought three sausages
(≈$\forall y$. y < the.boy & atom(y) → **y bought three sausages**)

(ii) Bill carried the boxes in twos.

1. Distributive Key = plural event of carrying
(≈ $\forall e'$. e' < **e** & atom(y) → Bill carried two boxes in e')

2. Distributive Share = Bill carried two boxes
(≈ $\forall e'$. e' < **e** & atom(y) → **Bill carried two boxes in e'**)

(17) **Generalization: Distributive Numeral Marks DIST-SHARE**

As illustrated in (18)-(19), an NP modified by a distributive numeral is never the 'distributive key'. Rather, it always forms part of the 'distributive share'.

Note: This is essentially a definitional property for 'distributive numerals'

(18) **Distributive Numerals Modify the DIST-SHARE, Never the DIST-KEY**

Scenario: We have two dogs, Sparky and Spot. Linda came over to wash them. First, she washed Spot. Then, she washed Sparky. Thus, two dogs were each washed by Linda.

a. Unmarked Numeral
Linda **déix** keitl aawashúch.
Linda **two** dog she.bathed
Linda bathed two dogs.
Judgment: True in scenario above (offered as translation of English sentence)

b. Distributive Numeral
Linda **dáxgaa** keitl aawashúch.
Linda **two.DIST** dog she.bathed
Judgment: Note true in scenario above. (≠ *Two dogs were each washed by Linda*)

(19) **Distributive Numerals Modify the DIST-SHARE, Never the DIST-KEY**

Scenario: We have three dogs. Six girls came over to wash them. Each dog was washed by a team of two (different) girls.

a. Unmarked Numeral:
Wé shaax'wsáani **nás'k** keitl has aawashúch.
those girls **three** dog they.bathed
The girls washed three dogs.
Judgment: True in this scenario (offered as translation of English sentence)

b. Distributive Numeral on Direct Object
Dáxnáx shaax'wsáani **nás'gigáa** keitl has aawashúch.
two girls **three.DIST** dog they.bathed
The girls washed three dogs each.
Judgment: Not true in this scenario (≠ *Three dogs were each washed by two girls*)

c. Distributive Numeral on Subject
Dáxgaanáx shaax'wsáani **nás'k** keitl has aawashúch.
two.DIST girls **three** dog they.bathed
Three dogs were each washed by two girls.
Judgment: True in this scenario (offered as description of the scenario above)

(20) **The Possibility of 'Participant-Distributive' and 'Event-Distributive' Construals**

- In the sentences in (15) and (19), the 'DIST-KEY' of the sentence seems to be some plural participant in the event ('my sons' in (15); 'three dogs' in (19)).
- In the sentences in (21)-(23) below, however, the 'DIST-KEY' seems to be some plural event.
- The possibility of both these 'construals' is a subject often discussed in the literature on distributive numerals (Gil 1982, Zimmermann 2002, Oh 2005, Balusu 2006, Champollion 2011)

  Terminology:
  - I will refer to the 'construals' where the DIST-KEY is a plural participant as 'participant-distributive' construals.
  - I will refer to the 'constrauls' where the DIST-KEY is a plural evnet as 'event-distributive' construals.

(21) **Event-Distributive Construals of Tlingit Distributive Numerals**

Scenario: My son went fishing every day last week. Each day he went fishing, he caught three fish.

a. Unmarked Numeral:

Ax	yéet	**nás'k**	xáat	aawashaat.
my	son	**three**	fish	caught

My son caught three fish. Judgment: Not true in the scenario above.

b. Distributive Numeral

Ax	yéet	**nás'gigáa**	xáat	aawashaat.
my	son	**three.DIST**	fish	caught

My son caught three fish each time. / My son caught fish three at a time / in threes
Judgment: True in scenario above

(22) **Event-Distributive Construals of Tlingit Distributive Numerals**

Scenario: Every day last week, my sons went out fishing. Every day, they caught a total of three fish.

Ax	kaa	yátx'i	**nás'gigáa**	xáat	has aawashaat.
my	male	children	**three.DIST**	fish	they.caught

My sons caught three fish each time / My sons caught fish three at a time / in threes.
Judgment: True in scenario above

(23) **Event-Distributive Construals of Tlingit Distributive Numerals**

a. Ax éesh **nás'gigáa** kóok haat yéi awsinei.
my father **three.DIST** box here he.carried
My father brought boxes three at a time.

b. Ax éesh **tlék'gaa** haat yéi awsinei wé kóok
my father **one.DIST** here he.carried those box
My father brought the boxes one by one.

c. **Tlék'gaa** ax éesh **nás'k** kóok haat yéi awsinei
one.DIST my father **three** box here he.carried
My father brought three boxes one by one.

d. Ax éesh **nás'k** kóok **tlék'gaa** haat yéi awsinei
my father **three** box **one.DIST** here he.carried
My father brought three boxes one by one.

(23) **Key Observations Regarding Event- and Participant-Distributive Construals**

Observations Concerning Event-Distributive Readings

a. Given (9b), (23b) shows that adverbial distributive numerals allow for these event-distributive construals.

b. Given (9a), (21b), (22), and (23a) show that *adnominal* distributive numerals also allow for these event-distributive construals.

c. The possibility of an event-distributive construal in (22) demonstrates that such construals are also possible when there is a plural NP in the sentence that could also in principle provide the DIST-KEY

Observations Concerning Participant-Distributive Readings

d. Given (9a), sentences (15b) and (19c) show that event-distributive construals are not obligatory for adnominal distributive numerals (duh).

e. Given (9b), sentence (24) below shows that such construals are also not obligatory for adverbial distributive numerals.

(24) **Participant-Distributive Construal of Adverbial Distributive Numeral**

Scenario: My neighbors have four dogs. My daughters Hazel and Bea went over to their house to wash those dogs. Hazel washed two dogs, and Bea washed the other two.

Ax	shaa	yátx'i	dáxgaa	has aawashúch	wé	keitl
my	female	children	two.DIST	they.bathed	those	dog

My daughters bathed those dogs two at a time / in twos.
Judgment: True in scenario above.

(25) **Distributive Numerals and Inverse Scope**

As reported for other languages (Zimmermann 2002, Oh 2005), inverse scope readings in Tlingit virtually require the use of a distributive numeral.

Scenario: We have three dogs. Six girls came over to wash them. Each dog was washed by a team of two (different) girls.

a. Unmarked Numeral

Dáxnáx	shaax'wsáani	**nás'k**	keitl	has aawashúch.
two	girls	**three**	dog	they.bathed

Two girls washed three dogs.
Judgment: Not true in scenario above

b. Distributive Numeral on Subject

Dáxgaanáx	shaax'wsáani	**nás'k**	keitl	has aawashúch.
two.DIST	girls	**three**	dog	they.bathed

Three dogs were each washed by two girls.
Judgment: True in scenario above (offered as description of the scenario above)

4. Separation of Events in Pluractional Readings

- Under the event-distributive construal, the DIST-KEY is some plural event, and the DIST-SHARE is distributed over subevents of this DIST-KEY
- Consequently, these subevents must be distinguished from one another is some fashion.
- *But how? By their time of occurrence? By their location? By their participants alone?*
  - Balusu (2006) explores this question for distributive numerals in Telugu.
  - The following data replicate his core results

First, sentences like (26) show that the subevents can be distinguished purely in terms of their temporal location, with their spatial location overlapping.

(26) **Temporal, Non-Spatial Separation of Subevents in Dist-Key**

Scenario: We are watching a dance performance. As part of this performance, the girls have divided into pairs. Each pair of girls goes up on stage and dances in turn.

Dáxgaa shaax'wsáani has aawal'eix.
two.DIST girls they.danced
The girls danced in twos / The girls danced two at a time.
Judgment: True in scenario above (offered as translation of English sentence)

Sentences like (27) show that the subevents can be distinguished purely in terms of their spatial location, with their temporal locations overlapping.

(27) **Spatial, Non-Temporal Separation of Subevents in Dist-Key**

Scenario: The girls are playing a funny sort of game. When we look outside, we see that they have grouped themselves into pairs. Each pair of girls is standing apart from the others, holding hands. The girls all count together in unison "one, two, three". At three, all the girls together jump at the same time.

Dáxgaa shaax'wsáani kei has kawdik'én
two.DIST girls they.jumped
The girls jumped in twos.
Judgment: True in scenario above (offered as translation of English sentence)

There are some limits, however, on how subevents can be distinguished from one another.

(28) **A Non-Temporal, Non-Spatial Version of Pluractional Reading is Impossible**

Scenario: The girls are playing a funny sort of game. When we look outside, we see that they are all standing together in a single group. Curiously, though, each is dressed just like some other girl. That is, two girls are both wearing a black dress, two are both wearing a white dress, two are both wearing a striped dress, etc. The girls all count together in unison "one, two, three". At three, all the girls together jump at the same time.

Judgment: Sentence (28) is *not* true in this scenario.

- In the scenario in (28), the only salient way divide the larger event into subevents in which there are two girls is to divide out subevents on the basis of how the girls are dressed.
- The unacceptability of sentence (27) in the context in (28) shows that this is not a linguistically/cognitively valid way of dividing the larger event into subevents…
- While this may be an interesting fact to note, it's not clear that there are any linguistic conclusions to be made from this fact…

5. Interpretations Observed for Particular Syntactic Configurations

In this section, I will catalog the possible interpretations observed for particular syntactic configurations containing distributive numerals.

The facts reported here are not significantly different from those reported for distributive numerals in other languages (Gil 1982, Choe 1987, Zimmermann 2002, Oh 2005, Balusu 2006).

(29) **Sentences of the Form 'Subject$_{Plural}$ > Distributive Numeral > Object$_{Plural}$ > Verb'**

a. Sentences of this form allow an interpretation where the object is part of the Dist-Share and the plural subject is Dist-Key.

(i) Ax kaa yátx'i **nás'gigáa** xáat has aawashaat.
my male children **three.DIST** fish they.caught
My sons caught three fish each / My sons caught fish three at a time.

Verifying Scenario:
My sons Tom and Ben went fishing. Tom caught three fish. Ben did too.

b. Sentences of this form do *not* allow an interpretation where the subject is part of the Dist-Share and the plural object is Dist-Key.

(i) **Dáxnáx** shaax'wsáani **nás'gigáa** keitl has aawashúch.
two girls **three.DIST** dog they.bathed
Two girls washed three dogs each.

Not a Verifying Scenario:
We have three dogs. Six girls came over to wash them. Each dog was washed by a team of two (different) girls.

c. Sentences of this form allow a event-distributive construal, where the object is part of the Dist-Share and a plural event is the Dist-Key.

(i) Ax kaa yátx'i **nás'gigáa** xáat has aawashaat.
my male children **three.DIST** fish they.caught
My sons caught three fish each time / My sons caught fish three at a time

Verifying Scenario:
Every day last week, my sons went out fishing. Every day, they caught a total of three fish.

(30) **Sentences of the Form 'Distributive Numeral > Subject$_{Plural}$ > Object$_{Plural}$ > Verb'**

a. Sentences of this form allow an interpretation where the subject is part of the Dist-Share and the plural object is Dist-Key.

(i) **Dáxgaanáx** shaax'wsáani **nás'k** keitl has aawashúch.
two.DIST girls **three** dog they.bathed
Three dogs were each washed by two girls.
Verifying Scenario:
We have three dogs. Six girls came over to wash them. Each dog was washed by a team of two (different) girls.

b. Sentences of this form do *not* allow an interpretation where object is part of the Dist-Share and the plural subject is Dist-Key

(i) **Dáxgaanáx** shaax'wsáani **nás'k** keitl has aawashúch.
two.DIST girls **three** dog they.bathed
Two girls each washed three (possibly different) dogs.
Not a Verifying Scenario:
My daughters, Hazel and Bea, went to wash our neighbors dogs. They worked separately. Each girl washed three dogs.

c. Sentences of this form allow an event-distributive construal where the subject is part of the Dist-Share and a plural event is the Dist-Key.

(i) **Dáxgaanáx** shaax'wsáani yóo keitl has aawashúch.
two.DIST girls those dog they.bathed
Every time, two (different) girls were bathing those dogs.
Verifying Scenario:
Our neighbor has three dogs, which are always very dirty. This week, every time we went over to their house, there were two (different) girls washing those three dogs.

(31) **Sentences of the Form 'Subject$_{Singular}$ > Distributive Numeral > Object$_{Plural}$ > Verb'**

Sentences of this form allow an event-distributive construal where the object is part of the Dist-Share and a plural event is the Dist-Key.

a. Ax yéet **nás'gigáa** xáat aawashaat.
my son **three.DIST** fish caught
My son caught three fish each time. / My son caught fish three at a time.

Verifying Scenario:
My son went fishing every day last week. Each day he went fishing, he caught three fish.

(32) **Sentences of the Form 'Distributive Numeral > Subject$_{Plural}$ > Verb'**

Sentences of this form allow an event-distributive construal where the subject is part of the Dist-Share and a plural event is the Dist-Key.

a. **Dáxgaa** shaax'wsáani has aawal'eix.
two.DIST girls they.danced
Girls danced in twos / Girls danced two at a time.

Verifying Scenario:
We are watching a dance performance. As part of this performance, the girls have divided into pairs. Each pair of girls goes up on stage and dances in turn.

(33) **Sentences of the Form 'Distributive Numeral > Subject$_{Plural}$ > Distributive Numeral > Object$_{Plural}$ > Verb'**

Sentences of this form allow an interpretation where the subject and the object are both part of the Dist-Share, and a plural evente is the Dist-Key.

a. **Dáxgaanáx** shaax'wsáani **nás'gigáa** keitl has aawashúch.
two.DIST girls **three.DIST** dog they.bathed
Every time, two girls were washing three dogs /
Girls in twos washed dogs in threes

Verifying Scenario:
Our neighbor has a bunch of dogs, which are always very dirty. This week, every time we went over to their house, there were two (different) girls washing three of the dogs.

(34) **Sentences of the Form 'Subject$_{Plural}$ > Distributive Numeral > Object > Verb$_{Stative}$'**

Sentences of this form allow an interpretation where the object is part of the Dist-Share and the plural subject is the Dist-Key.

a. **Nás'gináx** shaax'wsáani **dáxgaanáx** káax'w has asixán.
three girls **two.DIST** men they.love
Three girls love two men each.

Verifying Scenario:
Linda loves Tom and Paul. Sue loves John and Joe. Anne loves Frank and Jeff. Thus, the three girls each love two different boys.

(35) **Sentences of the Form Subject$_{\text{Plural}}$ > 'Distributive Numeral > Verb$_{\text{Stative}}$'**

Sentences of this form allow an interpretation where the subject is part of the Dist-Share. The Dist-Key is unclear in the examples obtained, but seems something like a set of implicit locations.

a. Wé kóok **tlék'gaa** yadál.
those box **one.DIST** heavy
Those boxes are each heavy / One by one, those boxes are heavy.
Verifying Scenario:
There is a stack of boxes before us. Each one weighs 100 pounds.

(36) **Sentences of the Form 'Subject$_{\text{Singular}}$ > Distributive Numeral > Object > Verb$_{\text{Stative}}$'**

Sentences of this form are semantically anomalous, and do not readily admit of any sensible interpretation.

a. Linda **dáxgaanáx** káax'w has asixán.
Linda **two.DIST** men they.love
(?) *Linda loves two men each.*
Judgment: No sensible interpretation. Definitely cannot describe a scenario where Linda loves two boys.

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6. Distributive Numerals as Pluractional Modifiers

- In this section, I will develop and defend a semantic analysis of Tlingit distributive numerals that will cover the facts above, as well as several other phenomena noted for other languages…

- This analysis will be based upon the work of Beck & von Stechow (2007) on pluractional adverbials like *piece by piece*.
  - Therefore, I will begin by briefly reviewing the core ideas behind their account.

6.1 A Brief Overview of Beck & von Stechow (2007), *Pluractional Adverbials*

The following is a simplification of the proposals of Beck & von Stechow (2007), but conveys the main ideas…

(37) **The Analysis of *Piece by Piece***

a. The LF: [by piece] *Some kind of reduplication produces the initial 'piece'*

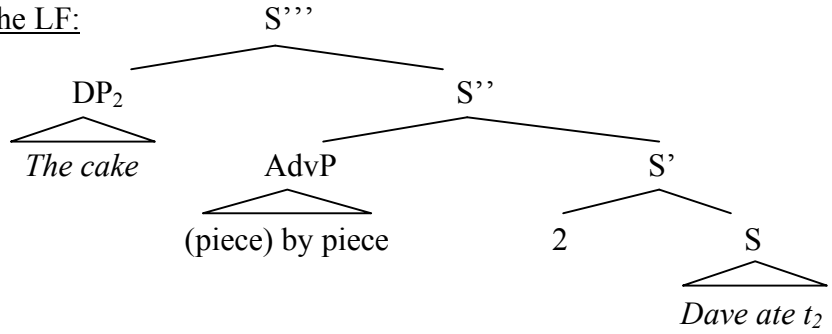
b. The Meaning of 'By'

[[by]] = $[\lambda Q_{<et>} : [\lambda P_{<e, \varepsilon t>} : *[\lambda x_e : \lambda e_\varepsilon : P(x)(e) \ \& \ Q(x)]]$

(38) **The Semantic Contribution of *Piece by Piece***

a. Sentence: Dave ate the cake piece by piece.

b. The LF:



c. The Semantic Computation

(i) [[S']] = [λx_e: λe_ε: *ate(e) & *Ag(e) = Dave & *Th(e) = x]

(ii) [[AdvP]] = [$\lambda P_{<e, \varepsilon t>}$: *[λx_e: λe_ε : P(x)(e) & piece(x)]]

(iii) [[S'']] = *[λx_e: λe_ε : *ate(e) & *Ag(e) = Dave & *Th(e) = x & piece(x)]

(iv) [[S''']] = T *iff*

$\exists e'$. *[λx_e: λe_ε : *ate(e) & *Ag(e) = Dave & *Th(e) = x & piece(x)](e')(the.cake)

d. Verifying Scenario:

Eating Events	Agent	Theme
e_1	Dave	$piece_1$
e_2	Dave	$piece_2$
e_3	Dave	$piece_3$
e_4	Dave	$piece_4$

- If the cake is divided into four pieces, *and* we identify the cake with the plurality of its four pieces, then (38c) will hold in scenario (38d).

Note: The key ideas here seem easily extendible to pluractional adverbs like *two by two.*

(39) **The Semantic Contribution of *Two by Two***

a. Sentence: Dave ate the candies two by two.

b. Predicted Truth Conditions: (Exercise for the reader)

$\exists e'$. *[λx_e: λe_ε : *ate(e) & *Ag(e) = Dave & *Th(e) = x & **|x| = 2**](e')(the.candies)

c. Verifying Scenario:

Eating Events	Agent	Theme
e_1	Dave	c_1+c_2
e_2	Dave	c_3+c_4
e_3	Dave	c_5+c_6
e_4	Dave	c_7+c_8

6.2 Some Problems for the Beck & von Stechow (2007) Analysis

(40) **First Problem**
The truth-conditions in (39c) also hold in a scenario like the following. However, intuitively, sentence (39a) requires that Dave eat *more* than two candies…

Eating Events	Agent	Theme
e_1	Dave	c_1+c_2

(41) **Second, More Serious Problem**
The sentence in (a) can be true in the scenario in (b).

a. The Sentence: The boys picked up the apples two by two.

b. Verifying Scenario:
The boys together picked up the apples; each boy picked up his apples in pairs.

Picking Events	Agent	Theme	
e_1	Bill	a_1+a_2	
e_2	Tom	a_3+a_4	
e_3	Jim	a_5+a_6	
e_4	Bill	a_7+a_8	
e_5	Tom	a_9+a_{10}	…

c. The Problem:
There is no LF that we can assign to (41a) by which the entry in (37b) will yield T-conditions that hold in (41b).

(42) **Possible LFs and Their Truth-Conditions**

a. First LF: [the apples [two-by-two [1 [the boys picked up t_1] …]

(i) *Predicted T-conditions:*

$\exists e' . *[\lambda x_e: \lambda e_\varepsilon : *ate(e) \& *Ag(e) = the.boys \& *Th(e) = x \& |\mathbf{x}| = \mathbf{2}](e')(the.apples)$

The apples can be formed from those things x such that x is a pair of things that <u>all</u> the boys collectively/cumulatively picked up.

b. Second LF: [the boys [* [2 [the apples [two-by-two [1 [t_2 picked up t_1] …]

(ii) *Predicted T-Conditions*

$\exists e'' . * [\lambda y_e: \lambda e' : *[\lambda x_e: \lambda e_E: pick\text{-}up(e) \& Ag(e)=y \& Th(e)=x \& |x|=2] (e')(the.apples)] (e)(the.boys)$

The boys can be formed from those individuals y that picked up <u>all</u> the apples in pairs.

(43) **Important Observations**

a. The T-conditions in (42a) and (42b) *do* seem to be possible interpretations of sentence (41a). **However, neither of those T-conditions hold in the verifying scenario in (41b).**

b. A similar problem could be raised for sentences like the following:

(i) *Sentence:* The boys ate the cake piece by piece.

(ii) *Verifying Scenario:* Each boy ate one piece at a time, and *together* they finished the cake.

(iii) *The Problem:* Again, there's no way to give an LF to sentence (i) whereby the entry in (37b) will yield T-conditions that hold in scenario (ii).

c. Our Desideratum:
A semantics for *two by two* which predicts that (41a) can be true in scenario (41b), *and* which predicts that it can receive readings akin to those in (42).

6.3 A Possible Solution to The Problems

(44) **Some Truth-Conditions That Would Work For Us**

$\exists e$. *pick-up(e) & *Ag(e) = the.boys & *Th(e) = the.apples &
$\langle e , \text{the.apples} \rangle = \sigma_{\langle e', y \rangle}$. participant(e',y) & |y| = 2 & e' < e & y < the.apples

The boys cumulatively picked up the apples, and
the apples are the sum of those things y such that
(i) *y is a proper sub-part of the the apples*
(ii) *y is a pair of things*
(iii) *y is a participant in a proper sub-event of e*

(45) **Solution to the Problem in (40)**

Note that the truth-conditions in (44) will *fail* to hold in scenarios like the following, where there are exactly two apples and the boys collectively pick them up.

Picking-up Events	Agent	Theme
e_1	Dave+Bill+Tom	a_1+a_2

- This is because, under the truth-conditions in (44), 'the apples' have to be formed form *proper parts* that are pairs.

(46) **Solution to the Problem in (41)**

The truth-conditions in (44) *will* hold in scenarios like the following, where the boys cumulatively pick up the apples, and each boy picks up his apples in twos.

Picking Events	Agent	Theme	
e_1	Bill	a_1+a_2	
e_2	Tom	a_3+a_4	
e_3	Jim	a_5+a_6	
e_4	Bill	a_7+a_8	
e_5	Tom	a_9+a_{10}	…

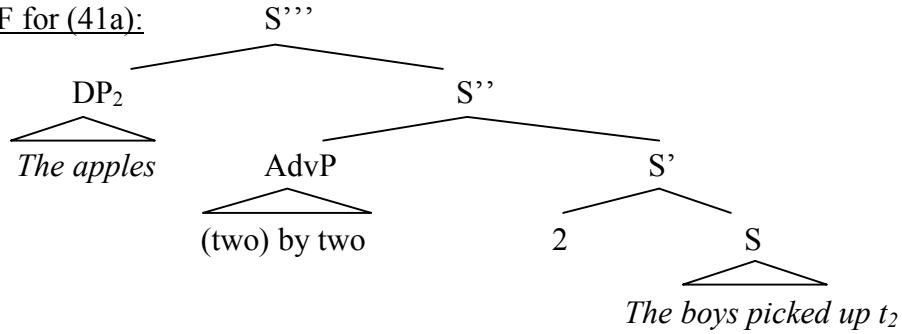
- In this scenario, 'the apples' can be formed from (i) proper sub-parts, that (ii) are pairs, and (iii) participated in some sub-event of the cumulative 'picking up' ($e_1+e_2+e_3+e_4+e_5$)

(47) **A Semantics for *By* That Will Yield These Truth-Conditions**

a. [[by]] =

$[\ \lambda R_{<et>} : [\ \lambda P_{<e,\ \varepsilon t>} : [\ \lambda x_e : [\ \lambda e_\varepsilon : P(x)(e)\ \&$
$<e\ ,\ x> \ =\ \sigma_{<e',\ y>}\ .\ \text{participant}(e',y)\ \&\ R(y)\ \&\ e' < e\ \&\ y < x\ ]\ \ldots\ ]$

b. <u>LF for (41a):</u>



c. <u>The Semantic Computation</u>

(i) [[S']] = $[\ \lambda x_e : \lambda e_\varepsilon : *\text{pick.up}(e)\ \&\ *\text{Ag}(e) = \text{the.boys}\ \&\ *\text{Th}(e) = x\ ]$

(ii) [[AdvP]] = $[\ \lambda P_{<e,\ \varepsilon t>} : [\ \lambda x_e : [\ \lambda e_\varepsilon : P(x)(e)\ \&\ <e\ ,\ x> \ =$
$\sigma_{<e',\ y>}\ .\ \text{participant}(e',y)\ \&\ |y| = 2\ \&\ e' < e\ \&\ y < x\ ]\ \ldots\ ]$

(iii) [[S'']] = $[\ \lambda x_e : \lambda e_\varepsilon : *\text{pick.up}(e)\ \&\ *\text{Ag}(e) = \text{the.boys}\ \&\ *\text{Th}(e) = x\ \&$
$<e\ ,\ x> \ =\ \sigma_{<e',\ y>}\ .\ \text{participant}(e',y)\ \&\ |y| = 2\ \&\ e' < e\ \&\ y < x\ ]\ ]$

(iv) [[S''']] = T *iff*

$\exists e\ .\ *\text{pick.up}(e)\ \&\ *\text{Ag}(e) = \text{the.boys}\ \&\ *\text{Th}(e) = \text{the.apples}\ \&$
$<e\ ,\ \text{the.apples}> \ =\ \sigma_{<e',\ y>}\ .\ \text{participant}(e',y)\ \&\ |y| = 2\ \&\ e' < e\ \&\ y < \text{the.apples}$

(48) **Adequacy of This Semantics, Part 1**

The sentence in (48a) will receive the truth-conditions in (48b), which indeed hold in scenarios like (48c).

a. Sentence: Dave ate the candies two by two.

b. Predicted Truth Conditions:
$\exists e$. *eat(e) & *Ag(e) = Dave & *Th(e) = the.candies &
$\langle e , \text{the.candies} \rangle = \sigma_{\langle e', y \rangle}$. participant(e',y) & |y| = 2 & e' < e & y < the.candies

There is a (plural) event of Dave (cumulatively) eating the candies, and the candies are the sum of all those things y such that (i) y is a proper part of the candies, and (ii) y is a pair of things, and (iii) y participated in a proper sub-event of the (plural) event of eating all the candies…

c. Verifying Scenario:

Eating Events	Agent	Theme
e_1	Dave	c_1+c_2
e_2	Dave	c_3+c_4
e_3	Dave	c_5+c_6
e_4	Dave	c_7+c_8

(49) **Adequacy of the Semantics, Part 2**

The truth-conditions in (44) also hold in scenarios like (49a), which validate the T-conditions in (42a).

a. Scenario: The boys picked up the apples by *collectively* picking up two apples each time.

Picking Events	Agent	Theme	
e_1	Bill+Tom+Jim	a_1+a_2	
e_2	Bill+Tom+Jim	a_3+a_4	
e_3	Bill+Tom+Jim	a_5+a_6	…

The truth-conditions in (44) also hold in scenarios like (49b), which validate the T-conditions in (42b).

b. Scenario: Each boy picked up all the apples in pairs.

Picking Events	Agent	Theme	
e_1	Bill	a_1+a_2	
...			
e_5	Bill	a_9+a_{10}	
e_6	Tom	a_1+a_2	
…			
e_{10}	Tom	a_9+a_{10}	… (and so on for Jim, too)

Thus, from the results in (45)-(49), we see that our proposed semantics in (47a) meets the desiderata in (43).

But, what does any of this have to do with distributive numerals?...

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7. A Semantics for Distributive Numerals in Tlingit

My analysis for Tlingit distributive numerals will build upon the semantics for pluractional adverbs in (47).

(50) **Key Hypotheses**

Pluractional numerals in Tlingit are structurally/semantically ambiguous.
- There are adverbial distributive numerals (type <eEt, eEt>)
- There are adnominal distributive numerals (type <et, <eEt, Et>>)

Although there is much to recommend a 'unified' account, there remains two key issues:

a. Issue 1:
Not every language allows adnominal distributive numerals to also function as adverbial modifiers, or *vice versa* (Gil 1982, Oh 2005).

b. Issue 2:
Given the distinct surface syntax of adnominal and adverbial distributive numerals, a unified syntactic/semantic analysis would have to involve unappealing covert movements.

(51) **Semantics for Adverbial Distributive Numerals**

- Adverbial distributive numerals are akin to pluractional adverbs in English.
- Their main difference is that they are restricted to only take things of 'type *n*' (numbers) as their first argument.

[[gaa]] =

$[\lambda n_n : [\lambda P_{<e, \varepsilon t>} : [\lambda x_e : [\lambda e_\varepsilon : P(x)(e) \ \&$
$<e , x> = \sigma_{<e', y>} . \text{participant}(e', y) \ \& \ |y| = n \ \& \ e' < e \ \& \ y < x \ ] \ldots]$

(52) **Illustration**

a. Sentence:

Ax	shaa	yátx'i	dáxgaa	has aawashúch	wé	keitl
my	female	children	two.DIST	they.bathed	those	dog

My daughters each bathed two of those dogs / bathed those dogs in twos.

b. Permissible LF [those dogs [two.DIST [1 [my daughters bathed t_1] …]

c. Derived T-Conditions

∃e . *bathed(e) & *Ag(e) = my.daughters & *Th(e) = the.dogs &
<e , the.dogs> = $\sigma_{<e', y>}$. participant(e',y) & |y| = 2 & e' < e & y < the.dogs

My daughters (cumulatively) bathed those dogs, and
*The dogs are the **proper** sum of pairs of things that took part in the washing*

d. Verifying Scenarios

(i) *Scenario Where the 'Distributive Key' is a Plural Participant* (See (24))

My neighbors have four dogs. My daughters Hazel and Bea went over to wash those dogs. Hazel washed two dogs, and Bea washed the other two.

Washings	Agent	Theme
e_1	Hazel	dog_1+dog_2
e_2	Bea	dog_3+dog_4

(ii) *Scenario Where the 'Distributive Key' is a Plural Event*

My neighbors have four dogs. My daughters Hazel and Bea went over to wash those dogs. First, they together washed two dogs at the same time. Then, they together washed the other two dogs at the same time.[2]

Washings	Agent	Theme
e_1	Hazel+Bea	dog_1+dog_2
e_2	Hazel+Bea	dog_3+dog_4

[2] Note that speakers do indeed accept sentence (52a) as true in scenarios like this.

(53) **Key Observation**

- The truth-conditions derived in (52c) hold in scenarios where a 'Participant-Distributive' construal would be true.
- Those truth-conditions *also* hold in scenarios where an 'Event-Distributive' construal would be true.
- Thus, we predict the facts noted in (23a) and (23e): that sentences with adverbial distributive numerals allow both participant-distributive and event-distributive 'construals'.
- Under our analysis here, these 'construals' do not represent different readings. Rather, they are simply different kinds of scenarios where the (univocal) sentence is true…

(54) **Semantics for Adnominal Distributive Numerals**

- Adnominal distributive numerals are not very different from adverbial ones.
- Their key difference is that they combine with an <et> predicate, supplied by the modified N.

$[\![\text{gaa}]\!] = [\ \lambda n_n : [\ \lambda Q_{<et>} : [\ \lambda P_{<e,\ \varepsilon t>} : [\ \lambda e_{\varepsilon} : \exists x.\ Q(x)\ \&\ P(x)(e)\ \&$
$<e\ ,\ x> = \sigma_{<e',\ y>}\ .\ \text{participant}(e',y)\ \&\ |y| = n\ \&\ e' < e\ \&\ y < x\ ]\ \ldots\ ]$

(55) **Illustration**

a. Sentence

Ax	kaa	yátx'i	**nás'gigáa**	xáat	has aawashaat.
my	male	children	**three.DIST**	fish	they.caught

My sons caught three fish each / caught fish in threes

b. Assumed LF [[three.DIST fish] [1 [my sons caught t_1] …]

c. Predicted Truth Conditions

$\exists e\ .\ \exists x\ .\ *\text{fish}(x)\ \&\ *\text{caught}(e)\ \&\ *\text{Ag}(e) = \text{my.sons}\ \&\ *\text{Th}(e) = x\ \&$
$<e\ ,\ x> = \sigma_{<e',\ y>}\ .\ \text{participant}(e',y)\ \&\ |y| = 3\ \&\ e' < e\ \&\ y < x$

There is a plural event e of my sons (cumulatively) catching some fish x, and
x is the sum of the entities y such that (i) y is a proper sub-part of x, and
(ii) y is a triplet, and (iii) y is a participant in some proper sub-event of e

d. Verifying Scenarios

(i) *Scenario Where the 'Distributive Key' is a Plural Participant* (See (15))
My sons went fishing. Tom caught three fish, and Bill caught three too.

Catchings	Agent	Theme
e_1	Tom	$fish_1+fish_2+fish_3$
e_2	Bill	$fish_4+fish_5+fish_6$

(ii) *Scenario Where the 'Distributive Key' is a Plural Event* (See (22))
Every day last week, my sons went out fishing. Every day, they caught a total of three fish.

Catchings	Agent	Theme
e_1	Tom+Bill	$fish_1+fish_2+fish_3$
e_2	Tom+Bill	$fish_4+fish_5+fish_6$
e_3	Tom+Bill	$fish_7+fish_8+fish_9$

(56) **Key Observation**

- Again, the truth-conditions derived in (55c) for a sentence with a distributive numeral hold *both* in 'Participant-Distributive' scenarios and 'Event-Distributive ones.
- Thus, we predict the facts noted in (23b), (23c), and (23d): that sentences with adnominal distributive numerals allow both participant-distributive and event-distributive 'construals'.
- Again, nder our analysis here, these 'construals' are not different readings. Rather, they are simply different kinds of scenarios where the (univocal) sentence is true…

So, we see that this analysis seems to capture the basic facts regarding distributive numerals…
In the following section, we'll see how it covers all the key facts form Sections 1 - 5

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8. Deriving the Observed Properties of Tlingit Distributive Numerals

In this section, we'll see how nearly all the facts from Sections 1-5 follow from our semantics.

(57) **Adnominal Distributive Numerals Cannot Modify Demonstratively Marked DPs (6)**

This follows from their type, since adnominal distributive numerals must combine with a numeral, and the an expression of type <et>, never type *e*.

(58) **The 'Distributive' Suffix -*Gaa* Can Only Modify Numerals (11)**

This follows from the type of the suffix –*gaa*, whose first argument must be of type *n*.

(59) **No Collective / Cumulative Readings of Sentences Containing Distributive Numerals**

- As noted in (13) and (14), sentence (59a) is false in scenarios like (59b,c).
- This follows from the predicted T-conditions in (59d).
  - Due to the condition that 'y < x' and '|y| = 2', it follows that there must be more than a total of two dogs washed.

a.

Wé	shaax'wsáani	**dáxgaa**	keitl	has aawashúch.
those	girls	**two.DIST**	dog	they.bathed

Those girls washed two dogs each / washed dogs in twos.

b. Collective Washing of Two Dogs:

Washings	Agent	Theme
e_1	$g_1+g_2+g_3$	d_1+d_2

c. Cumulative Washing of Two Dogs:

Washings	Agent	Theme
e_1	g_1+g_2	d_1
e_2	g_3	d_2

d. Predicted Truth-Conditions

$\exists e . \exists x . *dog(x) \& *wash(e) \& *Ag(e) = the.girls \& *Th(e) = x \&$
$<e , x> = \sigma_{<e', y>} . participant(e',y) \& |y| = 2 \& e' < e \& y < x$

There is a plural event e of the girls washing some dogs x, and
*x is the sum of the entities y such that (i) y is a **proper** sub-part of x, and*
(ii) y is a pair, and (iii) y is a participant in some proper sub-event of e

(60) **Distributive and Inverse-Scope Readings Require a Distributive Numeral (15), (25)**

- Like English-speakers, Tlingit speakers have a strong bias *for* 'surface level' parses, and *against* parses that employ covert '*'-operators and QR.
- In English, this bias is amplified by the possibility of using overt *each* to yield a reading that is only true in 'distributive scenarios'.
- Similarly, in Tlingit, this bias is amplified by the possibility of using overt -*gaa* to yield a reading that is only true in 'distributive scenarios' (59)
- Thus, if one wishes to use a sentence whose T-conditions hold in distributive scenarios, it will be more 'felicitous' to use a distributive numeral.

(61) **Distributive Numerals Never Modify the 'Distributive Key' (18), (19)**

Understanding how this generalization follows form our semantics takes some work, since under our analysis, sentences with distributive numerals don't really have distributive operators in their LFs…

- Intuitively, if a sentence containing a numeral expression '*n NP*' has a distributive reading where '*n NP*' forms part of the Dist-Share, then under that reading, there are *more* than *n* NPs.
    - Since, under this reading, there are *n NPs* for every member of the Dist-Key

- Furthermore, if such a sentence has a distributive reading where '*n NP*' forms part of the Dist-Key, then under that reading, there are *exactly n NP*s.
    - Since, under this reading, the numeral *n* takes scope above the DIST operator

- Now, we've already seen that if a distributive-numeral '*n-gaa*' modifies an NP, the truth-conditions of the sentence require that there are *more* than *n* NPs. (59)

- Thus, if one were to ever paraphrase the meaning of sentence containing '*n-gaa*' using a distributive operator, one must put '*n NP*' as part of the Dist-Share, never the Dist-Key (16)

(62) **The Possibility of Both 'Participant-' and 'Event-Distributive' Construals (23)**

- As noted in (53) and (56), our semantics predicts that such 'construals' are not separate readings.

- Rather, they are simply different kinds of scenarios where the very general truth-conditions of sentences with distributive numerals hold.

- More Acutely:

    - Under our semantics, distributive numerals convey that their <et> or *e* argument can be divided up into proper parts and distributed among various sub-events…

    - Thus, under our semantics, a sentence containing *n-gaa NP* will only be true if every sub-event contains *n* NPs in it.

    - Thus, we most directly derive/generate the 'event-distributive' construal.

    - The 'participant-distributive' construal is simply a special subcase, where each such sub-event also contains a sub-part of another argument of the verb

(63) **The Readings Associated with Sentences (29) and (30)**

The reader is invited to confirm that the more general results in (61) and (62) predict the facts observed in (29) and (30), for sentences of the form:

a. $\text{Subject}_{\text{Plural}}$ > Distributive Numeral > $\text{Object}_{\text{Plural}}$ > Verb
b. Distributive Numeral > $\text{Subject}_{\text{Plural}}$ > $\text{Object}_{\text{Plural}}$ > Verb

(64) **Sentences Containing Distributive Numeral Object and Singular Subject (31)**
Our semantics correctly predicts that sentences like (31a), repeated below, are interpretable, and are true in 'event-distributive' scenarios.

a. Sentence:

Ax	yéet	**nás'gigáa**	xáat	aawashaat.
my	son	**three.DIST**	fish	caught

My son caught three fish each time.

b. Predicted Truth- Conditions

$\exists e . \exists x .$ *fish(x) & *caught(e) & *Ag(e) = my.son & *Th(e) = x &
$\langle e , x \rangle = \sigma_{\langle e', y \rangle} .$ participant(e',y) & |y| = 3 & e' < e & y < x

c. Verifying Scenario for Truth-Conditions in (64b), and Sentence (64a)
Each day that my son went fishing, he caught three fish.

Catchings	Agent	Theme
e_1	my.son	fish_1+ fish_2+ fish_3
e_2	my.son	fish_4+ fish_5+ fish_6
e_3	my.son	fish_7+ fish_8+ fish_9

(65) **Intransitive Sentences with Distributive Numeral on Plural Subject (32)**
Our semantics correctly predicts that sentences like (32a), repeated below, are interpretable, and are true in 'event-distributive' scenarios.

a. Sentence:

Dáxgaa	shaax'wsáani	has aawal'eix.
two.DIST	girls	they.danced

Girls danced in twos / Girls danced two at a time.

b. Predicted T-Conditions

$\exists e . \exists x .$ *girls(x) & *danced(e) & *Ag(e) = x
$\langle e , x \rangle = \sigma_{\langle e', y \rangle} .$ participant(e',y) & |y| = 2 & e' < e & y < x

c. Verifying Scenario for Truth-Conditions (65b) and Sentence (65a)
Each pair of girls goes up on stage and dances in turn.

Dancings	Agent
e_1	girl_1+ girl_2
e_2	girl_3+ girl_4
e_3	girl_5+ girl_6

(66) **Sentences Where Subject and Object are Both Modified by Distributive Numerals**

Our semantics correctly predicts that sentences like (33a), repeated below, are interpretable, and are true in 'event-distributive' scenarios.

a. Sentence:

Dáxgaanáx	shaax'wsáani	**nás'gigáa**	keitl	has aawashúch.
two.DIST	girls	**three.DIST**	dog	they.bathed

Every time, two girls were washing three dogs

b. Predicted T-Conditions (Exercise for the reader)

$\exists e . \exists x . *girls(x) \ \& \ \exists z . *dogs(z) \ \& \ *wash(e) \ \& \ *Ag(e) = x \ \& \ *Thm(e) = z \ \&$
$<e , x> = \sigma_{<e', y>} . participant(e',y) \ \& \ |y| = 2 \ \& \ e' < e \ \& \ y < x$
$<e , z> = \sigma_{<e', y>} . participant(e',y) \ \& \ |y| = 3 \ \& \ e' < e \ \& \ y < z$

There is a plural event e of some girls x washing some dogs z, and
*x is the sum of the entities y such that (i) y is a **proper** sub-part of x, and*
(ii) y is a pair, and (iii) y is a participant in some proper sub-event of e
*z is the sum of the entities y such that (i) y is a **proper** sub-part of z, and*
(ii) y is a triplet, and (iii) y is a participant in some proper sub-event of e

c. Verifying Scenario for Truth-Conditions (66b), and Sentence (66a)
Our neighbor has a bunch of dogs, which are always very dirty. This week, every time we went over to their house, there were two (different) girls washing three (different) dogs.

Washings	Agent	Theme
e_1	$girl_1$+ $girl_2$	dog_1+ dog_2+ dog_3
e_2	$girl_3$+ $girl_4$	dog_4+ dog_5+ dog_6
e_3	$girl_5$+ $girl_6$	dog_7+ dog_8+ dog_9

(67) **Sentences Containing Distributive Numerals and Stative Verbs (34)-(36)**

- Under our semantics in (51) and (54), distributive numerals must take as argument a predicate 'P' of type <e, εt>
- Thus, our semantics requires distributive numerals to only appear in eventive sentences.
- **Consequently, sentences like (34)-(36), where the main predicate of the sentence is *stative* remain an outstanding challenge for this account.**

9. Deriving Some Properties of Distributive Numerals in Other Languages

- Facts parallel to those in (4)-(36) have been widely reported for other languages with distributive numerals (Gil 1982, Choe 1987, Zimmermann 2002, Oh 2005, Balusu 2006)
  - Thus, our account above clearly will predict those parallel facts in languages like Tagalog, Georgian, Korean, German, and Telugu.

- It will also predict certain additional facts that have been reported for other languages (and which either cannot nor have not been checked for Tlingit…)

(68) **The 'Locality Conditions' on Distributive Numerals (Oh 2005, Zimmermann 2002)**

- Oh (2001, 2005) notes that the Korean sentence in (68a) does not admit of a reading akin to the English sentence in (68b), whereby it is true in scenarios like (68c).
- Zimmermann (2002) also reports this fact for parallel German sentences.

a. Chemwentuli [aituli phwungsen-hana-**ssik**-ul saessta] malhaessta
store.clerks children balloon-one-**DIST-ACC** bought said
The store clerks said that the children bought one balloon each / each time.

b. Each store clerk said that the children bought one balloon.

c.

Sayings	Agent	Proposition Said
e_1	$clerk_1$	'The kids bought one balloon'
e_2	$clerk_2$	'The kids bought one balloon'
e_3	$clerk_3$	'The kids bought one balloon'

- This fact is predicted by our analysis, if we assume that Korean *ssik* (and German *jeweils*) have the semantics of Tlingit *–gaa*.

- If sentence (68a) has the LF in (68di), then it will have the T-conditions in (68dii), which fail to hold in the scenario in (68c)

d. (i) [The clerks said [one.DIST balloon [1 [the children bought t_1] …]

(ii) said (the clerks , ∃e . ∃x . *ballon(x) & *bought(e) & *Ag(e) = the.kids
& *Th(e) = x & <e , x> =
$\sigma_{<e', y>}$. participant(e',y) & |y| = 1 & e' < e & y < x
The clerks said the kids bought balloons, one balloon at a time.

- In order to derive any other LF for sentence (68a), we would have to QR *phwungsen-hana-**ssik**-ul* 'one.DIST balloon' into the main clause.
  - But, this would violate the clause-boundedness of QR

- Moreover, the reader is invited to confirm that, even if we allowed such QR, we would derive a *de re* reading incompatible with the scenario in (68c).

(69) **Distributive Numerals, Pluractional Morphology, and Scope (Henderson 2011)**

Henderson (2011) notes that, in Kaqchikel Mayan, only distributive numerals can 'scope below' verbal pluractional morphology.

- That is, sentence (69a) below – with a plain numeral – is only true if the *same* book is looked for on multiple occasions.

- However, sentence (69b) below – with a distributive numeral – is true only if *different* books are looked for on different occasions.

a. Xinkan**ala'** jun wuj
1sgS.searched.**PA** one book
I looked for a book (various times)
- True only if I looked for the *same* book multiple times. False otherwise.

b. Xinkan**ala'** **ju-jun** wuj
1sgS.searched.**PA** **DIST-one** book
I looked for books (various times).
- True only if I looked for *several* books on *different* occasions.

Interestingly, our semantics for distributive numerals predicts exactly these facts (though other phenomena Henderson (2011) discusses remain an outstanding problem).

(70) '**Lasersohnian' Analysis of Pluractional Morphology (Lasersohn 1995)**

[[PA]] =

$$[\ \lambda P_{<\varepsilon t>} : [\ \lambda e : |e| > n\ .\ \forall e'\ .\ e' \leq e\ \&\ atom(e') \rightarrow P(e') \\ \&\ \forall e', e''.\ e', e'' \leq e\ \&\ atom(e')\ \&\ atom(e'') \rightarrow \left\{ \begin{array}{l} \neg\ T(e') \circ T(e'') \\ \neg\ K(e') \circ K(e'') \\ \neg\ \theta(e') \circ \theta(e'') \end{array} \right\}\ ]$$

(71) **Truth-Conditions Derived for Sentence (69a)**

a. Logical Form [one book [1 [I searched-PA t_1] …]

b. Truth-Conditions
$\exists e\ .\ \exists x\ .$ *book(x) & |x| = 1 & *Ag(e) = speaker & *Thm(e) = x &
|e| > n & e' ≤ e & atom(e') → *search(e')
& ∀e', e''. e', e'' ≤ e & atom(e') & atom(e'') → ¬ *T*(e') ° *T*(e'')

There is an event e, whose theme is a book x and whose agent is the speaker,
And the event e is composed of many atomic events of search that do not overlap in their time.

Thus, we see that the semantics in (70) for pluractional morphology, combined with the syntactic assumptions in (71a) correctly predicts the observed semantics for (69a).

(72) **Truth-Conditions Derived for Sentence (69b)**

a. Logical Form [one-DIST book [1 [I searched-PA t_1] …]

b. Truth-Conditions

$\exists e . \exists x .$ *book(x) & *Ag(e) = speaker & *Thm(e) = x &
|e| > n & e' ≤ e & atom(e') → *search(e')
& ∀e', e''. e', e'' ≤ e & atom(e') & atom(e'') → ¬ *T*(e') ° *T*(e'')
& <e , x> = $\sigma_{<e', y>}$. participant(e',y) & |y| = 1 & e' < e & y < x

There is an event e, and a (plurality) of books x,
and the speaker is the Agent of e and x is the Theme of e, and
the event e is composed of many atomic events of searching that do not overlap in their time, and
x is the sum of all those atomic individuals that participated in a sub-event of e.

c. Verifying Scenario

Searchings	Agent	Theme
e_1	speaker	book$_1$
e_2	speaker	book$_2$
e_3	speaker	book$_3$

d. Not a Verifying Scenario

Searchings	Agent	Theme
e_1	speaker	book$_1$
e_2	speaker	book$_1$
e_3	speaker	book$_1$

(73) **Summary of Results**

- As shown in (71), we correctly predict that plain numerals are not permitted to 'scope under' pluractional morphology.
- As shown in (72), we correctly predict that the combination of a distributive numeral with a pluractional verb will yield a meaning where the numeral *seems* to scope below the pluractional.
    - As in the work of Henderson (2011), though, the distributive numeral is not actually within the scope of the pluractional morphology.
    - Rather, the meaning of the distributive numeral '*n-DIST NP*' independently serves to 'distribute' *n NPs* to each subevent of a plural event.
    - Thus, when a distributive numeral '*n-DIST NP*' occurs with a pluractional verb, the effect will be that each atomic subevent has *n NPs* in it

10. Binominal Each in English and Similar Constructions

(74) **Core Difference Between English Binominal Each and Distributive Numerals**

- As noted by Gil (1982) and Zimmermann (2002), English 'binominal each' (74a) seems quite similar to distributive numerals in languages like Tlingit.
- The key difference between them, though, is that English sentences like (74a) do not allow for event-distributive readings.
    - Consequently, (74a) is only true in scenarios like (74bi), and never in scenarios like (74bii) (*cf.* (55))
    - Consequently, sentences like (74c) are ill-formed (*cf.*

a. My sons caught three fish each.

b. (i) Verifying Scenario:

Catchings	Agent	Theme
e_1	Tom	$fish_1+fish_2+fish_3$
e_2	Bill	$fish_4+fish_5+fish_6$

(ii) Not a Verifying Scenario:

Catchings	Agent	Theme
e_1	Tom+Bill	$fish_1+fish_2+fish_3$
e_2	Tom+Bill	$fish_4+fish_5+fish_6$
e_3	Tom+Bill	$fish_7+fish_8+fish_9$

c. * My son caught three fish each.

Interestingly, we can extend the core analysis of distributive numerals above to binominal each in English, in a way that captures the facts in (74a-c)

(75) **Key Morpho-Syntactic Assumption (*cf.* Zimmermann 2002)**

In languages like English, distributive numerals (*i.e.,* 'binominal each') also take as argument a null pronoun, which must be bound by some higher argument.

a. LF of 'Three Fish Each' [[[three [each pro_1]] fish]

(76) **Key Semantic Assumption**

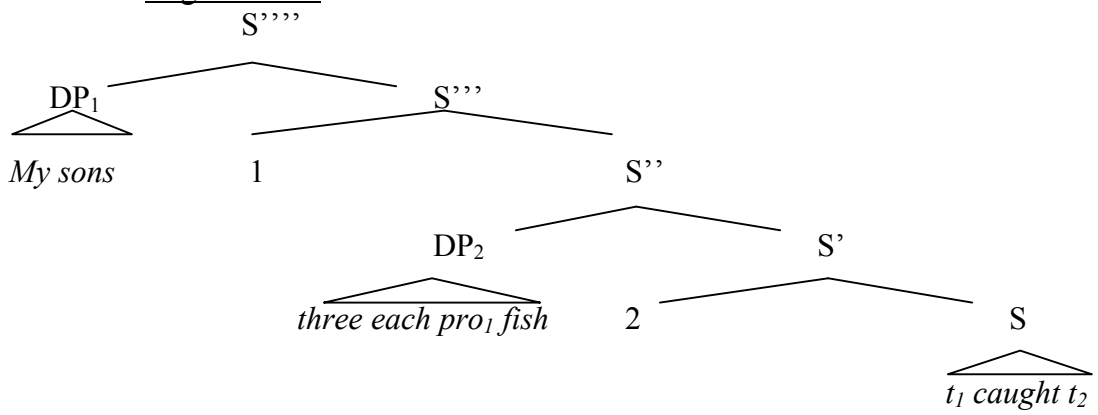
- This *pro* satisfies an additional argument place of the distributive numeral.

$$[\![\text{gaa}]\!] = [\ \lambda z_e : [\ \lambda n_n : [\ \lambda Q_{<et>} : [\ \lambda P_{<e,\ \varepsilon t>} : [\ \lambda e_\varepsilon : \exists x.\ Q(x) \ \&\ P(x)(e) \ \&$$
$$<e\ ,\ x> = \sigma_{<e',\ y>}\ .\ \text{participant}(e',y) \ \&\ |y| = n \ \&\ e' < e \ \&\ y < x \ \&$$
$$<e\ ,\ z> = \sigma_{<e',\ y>}\ .\ \text{participant}(e',y) \ \&\ |y| = 1 \ \&\ e' < e \ \&\ y < z\ ] \ldots]$$

(77) **Predicted Truth-Conditions of the Analysis**

a. Sentence: My sons caught three fish each.

b. Logical Form



c. Interpretation

(i) $[[S']]^g$ = $[\lambda x_e : [\lambda e_\varepsilon : *catch(e) \ \& \ *Ag(e) = g(1) \ \& \ *Th(e) = x]$

(ii) $[[DP_2]]^g$ =

$[\lambda P_{<e, \varepsilon t>} : [\lambda e_\varepsilon : \exists x. *fish(x) \ \& \ P(x)(e) \ \&$
$<e , x> = \sigma_{<e', y>} . participant(e',y) \ \& \ |y| = 3 \ \& \ e' < e \ \& \ y < x \ \&$
$<e , g(1)> = \sigma_{<e', y>} . participant(e',y) \ \& \ |y| = 1 \ \& \ e' < e \ \& \ y < g(1)] \ldots]$

(iii) $[[S'']]^g$ =

$[\lambda e_\varepsilon : \exists x. *fish(x) \ \& \ *catch(e) \ \& \ *Ag(e) = g(1) \ \& \ *Th(e) = x \ \&$
$<e , x> = \sigma_{<e', y>} . participant(e',y) \ \& \ |y| = 3 \ \& \ e' < e \ \& \ y < x \ \&$
$<e , g(1)> = \sigma_{<e', y>} . participant(e',y) \ \& \ |y| = 1 \ \& \ e' < e \ \& \ y < g(1)]$

(iv) $[[S''']]^g$ =

$[\lambda z : [\lambda e_\varepsilon : \exists x. *fish(x) \ \& \ *catch(e) \ \& \ *Ag(e) = z \ \& \ *Th(e) = x \ \&$
$<e , x> = \sigma_{<e', y>} . participant(e',y) \ \& \ |y| = 3 \ \& \ e' < e \ \& \ y < x \ \&$
$<e , z> = \sigma_{<e', y>} . participant(e',y) \ \& \ |y| = 1 \ \& \ e' < e \ \& \ y < z]$

(iv) $[[S'''']]^g$ = T *iff*

$\exists e : \exists x. *fish(x) \ \& \ *catch(e) \ \& \ *Ag(e) = my.sons \ \& \ *Th(e) = x \ \&$
$<e , x> = \sigma_{<e', y>} . participant(e',y) \ \& \ |y| = 3 \ \& \ e' < e \ \& \ y < x \ \&$
$<e , my.sons> = \sigma_{<e', y>} . participant(e',y) \ \& \ |y| = 1 \ \& \ e' < e \ \& \ y < my.sons$

(78) **Discussion of the Predicted Truth-Conditions, Part 1**

∃e: ∃x. *fish(x) & *catch(e) & *Ag(e) = my.sons & *Th(e) = x &
<e , x> = $\sigma_{<e', y>}$. participant(e',y) & |y| = 3 & e' < e & y < x &
<e , my.sons> = $\sigma_{<e', y>}$. participant(e',y) & |y| = 1 & e' < e & y < my.sons

There is an event e, and a plurality of fish x, such that
e is a (plural) event of catching, the (cumulative) agent of e is my sons, and
the (cumulative) theme of e is x, and
x is the sum of all those entities y such that (i) y is a ***proper*** *part of x,*
and (ii) y is a triplet, and (iii) y is a participant in subevent of e, and
my sons are the sum of all those entities y such that
(i) y is a ***proper*** *part of my sons, and (ii) y is an atom, and (iii) y is a participant of some subevent of e.*

a. Verifying Scenario:

Catchings	Agent	Theme
e_1	Tom	$fish_1+fish_2+fish_3$
e_2	Bill	$fish_4+fish_5+fish_6$

b. Not a Verifying Scenario:

Catchings	Agent	Theme
e_1	Tom+Bill	$fish_1+fish_2+fish_3$
e_2	Tom+Bill	$fish_4+fish_5+fish_6$
e_3	Tom+Bill	$fish_7+fish_8+fish_9$

- The truth-conditions above hold in the 'participant-distributive' scenario in (78a), since each atomic son is a participant (Agent/Theme) of some sub-event of e_1+e_2
- The truth-conditions above *don't* hold in the 'event-distributive' scenario in (78b), since the atomic sons are *not* participants (Agent/Theme) of any sub-event of e_1+e_2
- **Thus, our semantics predicts the facts in (74a,b) – that 'binominal each' in English does not allow 'event-distributive' construals…**

(79) **Discussion of the Predicted Truth-Conditions, Part 2**
Our semantics also predicts the fact in (74c), that the sentence below is ill-formed.

a. * My son caught three fish each.

b. Predicted Truth-Conditions (Exercise for the Reader)
∃e: ∃x. *fish(x) & *catch(e) & *Ag(e) = my.son & *Th(e) = x &
<e , x> = $\sigma_{<e', y>}$. participant(e',y) & |y| = 3 & e' < e & y < x &
<e , my.son> = $\sigma_{<e', y>}$. participant(e',y) & |y| = 1 & e' < e & y < my.son

The truth-conditions above cannot be satisfied, since the condition '|y| = 1 & y < my.son' requires 'my son', an atomic individual, to be made up of atomic *proper parts.*

Thus, our semantics for English 'binominal each' correctly predicts all its core properties (74).

- It also provides an explanation for the puzzle below.

(80) **No Inverse Scope with Binominal Each**

- Unlike normal cases of 'inverse scope', it is extremely difficult (to impossible) to construe 'binominal each' with inverse scope.
- That is, a sentence like (80a) seems rather ill-formed, and is not easily interpreted as describing a scenario like that in (80b).

a. ?? Three fish each were caught by my sons.

b. Inverse Scope Scenario:

Catchings	Agent	Theme
e_1	Tom	$fish_1+fish_2+fish_3$
e_2	Bill	$fish_4+fish_5+fish_6$

(81) **Explanation: Inverse Scope Would Lead to Weak Cross Over**

- Recall that *three fish each* is assumed to contain a pronoun that must be bound.
- In a sentence like (80a), the only way to satisfy this binding requirement is to QR the by-phrase subject *my sons* over the subject.
- However, as illustrated below, this leads to a Weak Cross Over configurations, which is typically viewed as impossible for QR.

[my sons [1 [three fish pro_1 [2 [t_2 were caught by t_1] …]

Weak Cross Over Configuration

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11. An Outstanding Problem

(82) **Korean *Kakkak* 'Each' Licenses the Appearance of Distributive *Ssik* (Oh 2005)**

Haksayng twu-myeng-i **kakkak** sangca han-kay-(**SSIK**)-lul wunpanhayssta.
student two-CL-NOM **each** box one-CL-**DIST**-ACC carried
Two students each carried one box.

Most Salient Interpretation

$\exists y. |y| = 2 \ \& \ *student(y) \ \& \ \forall z . z < y \ \& \ AT(z) \rightarrow$
$\exists e . \exists x . |x| = 1 \ \& \ *box(x) \ \& \ *carry(e) \ \& \ *Thm(e) = x \ \& \ *Ag(e) = z$

- As illustrated in (82) above, Oh (2005) reports that there is no salient difference between the sentence in (82) – with both *kakkak* 'each' and *ssik* 'DIST' – and a parallel sentence with *kakkak* alone

- That is, Oh (2005) reports that sentence (82) is true in a scenario where each of the students carries just one box.

    - As the reader is invited to confirm, however, our semantics for distributive numerals wrongly predicts that (82) entails that each student carried *more* than one box…

    - That is, in our semantics, sentence (82) is predicted to mean 'each student carried boxes one-by-one'.