DISTRIBUTIVE NUMERALS AND DISTANCE DISTRIBUTIVITY IN TLINGIT (AND BEYOND)

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This article develops a formal semantic and syntactic analysis of distributive numerals in Tlingit, a highly endangered language of Alaska, British Columbia, and the Yukon. Such numerals enforce a 'distributive reading' of the sentence, and thus are one instance of the broader phenomenon of 'distance distributivity' (Zimmermann 2002). As in many other languages, a Tlingit sentence containing a distributive numeral can describe two distinct kinds of 'distributive scenarios': (i) a scenario where the distribution is over some plural entity (e.g. 'My sons caught three fish each'), and (ii) one where the distribution is over some plural event (e.g. 'My sons caught three fish each time') (Gil 1982, Choe 1987, Zimmermann 2002, Oh 2005). Despite this apparent ambiguity, I put forth a univocal semantics for Tlingit distributive numerals, one whereby they consistently invoke quantification over events. Under this semantics, the ability of distributive numerals to describe both kinds of scenarios in (i) and (ii) is due not to an ambiguity, but instead to the sentences having relatively weak truth conditions. In contrast to prior analyses of distributive numerals and distance distributivity, the proposed semantics does not actually make use of distributive operators, but nevertheless retains a rather conservative picture of the syntax-semantics interface. The analysis can also account for certain locality effects noted for distance distributives in Korean and German (Zimmermann 2002, Oh 2005), as well as an intriguing puzzle regarding distributive numerals and pluractionality in Kaqchikel (Henderson 2011). Finally, I show how the analysis can be extended to the well-known case of English 'binominal *each*'.*

Keywords: distributivity, distributive numeral, distance distributivity, anti-quantifier, dependent indefinite, pluractional, pluractional adverb, Tlingit, binominal *each*

1. Distributive numerals, their analytic challenges, and prior approaches. As first noted by Gil (1982), distributive numerals pose many difficult challenges to theories of the syntax-semantics interface. In this article, I present and defend a novel analysis of these constructions, one that offers important conceptual advantages over previous accounts. A second, parallel goal of this article is to document and analyze the distributive numeral construction of Tlingit, a highly endangered and understudied Na-Dene language of Alaska, British Columbia, and the Yukon (Boas 1917, Naish 1966, Story 1966, Leer 1991, Dauenhauer & Dauenhauer 2000, Cable 2010). Although Tlingit provides the primary empirical content of the article, I also show how the proposed account offers improved insight into various puzzles concerning distributive numerals in other languages.

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The term ‘distributive numeral’ has its roots in classical grammatical and philological studies, but was introduced into formal linguistics through the work of Gil (1982). Since Gil’s seminal work, this phenomenon has been given several other technical designations, including ‘anti-quantifier’ (Choe 1987), ‘dependent indefinite’ (Farkas 1997), and ‘distance distributivity’ (Zimmermann 2002).[1] Indeed, the last of these—DISTANCE DISTRIBUTIVITY—is often taken to be a broader concept, one that also encompasses so-called ‘binominal *each*’ in English, a construction that is not universally recognized as a type of distributive numeral (Gil 1982). As we see below, the analysis developed here for distributive numerals in Tlingit offers new insights into the broader category of distance distributivity as well.

Whatever the label, the phenomenon of key interest is the one roughly defined in 1.

(1) DISTRIBUTIVE NUMERAL: A morphosyntactic construction containing a numeral, whereby (i) the sentence as a whole receives a distributive reading, and (ii) under the allowable readings, the numeral contained within the construction must be interpreted AS IF it is within the scope of a distributive operator.[2]

To help clarify this definition, the ‘distributive operator’ mentioned in 1 is essentially the following (Lasersohn 1995, Schwarzschild 1996).

(2) $[\![DIST]\!] = [\lambda P_{\langle et \rangle} : \lambda y_e : \forall x.\ x \leq \underbrace{\mathbf{y}}_{\boxed{\text{RESTRICTOR}}} \ \&\ \text{atom}(x) \rightarrow \underbrace{\mathbf{P}}_{\boxed{\text{SCOPE}}}(x)]$

Represented here as ‘*DIST*’, this operator denotes a function that takes as argument a property ‘P’ and a plurality ‘y’, and returns a value of ‘true’ if and only if every individual x within the plurality y has property P. Thus, this operator serves to ‘distribute’ the property P over the entities making up the plurality y. As indicated in 2, the ‘scope’ of this operator is simply the property P that is distributed over y, while the plurality y is commonly referred to as the ‘restrictor’ of the operator.

With this background in place, let us observe how the definition in 1 is exemplified via the following Tlingit sentences.[3]

[1] It should be noted that each of these four terms is associated with particular, distinct analyses of the construction in question, and so therefore comes with its own peculiar theoretical baggage. For example, the term ‘dependent indefinite’ is typically used in work making use of the core ideas of dynamic plural logic (Farkas 1997, Henderson 2011; see discussion below). Each of these labels generally picks out the same empirical phenomena, however, so they can be treated as functional synonyms. Such synonymy is not uncommon in literature focusing on specific constructions, for example, the labels ‘pluractional’ (Newman 1990, Lasersohn 1995) vs. ‘frequentative’ (van Geenhoven 2004) vs. ‘verbal plurality’ (Cusic 1981) vs. ‘distributive’ (Barker 1964).

[2] Please note the small caps ‘as if’ in this definition, and that condition (ii) does NOT state that the numeral must actually be interpreted within the scope of a distributive operator. Condition (ii) here instead merely states that the meaning is one that could (perhaps imperfectly) be represented by a formula where the numeral scopes under such an operator. Thus, the definition in 1 does not actually commit one to using distributive operators such as 2 in the analysis of distributive numerals. This is crucial, as one advantage of the analysis I propose here is that it makes no use of such operators.

[3] The following abbreviations are used in the glossing of example sentences: 1SGS: first-person singular subject, 2SGS: second-person singular subject, 3O: third-person object, 3S: third-person subject, ACC: accusative case, CL: classifier, DIST: distributive numeral marker, ERG: (optional) ergative case, FOC: focus particle, INDFS: indefinite human subject, NOM: nominative case, PA: pluractional suffix, PL: plural human argument, PFV: perfective aspect, Q: question particle.

In this article I provide only the roughest of glosses for individual Tlingit words, which can be morphologically quite complex. This simplification is the most radical for verbs, as I provide glosses only for their lexical

(3) Plain numerals and distributive numerals in Tlingit

a. **Nás'k** x̲áat has aawasháat. (HS)[4]
three fish PL.3O.PFV.3S.catch
'They caught three fish.'

b. **Nás'gig̲áa** x̲áat has aawasháat. (BB, WF)
three.DIST fish PL.3O.PFV.3S.catch
'They caught three fish each.' *or* 'They caught three fish each time.'

Sentence 3a contains the unmarked numeral *nás'k* 'three'. As detailed in §3, this sentence can, like its English translation, receive both so-called 'collective' and 'cumulative' readings (where exactly three fish are caught), and generally resists a 'distributive' reading (where the number of fish caught is a multiple of three). Sentence 3b, however, contains the distributive numeral *nás'gigáa* 'three.DIST'. This sentence cannot receive either the collective or cumulative reading of 3a, and only permits a distributive interpretation. Furthermore, as suggested by the two translations under 3b, such sentences appear at first glance to be ambiguous, in that they can describe two very different kinds of 'distributive scenarios'. These two scenario types are sketched in more detail in 4.

(4) a. PARTICIPANT-DISTRIBUTIVE SCENARIO: Each of them caught three fish.
$\underbrace{\forall x.\ x \leq \text{`}\mathbf{they}\text{'} \ \&\ \text{atom}(x)}_{\text{restrictor of } \mathit{DIST}} \rightarrow \underbrace{\exists e.\ \exists y.\ \mathbf{three.fish}(y)\ \&\ x \text{ caught } y \text{ in } e}_{\text{scope of } \mathit{DIST}}$

b. EVENT-DISTRIBUTIVE SCENARIO: They caught fish three at a time.
$\exists e.\ \underbrace{\forall e'.\ e' \leq \mathbf{e}\ \&\ \text{atom}(e')}_{\text{restrictor of } \mathit{DIST}} \rightarrow \underbrace{\exists y.\ \mathbf{three.fish}(y)\ \&\ \text{`they' caught } y \text{ in } e'}_{\text{scope of } \mathit{DIST}}$

In the scenario described in 4a, for each individual member x of some contextually salient plurality 'they', there is an event e of x catching three fish. Throughout this article, I refer to such scenarios as PARTICIPANT-DISTRIBUTIVE scenarios, given that the distribution of 'three fish' appears to be over some plural participant in the described scenario. In scenario 4b, however, there is a plurality of events e, and each individual member e′ of e is an event of 'they' catching three fish (altogether). Given that there are three fish to each event of catching (but not necessarily to each fisherman), I refer to scenarios like 4b as EVENT-DISTRIBUTIVE scenarios.

As we see in more detail below, Tlingit sentences like 3b are true both in participant-distributive scenarios like 4a and in event-distributive scenarios like 4b. Furthermore, as the logical formulae in 4 make clear, if we attempt to characterize the scenarios in 4a,b using a distributive operator like that in 2, then in both 4a and 4b the denotation of 'three fish' lies within the scope of that operator. Consequently, we find that the Tlingit construction in 3b fits the general definition in 1 of a distributive numeral.

When presented in these terms, distributive numerals raise two key challenges for theories of the syntax-semantics interface. The first simply concerns the ability for sentences containing such numerals to describe both participant-distributive and event-

content, their agreement morphology, and their aspectual category. Readers with an interest and background in Tlingit morphology should note that the order of elements in the gloss mirrors the order of their morphophonological exponents in the verb.

[4] Throughout this article, I indicate whether a Tlingit sentence structure was (i) constructed by the author and judged by speakers to be well formed, or (ii) actually spontaneously spoken by the language consultants themselves. In the former case, the Tlingit sentence is followed by a 'C', for 'constructed'. In the latter case, I provide the initials of the language consultant(s) who provided the sentence in question: BB: Beatrice Brown, MD: Margaret Dutson, SE: Selena Everson, WF: William Fawcett, and HS: Helen Sarabia. Again, it should be noted that all sentences marked with a 'C' were judged by all the consultants to be well formed.

distributive scenarios. After all, these kinds of scenarios seem to be quite distinct, and so it is a nontrivial task to develop a semantics for distributive numerals that can apply to both. In particular, note that while the restrictor of *DIST* in 4a is a plurality of entities, the restrictor in 4b is a plurality of EVENTS. Given that entities and events are commonly assumed to be two distinct semantic types—*e* and ε, respectively—one actually cannot (under common assumptions) obtain the meaning in 4b from the basic distributive operator in 2. For this reason, providing a single, unified semantics that allows for distribution over both entities and events is a key challenge for any analysis of distributive numerals.

A second key challenge is simply explaining how the distributive numeral is able to enforce the distributive reading of the sentence (Zimmermann 2002). After all, as the formulae in 4 make clear, the distributive numeral in sentences like 3b does not directly combine syntactically with either the scope or the restrictor of a distributive operator like 2. Rather, the numeral within the construction appears to contribute a STRICT SUBPART of the scope of such an operator. Consequently, while the distributive numeral appears to somehow contribute the meaning of 2, its (surface) syntactic position is not one from which meanings akin to 4a,b could be derived via such an operator. Put more simply and broadly, the distributive numeral morphology (e.g. the suffix *-gáa* in 3b) does not itself directly mark either the distributed property or the plurality distributed over. Rather, it marks only a strict subpart of the distributed property. It appears, then, that this morphology somehow signals the distribution of a property LARGER than the constituent it marks, so there is an apparent mismatch between the surface location of this morphology (the numeral) and the locus of its semantic effect (the larger, distributed property). As we will see presently, capturing and explaining this apparent mismatch is an especially difficult challenge.

In response to these challenges, prior approaches to distributive numerals have introduced mechanisms that in various ways diverge from common assumptions about the syntax-semantics interface. For reasons of space, I consider just three general approaches that have emerged in the last decade.

The first such approach is that of Oh (2001, 2005), who focuses on the distributive numerals of Korean (§6). Under this approach, distributive numerals do not actually themselves contribute distributivity to the meaning of the sentence. Rather, distributive numerals are semantically identical to unmarked numerals. They are, however, subject to a special syntactic licensing condition, requiring them to be c-commanded at logical form (LF) by the distributive operator in 2. Consequently, sentences like 3b are only able to receive the LFs in 5a,b.

(5) The possible LF structures for sentence 3b, in the analysis of Oh (2001, 2005)

a. Syntax: [*pro* [***DIST*** [∃e [e [[**nás'gigáa** x̲áat] has aawasháat] …]
three.DIST fish PL.3O.PFV.3S.catch
Meaning: ∀x. x ≤ '**they**' & atom(x) → ∃e. ∃y. **three.fish**(y) & x caught y in e

b. Syntax: [∃e [e [***DIST*** [*pro* [[**nás'gigáa** x̲áat] has aawasháat] …]
three.DIST fish PL.3O.PFV.3S.catch
Meaning: ∃e. ∀e′. e′ ≤ **e** & atom(e′) → ∃y. **three.fish**(y) & 'they' caught y in e′

c. Ill-formed LF: *[∃e [e [*pro* [[**nás'gigáa** x̲áat] has aawasháat] …]
three.DIST fish PL.3O.PFV.3S.catch
Meaning: ∃e. ∃y. **three.fish**(y) & x caught y in e
(collective/cumulative reading)

The ill-formedness of LF 5c entails that sentences containing distributive numerals will only allow distributive readings, and will not allow either collective or cumulative ones. Furthermore, Oh's system maps the LF in 5a to the participant-distributive interpretation, while the LF in 5b is mapped to the event-distributive interpretation. In this way, Oh (2001, 2005) predicts exactly the range of interpretations that sentences like 3b are observed to have.

Although Oh's account is in many ways quite elegant, it does present a more complicated picture of the syntax-semantics interface, in several respects. First and foremost is the introduction of the sui generis LICENSING MECHANISM holding between *DIST* and distributive numerals. The nature of this mechanism is left rather unclear in Oh's work, and although it is often analogized to the licensing of negative polarity items (NPIs), it appears to be subject to locality conditions that NPI licensing is not (§6; Oh 2001, n. 17). Moreover, for reasons discussed above, in order to derive both the participant- and event-distributive interpretations, Oh (2001, 2005) must assume two distinct *DIST* operators, one taking entities as restrictors and the other taking events. The existence of these two semantically distinct *DIST* operators renders a principled account of the crucial licensing mechanism all the more difficult. Finally, for more complex examples (e.g. 32–34 below), several additional covert movement operations must be posited, which in the case of Korean appear contrary to the language's more general preference for surface scope (Beck & Kim 1997, Beck 2006).

A second general approach to distributive numerals is represented in the work of Zimmermann (2002) and Champollion (2012). Although Champollion's (2012) analysis is in many respects different from Zimmermann's, it shares certain key features and so is subject to similar criticisms (n. 5). For reasons of space, my discussion here centers on the analysis developed by Zimmermann (2002).

Unlike Oh (2001, 2005), Zimmermann and Champollion propose that distributive numerals do (at some level) directly contribute a distributive operator akin to 2. Under Zimmermann's account, an NP modified by a distributive numeral has the syntax in 6.

(6) [D [[three fish] [Pred$_i$ [*DIST* *pro*$_k$] …]

According to this syntax, a distributive numeral construction contains four main ingredients: (i) the distributive operator *DIST*, (ii) an indexed variable *pro*$_k$, (iii) a special indexed element *Pred$_i$*, and (iv) a determiner *D*. These elements play the following semantic roles in the construction: (i) *DIST* contributes distributivity, (ii) *pro*$_k$ provides the restrictor of *DIST*, and (iii) the indexed element *Pred$_i$* combines with 'three fish' and (iv) *D* to yield the property distributed over *pro*$_k$. Zimmermann provides a formal semantics for each of these elements, which together map the structure in 6 to the denotation in 7.

(7) $\forall$x. x $\leq$ ***k*** & atom(x) $\rightarrow$ $\exists$y. three.fish(y) & ***i***(y)(x)
'For all individuals x in ***k***, there are three fish y such that relation ***i*** holds of x and y.'

Note that in the denotation above, there are two (boldfaced) free variables, *k* and *i*. Via special mechanisms introduced by Zimmermann, these variables can be bound by other elements within the clause. For example, if the variable *k* is bound by the plural subject in 3b, a participant-distributive interpretation can be obtained (8a). For the event-distributive interpretation of 3b, Zimmermann proposes that the variable *k* is left free and is simply understood in context to refer to a salient plurality of events (8b).

(8) a. Participant-distributive interpretation
$\forall$x. x $\leq$ '**they**' & atom(x) $\rightarrow$ $\exists$y. three.fish(y) & **$\exists$e. x caught y in e**
'For all individuals x in "**they**" there are three fish y such that x caught y.'

b. Event-distributive interpretation
$\forall$x. x $\leq$ **e** & atom(x) $\rightarrow$ $\exists$y. three.fish(y) & **'they' caught y in x**
'For all individuals (events) x in **e**, there are three fish y such that "they" caught y in x.'

Although Zimmermann's account avoids the problems inherent in the syntactic licensing condition of Oh 2001, 2005, it introduces its own complications to the theory of the syntax-semantics interface. Most notably, in order to derive the sentence meanings in 8 from the semantics in 7, a whole host of special composition rules must be introduced. The reader is referred to Zimmermann 2002 for details, but these special rules largely center upon the binding of the variable *i* in 7, contributed by the special element $Pred_i$ in 6. In addition, as the informal paraphrase in 8b suggests, in order to derive the event-distributive reading from the semantics in 6–7, Zimmermann (2002) must assume that events are of type *e*, and are not of their own semantic type ε. Finally, it must be mentioned that Zimmermann's syntactic analysis in 6 posits no special relationship between distributive numeral morphology and numerals. Consequently, the account wrongly predicts that the morphology deriving a distributive numeral should be able to combine with bare NPs like 'fish' (see 26 below).[5]

A third general approach to distributive numerals makes use of the special formal machinery provided by the DYNAMIC PLURAL LOGIC (DPlL) framework (van den Berg 1996). Although the accounts vary greatly in their details, such approaches to distributive numerals and distance distributivity can be found in the work of Henderson (2011) and Dotlačil (2012), with important precursors in the work of Farkas (1997) and Brasoveanu and Henderson (2009). Unfortunately, due to the technical complexity of the DPlL framework, I can offer only the barest sketch of the general structure of these accounts.

[5] The analysis developed by Champollion (2012) is quite different from Zimmermann's, but is nevertheless subject to some of the same criticisms. To briefly summarize the analysis, Champollion's semantics—sketched below—relies upon a special morphosyntactic mechanism of 'theta indexing', so that the distributive operator targets specific thematic roles.

(i) $[\![\mathit{DIST}\text{-}\boldsymbol{\theta}_C]\!] = [\lambda P_{\langle \varepsilon, t \rangle} : \lambda e_\varepsilon : e \in {}^*\{e' : P(e') \,\&\, C(\boldsymbol{\theta}(e'))\}]$

When 'θ' is a function mapping events to their participants (e.g. '*Theme(e)' in 44 below) and 'C' is a property of entities, the result is a participant-distributive reading. To obtain an event-distributive reading, the thematic role θ in (i) is set equal to the function τ mapping an event to its 'run-time', while 'C' is set as a property of times.

Consequently, under Champollion's (2012) account, a kind of type ambiguity seems to exist in the semantics of the *DIST* operator, so that 'θ' and 'C' can sometimes be of type ⟨ε, e⟩ and ⟨e, t⟩, respectively, while other times be of type ⟨ε, i⟩ and ⟨i, t⟩. This can be accomplished by means of a type polymorphism in the lexical entry for $\mathit{DIST}\text{-}\boldsymbol{\theta}_C$, so that the types for 'θ' and 'C' are given in the lexicon as ⟨ε, α⟩ and ⟨α, t⟩ (Champollion, p.c.). Nevertheless, one could argue that such type polymorphism is simply a 'shorthand' representing numerous lexical entries. This apparent type ambiguity can be entirely avoided, however, if one assumes that entities and times are actually of the same semantic type (Champollion, p.c.), an assumption akin to Zimmermann's (2002) view that entities and events are of the same type.

Finally, as the interested reader can confirm, Champollion (2012) shares Zimmermann's (2002) prediction that distributive numeral morphology should be able to combine with bare NPs like 'fish'. However, it should also be noted that Champollion (p.c.) counters that strictly constraining this morphology to only numerals would be too strong for languages like German and English, where 'distance distributives' can also appear with other cardinality predicates. Note the following examples from the internet.

(ii) a. Costs of mailing demos to stations will be [**several** dollars **each**].
b. I read the poems [**many** times **each**].

For further important discussion of these facts, the reader is referred to Szabolcsi 2010:130–33. (I thank Lucas Champollion for his helpful comments and critical discussion of these points.)

In brief, DPlL is a dynamic semantic framework, one that analyzes the meaning of a sentence in terms of the effect that it has upon the linguistic context. As in other dynamic frameworks, contexts are in DPlL modeled as sets of variable assignments G. Thus, the meaning of a sentence is modeled as a relation between such sets G, G'. A sentence/discourse is held to be true if its meaning can relate an initial empty context G_0 to some other context G'. The key distinguishing feature of DPlL is that, unlike earlier dynamic frameworks, its associated logical language allows one to formulate global constraints on the structure of the context set G. These global constraints allow one to model dependencies between quantificationally bound variables in discourse. For this reason, it is possible in this framework to develop a lexical entry for distributive numerals that predicts the key semantic effects observed in 1–4, without necessarily appealing to special syntactic principles or rules of semantic composition. Consequently, analyses of distributive numerals making use of this framework—such as those developed by Henderson (2011) and Dotlačil (2012)—effectively avoid all of the problems noted for Oh (2001, 2005), Zimmermann (2002), and Champollion (2012).

Of course, these analytic advantages come at the cost of the DPlL framework itself, which, as noted above, relies upon special assumptions about the representation of the context, the nature of linguistic meaning, and the semantics of quantificational binding. Again, space precludes a full description here, but the interested reader is referred to Brasoveanu 2008. It should again be noted that what truly distinguishes DPlL from other dynamic semantic frameworks is its use of global constraints on the set of variable assignments constituting the context G. As a consequence of this, DPlL is formally and computationally more complex than other dynamic frameworks. It would therefore be preferable to avoid the full power of the DPlL machinery, if at all possible, in the analysis of distributive numerals.

In summary, prior analyses of distributive numerals have required significant complications to the theory of the syntax-semantics interface. In contrast, the analysis developed here rests purely on relatively basic assumptions that are commonplace in the semantic literature on plurality and events. Furthermore, to my knowledge, ALL prior analyses of distributive numerals treat the ability of sentences like 3b to describe both participant- and event-distributive scenarios as a kind of ambiguity (Gil 1982, Oh 2001, 2005, Zimmermann 2002, Balusu 2006, Champollion 2012). That is, under previous accounts, the ability for 3b to describe both scenarios in 4 is captured by mapping 3b to two different sets of truth conditions.[6] However, I propose that Tlingit sentences like 3b are not truly ambiguous. That is, I show below that such sentences can be given a single, general set of truth conditions that covers both scenarios in 4. Furthermore, we see that this univocal semantics can also predict a number of more subtle facts regarding distributive numerals in Tlingit, Korean, German, and Kaqchikel (Mayan). Finally, we see that a small change to the proposed semantics yields a novel analysis of the English binominal *each* construction, one that predicts certain curious differences between binominal *each* and canonical distributive numerals.

The remainder of this article is structured as follows. Section 2 provides some basic background about the Tlingit language, and also explains how the original data appearing in this article were collected. I then discuss the morphosyntax of distributive numerals in Tlingit, showing in particular that such numerals can serve as either adverbial or adnominal modifiers (§3). The core semantic properties of the construction are intro-

[6] Anna Szabolcsi (p.c.) reports that an earlier, unpublished draft of Balusu 2006 did not rely upon semantic ambiguity to capture these facts, and instead developed an analysis quite close to the one developed in §5.

duced in §4. Among other facts, I show here that the syntactic attachment site of the distributive numeral has no effect upon the kind of distributive scenario the sentence describes. That is, no matter whether the distributive numeral is adverbial or adnominal, the sentence may be true in either participant-distributive or event-distributive scenarios. The formal semantic and syntactic analysis of Tlingit distributive numerals is then presented (§5), and we see how the proposed analysis could explain certain puzzles concerning distributive numerals in other languages in §6, while §7 discusses the possible treatment of binominal *each* in English.

2. LINGUISTIC AND METHODOLOGICAL BACKGROUND. The Tlingit language (Lingít) is the traditional language of the Tlingit people of Southeast Alaska, Northwest British Columbia, and Southwest Yukon Territory. It is the sole member of the Tlingit language family, a subbranch of the larger Na-Dene language family (Campbell 1997, Mithun 1999, Leer 2010). It is thus distantly related to the Athabaskan languages (e.g. Navajo, Slave, Hupa) and shares their complex templatic verbal morphology (Leer 1991). As mentioned in n. 3, I largely suppress this complex structure in my glossing of Tlingit verbs.

Tlingit is a highly endangered language. While there has been no official count of fully fluent speakers, it is privately estimated by some that there may be fewer than 200 (James Crippen (Dzéiwsh), Lance Twitchell (X̲'unei), p.c.). Most of these speakers are over the age of seventy, and there is no known native speaker below the age of fifty (Dauenhauer & Dauenhauer 1987). There are extensive, community-based efforts to revitalize the language, driven by a multitude of Native organizations and language activists too numerous to list here. Thanks to these efforts, some younger adults have acquired a significant degree of fluency, and there is growing optimism regarding a new generation of native speakers.

Unless otherwise noted, all data reported here were obtained through interviews with native speakers of Tlingit. Five fluent Tlingit elders participated: Beatrice Brown (Sa.áax̲w), Margaret Dutson (Sháax' sáani), Selena Everson (Kaséix̲), William Fawcett (Kóoshdaak'w Éesh), and Helen Sarabia (K̲áachku.aak̲w). All five were residents of Juneau, Alaska, at the time of our meeting, and are speakers of the Northern dialect of Tlingit (Leer 1991). Three or four elders were present at each of the interviews, which were held in a classroom at the University of Alaska Southeast in Juneau.

The linguistic tasks presented to the elders were straightforward translation and judgment tasks. The elders were presented with various scenarios, paired with English sentences that could felicitously describe those scenarios. The scenarios were described orally to the elders, and also represented pictorially, through the use of cartoons like that in Figure 1.

The elders were asked to freely describe the scenarios, as well as to translate certain targeted English sentences describing them. In order to more systematically study their semantics, sentences containing distributive numerals were explored using truth/felicity-judgment tasks, a foundational methodology of semantic fieldwork (Matthewson 2004). The elders were thus asked to judge the 'correctness' (broadly speaking) of various Tlingit sentences relative to certain scenarios. The sentences evaluated were either ones offered earlier by the speakers for other scenarios, or ones constructed by me and judged by the speakers to be 'natural sounding' and correct for other scenarios. As mentioned in n. 4, I notationally distinguish constructed examples from ones uttered spontaneously by the elders.

Finally, it should be noted that unless otherwise indicated, all speakers agreed upon the reported status of the sentences presented here.

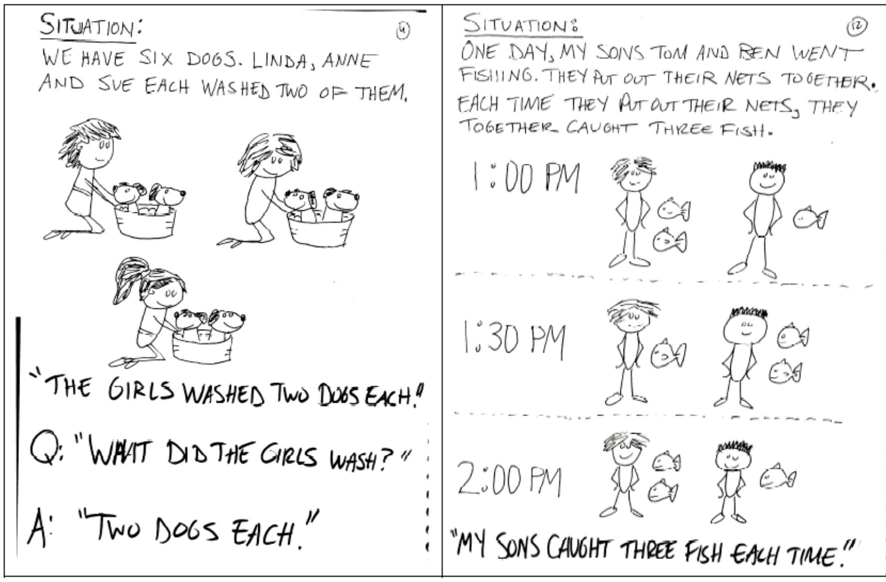


FIGURE 1. Sample of the cartoons used during interviews.

3. THE MORPHOLOGY AND SYNTAX OF DISTRIBUTIVE NUMERALS IN TLINGIT. As documented by Leer and colleagues (2001:26), distributive numerals are formed in Tlingit by suffixing *-gáa* to the base of the unmarked numeral. As with many suffixes in Tlingit, this distributive suffix bears a tone opposite to that of the immediately preceding syllable. Moreover, for the numerals one to three, certain phonological changes happen to the numeral root. The numerals one to five (for nonhumans) are illustrated in 9.

(9) Nonhuman distributive numeral series in Tlingit (Leer et al. 2001:26)

a. UNMARKED NUMERALS		b. DISTRIBUTIVE NUMERALS	
tléix’	‘one’	tlék’gaa	‘one by one, one each’
déix̱	‘two’	dáx̱gaa	‘in twos, two each’
nás’k	‘three’	nás’gigáa	‘in threes, three each’
daax’oon	‘four’	daax’oongáa	‘in fours, four each’
keijín	‘five’	keijíngaa	‘in fives, five each’

Numerals modifying human nouns in Tlingit appear with a ‘human classifier’ suffix *-náx̱* (10a). Similarly, when distributive numerals modify a human noun, they also take the classifier *-náx̱*. As illustrated in 10b, the classifier *-náx̱* appears to the right of the distributive suffix *-gáa*.

(10) Human distributive numeral series in Tlingit (Leer et al. 2001:26)

a. UNMARKED NUMERALS		b. DISTRIBUTIVE NUMERALS	
tléináx̱	‘one’	tlék’gaanáx̱	‘one by one, one each’
dáx̱náx̱	‘two’	dáx̱gaanáx̱	‘in twos, two each’
nás’gináx̱	‘three’	nás’gigáanáx̱	‘in threes, three each’
daax’ooninάx̱	‘four’	daax’oongáanáx̱	‘in fours, four each’
keijíninάx̱	‘five’	keijíngaanáx̱	‘in fives, five each’

Distributive numerals are exceedingly rare in spontaneous speech. The few examples that occur in published Tlingit texts appear to have an adverbial syntax, as illustrated below.

(11) **Tlék'gaanáx̱** áwé has wuduwax̱oox̱.
one.DIST.HUM FOC PL.3O.PFV.INDFS.call
'They called them one by one.' (Edwards 2009:260)

Given that all languages allow distributive numerals to function as adverbs (Gil 1982), the possibility and prevalence of adverbial structures like 11 is not surprising. In many languages, however, distributive numerals can also function as adnominal modifiers (Gil 1982, Choe 1987, Zimmermann 2002, Oh 2005, Balusu 2006). Interestingly, it is not unusual to find Tlingit distributive numerals in positions where they appear as if they could be adjoined to a noun. For example, note the surface similarity between 3a and 3b above, where the former contains an unmarked numeral that is undoubtedly an adnominal modifier. This raises the question of whether distributive numerals in Tlingit can also, as in other languages, attach adnominally. Unfortunately, given the freedom of word order in the language, there are rather few clear, positive tests for constituency (Cable 2010). Nevertheless, certain facts point toward the conclusion that the language does also possess adnominal distributive numerals.

First, among the sentences spontaneously uttered during my interview sessions, several had the form illustrated in 12.

(12) Distributive numerals preceding left-peripheral nouns
Nás'gigáa keitl **áwé** has aawashúch. (WF)
three.DIST dog **FOC** PL.3O.PFV.3S.bathe
'They bathed three dogs each.'

In sentences like 12, the focus particle *áwé* follows a string consisting of a distributive numeral and a noun. As detailed by Leer (1991), this focus particle optionally marks a phrase occupying a left-peripheral 'focus position'. This raises the question of the attachment site of the distributive numeral. Note that if the numeral were NOT attached to the noun, then it would have to occupy a separate, unmarked focus position. While it is possible for there to be two left-peripheral 'focus phrases' within a single clause, such structures are rather marked and uncommon (Leer 1991:23); moreover, in such structures, the initial focus phrase is almost always a sentence connective (Leer 1991:23). Consequently, given the relative frequency of sentences like 12 during my interviews, I conclude that the distributive numerals in such structures most likely have an adnominal attachment site. Supporting this conclusion is the fact that the distributive numeral in these sentences appears to form an intonational unit with the following noun, whereas distinct focus phrases are typically separated by a noticeable break. Incidentally, the ability for distributive numerals and nouns to form intonational units together is supported by the fact that, when considering certain constructed examples, speakers would sometimes repeat such strings to themselves, as clearly independent units.

(13) Distributive numerals and nouns forming intonational units
… **Dáx̱gaa** keitl … … **dáx̱gaa** keitl … (WF)
two.DIST dog **two.DIST** dog

While it is imperfect evidence, these intonational facts lend credence to the view that distributive numerals can in Tlingit be adnominal modifiers.

This conclusion is also supported by several basic (though imperfect) syntactic diagnostics. First, speakers report that it is possible to conjoin two strings consisting of a distributive numeral followed by a bare NP.

(14) Conjunction test for constituency with distributive numerals and NPs
[Scenario: My sons went to the store to buy some apples and some potatoes. Each one bought two apples and three potatoes.]

[[**Dáxgaa** x'áax'] ka [**nás'gigáa** k'únts']] áwé has aawa.oo. (C)
two.DIST apple and **three.DIST** potato FOC PL.3O.PFV.3S.buy
'They bought two apples each and three potatoes each.'

The acceptability of such conjunction structures is a necessary (though not always sufficient) condition for constituency, and so supports the view that Tlingit distributive numerals can function as adnominal modifiers. Similar supporting evidence rests in the ability for distributive numerals to appear in elliptical answers to WH-questions. As illustrated in 15b and 16b, the answer to a WH-question can consist of a distributive numeral followed by a noun.

(15) Distributive numerals in elliptical answers
a. Question prompt
Daa sáwé has aawasháat yá i káa yátx'i? (C)
what Q.FOC PL.3O.PFV.3S.catch these your male children
'What did your sons catch?'
b. Possible elliptical answers
(i) Nás'k xáat.
three fish
'Three fish.'
(ii) **Nás'gigáa** xáat. (C)
three.DIST fish
'Three fish each.'

(16) a. Question prompt
Daa sáwé has aawashúch wé shaax'wsáani? (C)
what Q.FOC PL.3O.PFV.3S.bathe those girls
'What did the girls bathe?'
b. Possible elliptical answers
(i) Déix keitl.
two dogs
'Two dogs.'
(ii) **Dáxgaa** keitl. (C)
two.DIST dog
'Two dogs each.'

Importantly, although speakers report that the discourses in 15 and 16 sound relatively natural, they emphatically reject the discourse in 17b–c below. That is, an elliptical answer to a WH-question cannot consist of an adverb followed by a noun, as in 17c.

(17) Elliptical answers in Tlingit must be constituents
a. Target sentence
Tláakw útlxi xwaaxáa. (C)
quickly boiled.fish 3O.PFV.1SGS.eat
'I ate the *utlxi* (boiled fish) quickly.'
b. Question prompt
Daa sáwé yeexáa? (C)
what Q.FOC 3O.PFV.2SGS.eat
'What did you eat?'
c. Impossible answer
*Tláakw útlxi. (C)
quickly boiled.fish

Given the sharp unacceptability of discourses like 17b–c, the acceptability of 15a–15b(ii) and 16a–16b(ii) suggests that the distributive numerals in 15b(ii) and 16b(ii) are not adverbs, but rather adnominal modifiers.

One final argument that distributive numerals can be adnominal surrounds the unacceptability of sentences like those in 18.

(18) a. *Ax sháa yátx'i wé **dáxgaa** keitl has aawashúch. (C)
my female children those **two.DIST** dog PL.3O.PFV.3S.bathe

b. *Ax̲ sháa yátx'i **dáx̲gaa** wé keitl has aawashúch. (C)
my female children **two.DIST** those dog PL.3O.PFV.3S.bathe

The ill-formedness of 18a,b demonstrates that distributive numerals in Tlingit cannot directly modify NPs with demonstratives, a feature shared with distributive numerals in many other languages (Zimmermann 2002, Oh 2005). Importantly, there are two ways to correct the sentences in 18. The first is to move the demonstrative DP to a postverbal position, as in 19.

(19) Ax̲ sháa yátx'i **dáx̲gaa** has aawashúch **yú keitl**. (BB)[7]
my female children **two.DIST** PL.3O.PFV.3S.bathe **those dog**
'My daughters bathed those dogs two at a time.'

Note that, given the ill-formedness of 18a,b, the distributive numeral in 19 must be base-generated as an adverb, and could not be a 'floated' adnominal modifier of the postverbal demonstrative DP.

At first glance, the contrast between 18b and 19 is somewhat puzzling. After all, if distributive numerals can function as adverbs (19), why isn't 18b accepted under a parse where the distributive numeral is an adverb, as sketched in 20 below?

(20) Unallowable parse of sentence 18b
[$_{S}$ [$_{DP}$ Ax̲ sháa yátx'i] [$_{VP}$ [$_{Adverb}$ **dáx̲gaa**] [$_{VP}$ [$_{DP}$ wé keitl]
my female children **two.DIST** those dog
has aawashúch]]
PL.3O.PFV.3S.bathe

The answer is that structures like 20 run afoul of a more general principle of Tlingit sentence formation. As detailed by Leer (1991), Tlingit speakers generally prefer to minimize the amount of phrasal material preceding the verb in a sentence. Thus, if there are more than three major constituents in a sentence, there is a very strong preference among speakers for at least one of those constituents to appear after the verb, as in 19.

Given this general word-order preference, the second means for improving 18a,b is quite revealing. Speakers have explicitly observed that sentences 18a,b become acceptable if one simply omits the demonstrative, as in 21.

(21) Ax̲ sháa yátx'i **dáx̲gaa** keitl has aawashúch. (C)
my female children **two.DIST** dog PL.3O.PFV.3S.bathe
'My daughters bathed two dogs each.' *or* 'My daughters bathed two dogs each time.'

Importantly, the contrast between 18b and 21 provides further evidence that distributive numerals in Tlingit can be adnominal. After all, if such numerals could only be adverbs, then sentence 21 would necessarily have the dispreferred structure in 20, and there would be no substantive difference between 21 and 18b. However, if distributive numerals can attach to NPs, then sentence 21 would allow the parse in 22.

(22) Allowable parse of sentence 21
[$_{S}$ [$_{DP}$ Ax̲ sháa yátx'i] [$_{VP}$ [$_{DP}$ **dáx̲gaa** keitl] has aawashúch]]
my female children **two.DIST** dog PL.3O.PFV.3S.bathe

Note that, under this parse, sentence 21 places only TWO major constituents before the verb, just as in 19. Therefore, 21 does not run afoul of the general word-order preference that militates against 18b. Importantly, though, this explanation requires that the

[7] The difference between the demonstratives in 18 and 19 is inconsequential; speakers also accepted a constructed sentence identical to 19, but with the demonstrative *wé* instead of *yú*. The difference between these two demonstratives is complex, but *yú* generally indicates greater distance from the speaker (Leer 1991).

distributive numeral *dáx̲gaa* 'two.DIST' and the noun *keitl* 'dog' can together form a single constituent.

This explanation for the contrast between 18b and 21 receives further support from the ill-formedness of the following sentences.

(23) a. *Ax̲ sháa yátx'i keitl **dáx̲gaa** has aawashúch. (C)
my female children dog **two.DIST** PL.3O.PFV.3S.bathe
b. ***Dáx̲gaa** ax̲ sháa yátx'i keitl has aawashúch. (C)
two.DIST my female children dog PL.3O.PFV.3S.bathe

When presented the word orders in 23, speakers strongly rejected them as 'incorrect' and offered the sentence in 21 as a correction. This contrast follows from the account offered above. In 23b, the subject 'my daughters' intervenes between the distributive numeral and the noun *keitl* 'dog'. Thus, the latter two cannot form a constituent, and so the sentence unacceptably contains three major phrases before the verb. Regarding sentence 23a, note that nearly all adnominal modifiers in Tlingit are prenominal (Naish 1966, Leer 1991).[8] Consequently, it would be natural to assume that adnominal distributive numerals in Tlingit must be prenominal as well. Therefore, the distributive numeral in 23a cannot form a constituent with the NP *keitl* 'dog', and so the sentence again contains an unacceptable number of preverbal constituents. Finally, if it is assumed that distributive numerals can ONLY be adverbs, then the contrast between 21 and 23 becomes obscure. After all, given the freedom of its word order, adverbs in Tlingit can generally precede the subject or follow the object (Leer 1991).

Taken together, the facts in 12–23 indicate that distributive numerals in Tlingit can function as adnominal modifiers. Moreover, the contrast between 18b and 21 shows that adnominal distributive numerals can attach only to bare NPs, never to DPs headed by demonstratives. This leads to the following generalization, which was noted earlier under 19.

(24) DIAGNOSTIC FOR ADVERBIAL DISTRIBUTIVE NUMERALS IN TLINGIT: If a sentence is of the form in 19—distributive numeral > verb > demonstrative DP—then the distributive numeral must be ADVERBIAL.

This generalization is used in §4 below as a diagnostic for showing that a distributive numeral is adverbial, and not adnominal. Furthermore, as we have just seen, the contrast between 18b and 21 also leads to the generalization in 25.

(25) DIAGNOSTIC FOR ADNOMINAL DISTRIBUTIVE NUMERALS IN TLINGIT: If a sentence is of the form in 21—subject > distributive numeral > bare NP > verb—then the distributive numeral must be ADNOMINAL.

In the following section, I use this generalization as a diagnostic showing that a distributive numeral is adnominal, rather than adverbial.

Finally, let us briefly note that, although nouns can be modified by distributive numerals, they cannot themselves bear the distributive suffix *-gáa* (26b). Rather, this suffix is entirely restricted to numerals, and cannot appear upon other cardinality predicates, such as *shayadihéini* 'many' (26c).

(26) The distributive suffix *-gáa* is specific to numerals
a. **Nás'gigáa** x̲áat has aawasháat. (BB, WF)
three.DIST fish PL.3O.PFV.3S.catch
'They caught three fish each.' *or* 'They caught three fish each time.'

[8] The only exceptions are a small, closed class of adjectival modifiers, such as *tlein* 'big' (Naish 1966, Leer 1991).

b. *X̲áat**gaa** has aawasháat. (C)
fish.**DIST** PL.3O.PFV.3S.catch
(≠ 'They each caught fish.')

c. *Shayadihéini**gáa** x'áax' áwé has aawa.oo. (C)
many.**DIST** apple FOC PL.3O.PFV.3S.buy
(≠ 'They each bought many apples.')

4. SEMANTIC DESCRIPTION OF DISTRIBUTIVE NUMERALS IN TLINGIT. A definitional feature of distributive numerals is that they enforce distributive readings of sentences, and rule out both collective and cumulative readings (Gil 1982, Choe 1987, Oh 2005).[9] It can be easily shown that the same holds for distributive numerals in Tlingit. First, in scenarios like that in 27, where the girls act 'as a team' to wash the dogs together, it is commonly held that the predicate 'bathe two dogs' holds collectively of the subject. Importantly, in such scenarios, only sentence 27a containing the unmarked numeral *déix̲* 'two' is true. Thus, sentence 27a allows a collective reading while 27b does not.

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

a. Wé shaax'wsáani **déix̲** keitl has aawashúch. (BB)
those girls **two** dog PL.3O.PFV.3S.bathe
'The girls bathed two dogs.' JUDGMENT: True in the scenario above.

b. Wé shaax'wsáani **dáx̲gaa** keitl has aawashúch. (C)
those girls **two.DIST** dog PL.3O.PFV.3S.bathe
JUDGMENT: Not true in the scenario above.

In a similar fashion, it can be shown that Tlingit distributive numerals do not allow for cumulative readings, while unmarked numerals do. For example, in the scenario in 28, the sons catch a total of three fish, but do not (necessarily) work together as a team. The ability of the English sentence *My sons caught three fish* to describe such a scenario is often attributed to it allowing a cumulative interpretation. Importantly, in such scenarios, the Tlingit sentence containing the unmarked numeral is true (28a), while the one containing the distributive numeral is not (28b).

(28) [Scenario: My sons Tom and Ben went fishing. Tom caught two fish. Ben caught one.]

a. Ax̲ k̲áa yátx'i **nás'k** x̲áat has aawasháat. (C)
my male children **three** fish PL.3O.PFV.3S.catch
'My sons caught three fish.' JUDGMENT: True in the scenario above.

b. Ax̲ k̲áa yátx'i **nás'gigáa** x̲áat has aawasháat. (C)
my male children **three.DIST** fish PL.3O.PFV.3S.catch
JUDGMENT: Not true in the scenario above.

Although distributive numerals do not allow for collective or cumulative readings, they do allow for distributive ones. Indeed, if one ever wishes to express a distributive meaning in Tlingit, then a distributive numeral is virtually obligatory, as shown in 29 and 30.

[9] For more on the distinction between collective, cumulative, and distributive readings, I refer the reader to various foundational works in the literature on plural semantics: Link 1983, Scha 1984, Lasersohn 1995, 2011, Schwarzschild 1996, Landman 2000, Kratzer 2003, 2008.

(29) [Scenario: We have six dogs. Linda, Anne, and Sue each bathed two of them.]

a. Wé shaax'wsáani **déix̲** keitl has aawashúch. (BB)
those girls **two** dog PL.3O.PFV.3S.bathe
'The girls bathed two dogs.' JUDGMENT: Not true in the scenario above.[10]

b. Wé shaax'wsáani **dáx̲gaa** keitl has aawashúch. (C)
those girls **two.DIST** dog PL.3O.PFV.3S.bathe
'The girls bathed two dogs each.' JUDGMENT: True in the scenario above.

(30) [Scenario: My sons Tom and Ben went fishing. Tom caught three fish, and Ben did too.]

a. Ax̲ k̲áa yátx'i **nás'k** x̲áat has aawasháat. (C)
my male children **three** fish PL.3O.PFV.3S.catch
'My sons caught three fish.' JUDGMENT: Not true in the scenario above.[11]

b. Ax̲ k̲áa yátx'i **nás'gig̲áa** x̲áat has aawasháat. (C)[12]
my male children **three.DIST** fish PL.3O.PFV.3S.catch
'My sons caught three fish each.' JUDGMENT: True in the scenario above.

Let us now recall the definition in 1 of a distributive numeral, repeated in 31. The facts in 27–30 indicate that distributive numerals in Tlingit possess the property in (i). Furthermore, the facts in 32 show that such numerals also possess the property in (ii).

(31) DISTRIBUTIVE NUMERAL: A morphosyntactic construction containing a numeral, whereby (i) the sentence as a whole receives a distributive reading, and (ii) under the allowable readings, the numeral contained within the construction must be interpreted AS IF it is within the scope of a distributive operator.

(32) NP modified by distributive numeral must be in scope of distributive operator
[Scenario: We have three dogs. Six girls came over to bathe them. Each dog was bathed by a team of two (different) girls.]

a. **Dáx̲náx̲** shaax'wsáani **nás'gig̲áa** keitl has aawashúch. (HS)
two.HUM girls **three.DIST** dog PL.3O.PFV.3S.bathe
'Two girls bathed three dogs each.' JUDGMENT: Not true in this scenario.

[10] There is some evidence to suggest that speakers marginally allow plain numeral sentences like 29a to receive a distributive reading. First, some speakers initially accepted 29a as true in this scenario, though they later revised their judgment. In addition, one speaker (WF) offered *déix̲ keitl* 'two dogs' as the answer to the question *Daa sáwé has aawashúch?* 'What did they bathe?' under the scenario in 29.

[11] As with sentence 29a, some speakers initially accepted 30a as true in the associated scenario. This suggests that a distributive interpretation of 30a may be marginally possible.

[12] Although 30b was constructed, sentence (i) below was spontaneously offered as a description of the scenario under 30. In addition, the speaker explicitly translated this sentence back into English as *They caught three each*.

(i) **Nás'gig̲áa** x̲áat áwé has aawasháat. (WF)
three.DIST fish FOC PL.3O.PFV.3S.catch
'They caught three fish each.'

b. **Dáxgaanáx** shaax'wsáani **nás'k** keitl has aawashúch. (HS)
two.DIST.HUM girls **three** dog PL.3O.PFV.3S.bathe
'Three dogs were each bathed by two girls.' JUDGMENT: True in this scenario.

The sentences in 32a,b differ only in the location of the distributive suffix *-gáa*; in 32a, it marks the numeral in object position, while in 32b, it appears on the numeral modifying the subject. Importantly, only sentence 32b is accepted as true in the scenario under 32. Finally, note that a logical representation of this scenario using the distributive operator in 2 would appear as in 33 below.

(33) Representation of the scenario in 32 using the distributive operator in 2
∃z. **three.dogs**(z) & ∀x. x ≤ **z** & atom(x) → ∃e. ∃y. **two.girls**(y) & y bathed x in e
restrictor of *DIST* scope of *DIST*
'There is a group of three dogs z, and for each atomic member x of z, there is an event e, and a (possibly different) group of two girls y such that y bathed x in e.'

Crucially, under this representation, only the numeral 'two' modifying the subject appears within the SCOPE of the distributive operator; the numeral 'three' modifying the object actually scopes above the operator. Consequently, the contrast between 32a and 32b demonstrates that the numeral suffixed with *-gáa* must be interpreted as if it is within the scope of the distributive operator. Thus, Tlingit distributive numerals indeed exhibit the property in 31(ii).

We have seen that distributive readings of numerals in Tlingit require the presence of the distributive suffix *-gáa*, and that numerals marked with *-gáa* must be interpreted as if they scope below a distributive operator. A direct consequence of this, often reported for other languages with distributive numerals (Gil 1982, Oh 2005), is that an 'inverse-scope' reading of a transitive sentence with a numerically modified subject is possible only if the subject is modified by a distributive numeral. After all, the hallmark of such inverse-scope readings is that the sentence is interpreted as if the subject lies within the scope of a distributive operator, whose restrictor is some NP occupying a position syntactically lower than the subject. The following data illustrate.

(34) Distributive numerals are required for inverse-scope readings
[Scenario: We have three dogs. Six girls came over to bathe them. Each dog was bathed by a team of two (different) girls.]

a. Unmarked numeral
Dáxnáx shaax'wsáani **nás'k** keitl has aawashúch. (C)[13]
two.HUM girls **three** dog PL.3O.PFV.3S.bathe
'Two girls bathed three dogs.' JUDGMENT: Not true in scenario above.

b. Distributive numeral on subject
Dáxgaanáx shaax'wsáani **nás'k** keitl has aawashúch. (HS)
two.DIST.HUM girls **three** dog PL.3O.PFV.3S.bathe
'Three dogs were each bathed by two girls.' JUDGMENT: True in scenario above.

[13] Note that sentence 34a was strongly rejected in this scenario, even by those speakers who had earlier momentarily accepted the truth of 29a and 30a in their associated scenarios. This suggests that distributive readings of unmarked numeral sentences are only (marginally) possible in cases of surface scope.

In §1, we briefly saw that Tlingit sentences containing distributive numerals often appear at first glance to be ambiguous, in that they can often be true in either participant-distributive or event-distributive scenarios. Furthermore, in §3, we saw that such sentences in Tlingit can also sometimes be syntactically ambiguous, in that distributive numerals are able to attach both adnominally and adverbially in the language. This naturally raises the question of whether these ambiguities are linked. That is, does the syntactic attachment site of the distributive numeral at all affect what kind of distributive scenario the sentence can describe? Interestingly, as in other languages with distributive numerals, the answer appears to be 'no' (Zimmermann 2002, Oh 2005; cf. Gil 1982).

To begin, note that sentences 35a and 35b are judged as true in the participant-distributive scenarios they are paired with.

(35) Distributive numerals and participant-distributive scenarios

a. [Scenario: My sons Tom and Ben went fishing. Tom caught three fish; Ben did too.]

Ax̲ k̲áa yátx'i **nás'gig̲áa** x̲áat has aawasháat. (C)
my male children **three.DIST** fish PL.3O.PFV.3S.catch
'My sons caught three fish each.' JUDGMENT: True in the scenario above.

b. [Scenario: We have six dogs. Linda, Anne, and Sue each bathed two of them.]

Dáx̲gaa áwé nás'ginác̲ shaax'wsáanich has aawashúch wé keitl.
two.DIST FOC three.HUM girls.ERG PL.3O.PFV.3S.bathe those dog
JUDGMENT: True in the scenario above. (BB)

In scenario 35a, there are three fish to each boy, and in scenario 35b, there are three dogs to each girl. Thus, in each of these scenarios, the distribution is over some plural participant in the sentence, and so they are both participant-distributive scenarios. Importantly, both sentence 35a and 35b are judged true in their paired scenario. Furthermore, note that sentence 35a is of the form: subject > distributive numeral > bare NP > verb. Consequently, given the generalization in 25, we know that the distributive numeral in 35a must be ADNOMINAL. Moreover, sentence 35b is of the form: distributive numeral > verb > demonstrative DP. Thus, generalization 24 entails that the distributive numeral in 35b is ADVERBIAL.[14] Taken together, the facts in 35 show that the attachment site of the distributive numeral does not affect whether the sentence can describe a participant-distributive scenario.

In a similar way, it can be shown that the syntactic status of the distributive numeral does not affect whether the sentence describes an event-distributive scenario.

(36) Distributive numerals and event-distributive scenarios

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

Ax̲ k̲áa yátx'i **nás'gig̲áa** x̲áat has aawasháat. (C)
my male children **three.DIST** fish PL.3O.PFV.3S.catch
JUDGMENT: True in the scenario above.

[14] The adverbial status of *dáx̲gaa* 'two.DIST' in 35b is also ensured by the fact that it does not bear the human suffix *-náx̲*, and so could in no way be modifying the subject 'three girls'. Intuitively, it is semantically 'associating' with the demonstrative DP *wé keitl* 'those dogs'. Given the facts discussed in §3, however, the distributive numeral could in no way be a 'floated' adnominal modifier of that DP, and so it must be adverbial in 35b.

b. [Scenario: My neighbors have eight dogs. My daughters went over to bathe their dogs. First, they together bathed two dogs at the same time. Then, they together bathed another two dogs at the same time. Then, they did another two dogs together, and then another two together, until all eight dogs were bathed.]
Ax sháa yátx'i **dáxgaa** has aawashúch yú keitl. (BB)
my female children **two.DIST** PL.3O.PFV.3S.bathe those dog
JUDGMENT: True in the scenario above.

In scenario 36a, there are three fish to each event of my sons fishing (but not to each son), and in scenario 36b, there are two dogs to each event of bathing (but not to each daughter). Thus, in each of these scenarios, the distribution is over some plurality of fishing/bathing events, and so they are both event-distributive scenarios. Again, it is important to note that both 36a and 36b are true in their paired scenario. Moreover, given generalization 25, we know that 36a contains an ADNOMINAL distributive numeral, while generalization 24 entails that 36b contains an ADVERBIAL distributive numeral. Consequently, the facts in 36 show that both adnominal and adverbial distributive numerals allow readings that cover event-distributive scenarios. Altogether, then, we see from 35 and 36 that the syntactic status of the distributive numeral does not affect the kind of distributive scenario the sentence can describe.

There are, however, other factors that can affect the kinds of scenarios describable by a distributive numeral sentence. In particular, as has been reported for other languages (Gil 1982, Oh 2005), there are certain sentence structures that can only describe event-distributive scenarios. First, note that all of the examples considered thus far are transitive sentences containing two plural arguments. Distributive numerals are also possible, however, in transitive sentences containing only one plural argument. As shown in 37, the only interpretation reported for such sentences describes an event-distributive scenario.

(37) Transitive sentence with a distributive numeral and only one plural argument
Nás'gigáa xáat áwé aawasháat. (WF)
three.DIST fish FOC 3O.PFV.3S.catch
'He caught three fish each time.'
SPEAKER COMMENT: 'This means every time he went out—in the morning, in the evening—he caught three.'

Furthermore, it is possible for distributive numerals to appear in intransitive sentences, just so long as the subject is plural. Again, the only interpretation reported is one that describes an event-distributive scenario.

(38) Intransitive sentence with a distributive numeral
[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.]
Dáxgaanáx áwé has aawal'éx. (WF, BB)
two.DIST.HUM FOC PL.PFV.3S.dance
'They danced in twos.'

Finally, it is possible for a sentence to contain two distributive numerals, each modifying a different NP. As reported for other languages (Gil 1982, Oh 2005), such sentences are judged to be awkward and difficult to understand. However, the meaning speakers identify for them is one that covers an event-distributive scenario.

(39) Transitive sentence with two distributive numerals
[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 bathing three (different) dogs.]

Dá<u>x</u>g<u>a</u>aná<u>x</u>	shaax'wsáani	**nás'gigáa**	keitl	has aawashúch.	(C)
two.DIST.HUM	girls	**three.DIST**	dog	PL.3O.PFV.3S.bathe	

'Each time, two girls bathed three dogs.' *or* 'Girls in twos bathed dogs in threes.'

JUDGMENT: True in the scenario above.

The facts discussed thus far constitute the empirical core of this article. In the following section, I develop a formal semantic analysis of these data, one that builds upon much recent work on the semantics of plurality and pluractionality (Beck & von Stechow 2007, Kratzer 2008, Henderson 2011). In addition to predicting the core facts above, this analysis can also account for certain interesting patterns observed for distributive numerals in other languages, and offers a novel perspective on the semantics of the English binominal *each* construction.

5. FORMAL SEMANTIC ANALYSIS. This section presents the proposed formal semantic analysis of the distributive suffix -*gáa* in Tlingit. I begin in §5.1 with an overview of the key background assumptions.

5.1. THE KEY INGREDIENTS. For reasons of space, much of my discussion here presupposes some familiarity with the semantic literature on plurality, distributivity, and pluractionality (Lasersohn 1995, Schwarzschild 1996, Beck & von Stechow 2007, Kratzer 2008). To begin, I assume throughout the following central hypothesis.

(40) THE CUMULATIVITY OF ALL NATURAL LANGUAGE PREDICATES (Krifka 1992, Kratzer 2008): If P is a lexical item of a natural language, then $[\![P]\!]$ satisfies the condition in 41.

(41) CUMULATIVITY CONDITION: For any entities $x_1, \ldots, x_n, y_1, \ldots, y_n$, if $[\![P]\!](x_1)\ldots(x_n) = T$, and $[\![P]\!](y_1)\ldots(y_2) = T$, then $[\![P]\!](x_1 + y_1)\ldots(x_n + y_n) = T$.

According to the principle in 41, for any natural language predicate *P*, if *P* holds between the entities $x_1, \ldots, x_n$, and holds between the entities $y_1, \ldots, y_n$, then *P* holds for the plural sums $(x_1 + y_1)\ldots(x_n + y_n)$. To briefly illustrate, consider the relation 'father of' sketched in 42.

(42) Illustration of cumulative relations

FATHERS	'father of'	DAUGHTERS
Bill		Sue
Frank		Jen
Bill + Frank		Sue + Jen

Suppose that, as sketched above, Bill is the father of Sue, and Frank is the father of Jen. Intuitively, Bill and Frank are therefore the father(s) of Sue and Jen. The validity of this inference is captured by the cumulativity condition in 41. After all, if 'father of' holds between Bill and Sue, and between Frank and Jen, then 41 entails that—as sketched above—'father of' must also hold between the pluralities Bill + Frank and Sue + Jen. I refer the reader to the works cited above for more background on the key hypothesis in 41.

As in much work that assumes 41, I employ an asterisk '*' as a small notational mnemonic, to remind the reader that the predicates in question are all assumed to be 'cumulative', as defined in 41.[15] Thus, I employ predicates like '[λx : *dog(x)]', where the '*' is simply a reminder that this predicate holds both of individual dogs and dog pluralities.

Next, regarding definite plurals, I adopt the commonplace view that definite determiners have the semantics in 43a, where the 'maximality' operator 'σ_x' is defined as in 43b.

(43) The semantics of definite DPs
  a. $[\![\text{the/this/that}]\!] = [\lambda P_{\langle et\rangle} : \sigma_x.\ P(x)]$
  b. Definition of the operator 'σ_x'
    (i) Definition of cumulative closure: If S is a set, then *S is the smallest set such that (i) $S \subseteq {}^*S$, and (ii) if α and $\beta \in {}^*S$, then $\alpha + \beta \in {}^*S$.
    (ii) $\sigma_x.\ Q(x) =_{df}$ the entity α such that $\alpha \in {}^*\{x : Q(x)\}$ and if $\gamma \in {}^*\{x : Q(x)\}$, then $\gamma \leq \alpha$

Note that, for purposes of simplicity, I also ignore here the deictic content of demonstratives and treat them as semantically akin to definite determiners. Therefore, a demonstrative DP such as *those dogs* will denote the entity 'σ_x. *dog(x)', which equates to the largest possible plurality of dogs.

A third core assumption of my analysis is that verbs are pure (cumulative) relations between events and their internal arguments, as illustrated in 44.

(44) Verbs are (cumulative) relations between events and themes (Kratzer 2008)[16]
  a. $[\![\text{bathe}]\!] = [\lambda x_e : \lambda e_\varepsilon : {}^*\text{bathe}(e)\ \&\ {}^*\text{Theme}(e) = x]$
  b. $[\![\text{catch}]\!] = [\lambda x_e : \lambda e_\varepsilon : {}^*\text{catch}(e)\ \&\ {}^*\text{Theme}(e) = x]$

Thus, if the individual events of 'dog-bathing' are as in 45a, then the relation 'bathe' holds between all of the event-dog pairs in 45b.

(45) Illustration of (cumulative) verbal semantics
  a. Atomic events of bathing

BATHINGS	DOGS BATHED
e_1	Sparky
e_2	Spot
e_3	Rex

  b. Denotation of 'bathe'

$$\left\{\begin{array}{l} \langle e_1, \text{Sparky}\rangle \\ \langle e_2, \text{Spot}\rangle \\ \langle e_3, \text{Rex}\rangle \\ \langle e_1{+}e_2, \text{Sparky+Spot}\rangle \\ \langle e_1{+}e_3, \text{Sparky+Rex}\rangle \\ \langle e_2{+}e_3, \text{Spot+Rex}\rangle \\ \langle e_1{+}e_2{+}e_3, \text{Sparky+Spot+Rex}\rangle \end{array}\right\}$$

Of course, if only the internal argument of a verb is represented in its lexical meaning (44), then additional syntactic means are required to link the verb to its external argument. Following much literature, I assume that the external argument of the verb is provided by a little-*v* head, with the semantics in 46.

(46) The semantics of little-*v* (Kratzer 1996)
  $[\![v]\!] = [\lambda x_e : \lambda e_\varepsilon : {}^*\text{Agent}(e) = x]$

[15] In the broader literature on plurality, the '*'-operator creates a cumulative predicate from a noncumulative one.

[16] It should be noted that 'x_e' is a variable ranging over ENTITIES (type *e*), while 'e_ε' is a variable ranging over EVENTS (type ε). This notation—though common in formal semantics—can be confusing when first encountered.

Assuming the semantic rule of EVENT IDENTIFICATION in 47, we can derive the meaning in 48b for the *v*P represented in 48a.

(47) THE RULE OF EVENT IDENTIFICATION (Kratzer 1996): If X consists of two daughter nodes, Y and Z, and Y is of type ⟨e, εt⟩, while Z is of type ⟨εt⟩, then ⟦X⟧ = [λx : λe : ⟦Z⟧(e) & ⟦Y⟧(x)(e)].

(48) Illustration of the compositional semantics
  a. $[_{vP}\ [_{DP}$ The girls$]\ [_{vP}\ v\ [_{VP}$ bathed $[_{DP}$ the dogs$]]]]$
  b. $[\lambda e_\varepsilon$: *bathe(e) & *Agent(e) = σ_x.*girl(x) & *Theme(e) = σ_y.*dog(y)]

To briefly unpack the meaning in 48b, note that the metalanguage predicates '*bathe', '*Agent', and '*Theme' are all cumulative. Consequently, if the individual events of dog bathing are as in 49a, then the cumulative relations in 49b will all hold.

(49) Illustration of the cumulative semantics of *v*P
  a.

INDIVIDUAL BATHINGS	AGENT	THEME
e_1	Jen	Sparky
e_2	Sue	Spot
e_3	Laura	Rex

  b. (i) *bathe($e_1 + e_2 + e_3$)
  (ii) *Agent($e_1 + e_2 + e_3$) = Jen + Sue + Laura (= σ_x.*girl(x))
  (iii) *Theme($e_1 + e_2 + e_3$) = Sparky + Spot + Rex (= σ_y.*dog(y))

Finally, since the plurality Jen + Sue + Laura is equivalent to 'σ_x.*girl(x)' and Sparky + Spot + Rex is 'σ_y.*dog(y)', it therefore follows that the plural event $e_1 + e_2 + e_3$ would satisfy predicate 48b.

A semantics for the *v*P having been provided in 48a, let us now consider the semantics of the sentence containing it. For purposes of simplicity, I ignore tense and aspect in this article. Indeed, the only assumption I make concerning the sentence as a whole is the following.

(50) EXISTENTIAL CLOSURE OF THE EVENT ARGUMENT: Above the *v*P, there is an existential binder over the event argument.

Consequently, the sentence in 51a is assumed to have the LF in 51b, and thus the truth conditions in 51c.

(51) Illustration of the semantics
  a. The girls bathed the dogs.
  b. LF structure
  $[_S\ \exists e\ [_{vP}\ [_{DP}$ The girls$]\ [_{vP}\ v\ [_{VP}$ bathed $[_{DP}$ the dogs$]]]]]$
  c. Truth conditions
  ∃e. *bathe(e) & *Agent(e) = σ_x.*girl(x) & *Theme(e) = σ_y.*dog(y)

Now, recall that under the scenario in 49a, the predicate in 48b holds of the plural event $e_1 + e_2 + e_3$. Consequently, we predict that the existential truth conditions in 51c will also be true in that scenario. Thus, our semantics correctly predicts that sentence 51a will be true in a scenario where (i) Jen bathes Sparky, (ii) Sue bathes Spot, and (iii) Laura bathes Rex.

The assumptions presented above are by no means unique in the semantic literature on plurality. However, there are three additional ingredients required by my analysis, which are relatively novel. The first is the metalanguage predicate 'Participant', defined as follows.

(52) The predicate 'Participant'
  Participant(e,x) iff x bears a 'theta relation' to e
  iff x is Agent of e, or x is Theme of e, or x is Goal of e, …

That is, the predicate 'Participant' will hold between any event and some thematic participant in that event, that is, its agent, its theme, its goal, and so forth.

The second additional ingredient is the binary maximality operator '$\sigma_{\langle x, y\rangle}$', defined below (cf. 43b).

(53) Binary maximality operator

a. Pair addition: $\langle x_1, x_2\rangle + \langle y_1, y_2\rangle =_{df} \langle x_1+y_1, x_2+y_2\rangle$

b. $\sigma_{\langle x, y\rangle}. Q(x)(y) =_{df}$ the pair $\langle \alpha, \beta\rangle$ such that $\langle \alpha, \beta\rangle \in {}^*\{\langle x, y\rangle : Q(x)(y)\}$, and if $\langle \gamma, \delta\rangle \in {}^*\{\langle x, y\rangle : Q(x)(y)\}$, then $\gamma \leq \alpha$, and $\delta \leq \beta$.

To define the operator '$\sigma_{\langle x, y\rangle}$', we first define the '+' operator in 53a for pairs (Krifka 1992, Kratzer 2008). Under this definition, the sum of the pair $\langle x_1, x_2\rangle$ and the pair $\langle y_1, y_2\rangle$ is the pair $\langle x_1+y_1, x_2+y_2\rangle$. With this in place, we can define the expression '$\sigma_{\langle x, y\rangle}. Q(x)(y)$' in 53b as being the sum of all the pairs in $\{\langle x, y\rangle : Q(x)(y)\}$. For example, in the scenario sketched in 49a, the formula '$\sigma_{\langle e, y\rangle}$. *bathe(e) & Theme(e) = y' would be equal to $\langle e_1$, Sparky$\rangle$ + $\langle e_2$, Spot$\rangle$ + $\langle e_3$, Rex$\rangle$, and so would be the pair $\langle e_1+e_2+e_3$, Sparky+Spot+Rex$\rangle$.

Finally, following Scha (1984) and Krifka (1990), I assume that there is a distinct type '*n*' of integers, and that numerals are expressions of type *n*, as follows.

(54) An integer semantics for numerals (Scha 1984, Krifka 1990)

a. $[\![\text{one}]\!] = 1$

b. $[\![\text{two}]\!] = 2$

c. $[\![\text{three}]\!] = 3$

With these ingredients in place, we can now examine the proposed semantics for Tlingit distributive numerals.

5.2. THE SEMANTICS OF DISTRIBUTIVE NUMERALS IN TLINGIT. To begin, I assume that the distributive suffix *-gáa* in Tlingit is lexically ambiguous. That is, there are two homophonous *-gáa* suffixes, one creating adverbial distributive numerals, and the other creating adnominal distributive numerals. While this proposed ambiguity might justly be criticized, there are two difficult challenges facing any attempt at a fully unified semantics for adnominal and adverbial distributive numerals. The first is simply that many languages with adverbial distributive numerals do not permit them to be adnominal modifiers, and vice versa (Gil 1982, Oh 2005). Consequently, an analysis that predicts all adverbial distributive numerals to also function as adnominal modifiers would seem to drastically overgenerate. The second challenge is simply that *v*Ps and NPs have quite different semantic types—$\langle \varepsilon t\rangle$ and $\langle et\rangle$—and so any unified analysis of adverbial and adnominal distributive numerals would per force need to appeal to specialized composition rules, undermining its presumed elegance.[17]

For these reasons, I assume that there is a distinct distributive suffix *-gáa*$_{\text{ADV}}$ in Tlingit with the semantics in 55.[18]

[17] The reader should note that, as shown below, the proposed ambiguity in *-gáa* will NOT be used to derive the ability of distributive numerals to describe both participant- and event-distributive scenarios. Consequently, for the reasons outlined above, any account that attempts to derive the facts in 3–4 by appealing to ambiguity must actually posit a FOUR-WAY ambiguity, between (i) adverbial vs. adnominal distributive numeral and (ii) entity vs. event distribution. Again, as shown below, the proposed account avoids positing the ambiguity in (ii), but must still retain the ambiguity in (i).

[18] I would like to note that this semantics is both inspired by and based upon the semantics for pluractional adverbs (e.g. *one by one*) developed by Beck and von Stechow (2007), as well as the treatment of the German adverb *jeweils* by Kratzer (2008).

(55) Semantics for adverbial distributive numerals

$[\![\text{-gáa}_{\text{ADV}}]\!] =$

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

The explicit examples below help to clarify the content of this lexical entry. For the moment, however, we can break down the meaning in 55 as follows. The adverb-creating *-gáa* suffix takes as argument an integer ‘n’ and a relation ‘P’ between entities and events, and then returns a relation between entities and events, which holds of an entity ‘x’ and an event ‘e’ iff (i) the relation P holds between x and e, and (ii) the pair ⟨e, x⟩ is the sum of those pairs ⟨e′, y⟩ such that (i) y is a proper part of x, and (ii) y is a plurality of cardinality of n, (iii) e′ is a proper part of e, and (iv) y is a participant in e′.

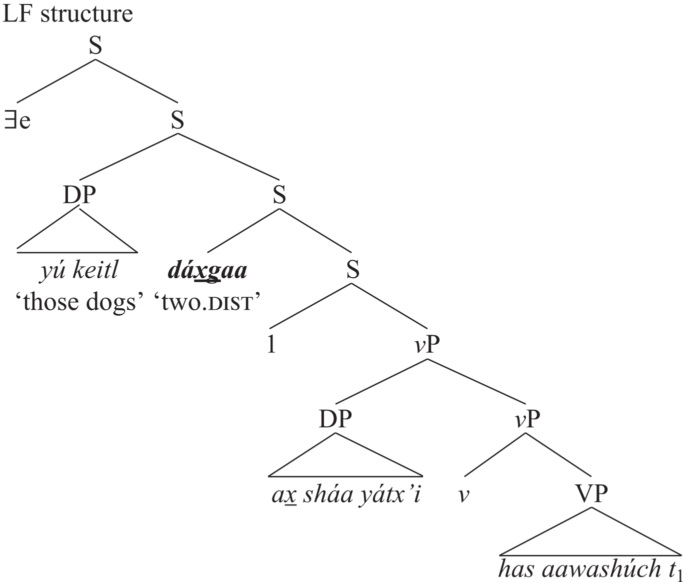
To get a better handle on this denotation, let us consider the sentence in 56a below. Given generalization 24, the distributive numeral *dáx̲gaa* in 56a is adverbial. Moreover, following Beck and von Stechow’s (2007) analysis of the English adverb *one by one*, I assume that the structure in 56b is a possible LF for 56a. Under this LF structure, the DP *yú keitl* ‘those dogs’ undergoes movement, creating the lambda operator ‘1’ (Heim & Kratzer 1998). This movement of the direct object is followed by a ‘tucking-in’ movement of the distributive numeral, between the direct object and the lambda that its movement creates. I refer the reader to Beck & von Stechow 2007 for more discussion of this LF syntax. Given this LF, however, our semantics in 55 yields the truth conditions in 56c.

(56) The compositional semantics of adverbial distributive numerals

a. Tlingit sentence

Ax̲ sháa yátx’i **dáx̲gaa** has aawashúch yú keitl. (BB)
my female children **two.DIST** PL.3O.PFV.3S.bathe those dog

b. LF structure



c. Predicted truth conditions

$\exists e.\ {*}\text{bathe}(e)\ \&\ {*}\text{Agent}(e) = \sigma_x.{*}\text{my.daughter}(x)\ \&\ {*}\text{Theme}(e) = \sigma_y.{*}\text{dog}(y)\ \&$
$\langle e, \sigma_y.{*}\text{dog}(y)\rangle = \sigma_{\langle e', z\rangle}.\ z < \sigma_y.{*}\text{dog}(y)\ \&\ |z| = 2\ \&\ e' < e\ \&\ \text{Participant}(e',z)$

'My daughters (cumulatively) bathed those dogs, and
the dogs are the proper sum of pairs of things that took part in the bathing.'

Given our assumptions from the previous section, the truth conditions in 56c can be read informally as follows: there is a (plural) event e of bathing, whose agent is my daughters and whose theme is the dogs, and the pair consisting of e and the dogs is the sum of those pairs $\langle e', z\rangle$ such that z is a pair of dogs, e′ is a proper part of e, and z participates in e′. Breaking this down still further, we see that these truth conditions amount to the claim that my daughters cumulatively bathed the dogs, and the dogs can be broken down into pairs, each of which is the theme of some subevent of the larger event of bathing. While this is still quite a mouthful, consider how it applies to the participant-distributive scenario in 35b, repeated below.

(57) Participant-distributive scenario: We have six dogs. Linda, Anne, and Sue (my daughters) each bathed two of them.

BATHINGS	AGENT	THEME
e_1	Linda	Sparky + Rex
e_2	Anne	Spot + Fido
e_3	Sue	Lucky + Lassie

Consider the plural event $e_1 + e_2 + e_3$. Given the assumptions from §5.1, it follows that $*\text{Agent}(e_1 + e_2 + e_3) = \text{Linda} + \text{Anne} + \text{Sue} = \sigma_x.*\text{my.daughter}(x)$. Moreover, it follows that $*\text{Theme}(e_1 + e_2 + e_3) = \text{Sparky} + \text{Rex} + \text{Spot} + \text{Fido} + \text{Lucky} + \text{Lassie} = \sigma_y.*\text{dog}(y)$. Therefore, in scenario 57, the condition '$\exists e.\ *\text{bathe}(e)\ \&\ *\text{Agent}(e) = \sigma_x.*\text{my.daughter}(x)\ \&\ *\text{Theme}(e) = \sigma_y.*\text{dog}(y)$' in 56c holds. Now, consider the pair $\langle e_1+e_2+e_3, \text{Sparky+Rex+Spot+Fido+Lucky+Lassie}\rangle$. Note that this pair is the sum of the pairs $\{\langle e_1, \text{Sparky+Rex}\rangle, \langle e_2, \text{Spot+Fido}\rangle, \langle e_3, \text{Lucky+Lassie}\rangle\}$. Moreover, note that this set of pairs is equal to the set $\{\langle e', z\rangle : z < \sigma_y.*\text{dog}(y)\ \&\ |z| = 2\ \&\ e' < e_1+e_2+e_3\ \&\ \text{Participant}(e',z)\}$. Therefore, it follows from our definition in 53b that the pair $\langle e, \sigma_y.*\text{dog}(y)\rangle = \langle e_1+e_2+e_3, \text{Sparky+Rex+Spot+Fido+Lucky+Lassie}\rangle = \sigma_{\langle e', z\rangle}.\ z < \sigma_y.*\text{dog}(y)\ \&\ |z| = 2\ \&\ e' < e\ \&\ \text{Participant}(e',z)$. Putting both of these observations together, we find that all of the truth conditions in 56c hold in scenario 57.

Given that the predicted truth conditions hold in scenario 57, we see that our semantics correctly predicts that sentences containing adverbial distributive numerals are interpreted as true in participant-distributive scenarios. Now let us consider the event-distributive scenario in 36b, repeated below.

(58) Event-distributive scenario: My neighbors have eight dogs. My daughters went over to bathe their dogs. First, they together bathed two dogs at the same time. Then, they together bathed another two dogs at the same time. Then, they did another two dogs together, and then another two together, until all eight dogs were bathed.

BATHINGS	AGENT	THEME
e_1	Linda + Anne + Sue	Sparky + Rex
e_2	Linda + Anne + Sue	Spot + Fido
e_3	Linda + Anne + Sue	Lucky + Lassie
e_4	Linda + Anne + Sue	Ruffles + Toto

Intuitively, in this scenario it is again the case that the girls cumulatively bathed the dogs, and the dogs can be broken down into pairs, each of which is theme to some subevent of the larger (cumulative) bathing. Thus, it would seem our semantics correctly predicts 56a to be true in scenario 58. We can also see this in more detail as follows. Consider the plural event $e_1 + e_2 + e_3 + e_4$. As before, it is the case that *bathe($e_1 + e_2 + e_3 + e_4$), *Agent($e_1 + e_2 + e_3 + e_4$) = σ_x.*my.daughter(x), and *Theme($e_1 + e_2 + e_3 + e_4$) = σ_y.*dog(y). Moreover, consider the pair ⟨e_1+e_2+e_3+e_4, Sparky+Rex+Spot+Fido+Lucky+Lassie+Ruffles+Toto⟩ = ⟨e_1+e_2+e_3+e_4, σ_y.*dog(y)⟩. Clearly, this pair is the sum of the pairs {⟨e_1, Sparky+Rex⟩, ⟨e_2, Spot+Fido⟩, ⟨e_3, Lucky+Lassie⟩, ⟨e_4, Ruffles+Toto⟩}. Moreover, note that this latter set is equal to the set {⟨e′, z⟩ : z < σ_y.*dog(y) & |z| = 2 & e′ < e_1+e_2+e_3+e_4 & Participant(e′,z)}. It therefore follows that ⟨e_1+e_2+e_3+e_4, σ_y.*dog(y)⟩ = $\sigma_{\langle e', z\rangle}$. z < σ_y.*dog(y) & |z| = 2 & e′ < e & Participant(e′,z). Putting both of these observations together, we find that all of the truth conditions in 56c hold in scenario 58.

Thus, we find that our semantics in 55 correctly predicts that sentences like 56a, containing adverbial distributive numerals, will be true both in participant-distributive and event-distributive scenarios. But what of sentences containing adnominal distributive numerals? As noted earlier, I assume that there is a second distributive suffix *-gáa*$_{\text{ADN}}$ in Tlingit, which derives adnominal distributive numerals and has the semantics in 59.

(59) Semantics for adnominal distributive numerals

$[\![\text{-gáa}_{\text{ADN}}]\!]$ =

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

Again, the proposed semantics is rather complex, but can be broken down as follows. The adnominal *-gáa* takes as argument an integer ‘n’ and an ⟨et⟩ predicate ‘Q’, supplied by the modified NP. It then takes as argument a relation ‘P’ between entities and events, and returns a predicate of events. This predicate of events holds of an event ‘e’ iff (i) there is an ‘x’ such that Q(x) holds, and the relation P holds between x and e, and (ii) the pair ⟨e, x⟩ is the sum of those pairs ⟨e′, y⟩ such that (i) y is a proper part of x, and (ii) y is a plurality of cardinality of n, (iii) e′ is a proper part of e, and (iv) y is a participant in e′.

As before, we can clarify the content of this proposal through an illustrative example. Consider sentence 60a below. Given generalization 25, this sentence contains an adnominal distributive numeral. I assume that this sentence receives the simple, ‘surface-faithful’ LF structure in 60b, where the NP marked by the distributive numeral remains in situ within the *v*P. With this LF, the semantics in 59 predicts the truth conditions in 60c.

(60) The compositional semantics of adnominal distributive numerals

a. Tlingit sentence

Ax̲ k̲áa yátx’i **nás’gigáa** x̲áat has aawasháat. (C)

my male children **three.DIST** fish PL.3O.PFV.3S.catch

b. LF structure

[$_S$ ∃e [$_{vP}$ ax̲ k̲áa yátx’i [$_{vP}$ *v* [$_{VP}$ [**nás’gigáa** x̲áat] has aawasháat]]]]

c. Predicted truth conditions

$\exists e.\ \exists x.\ {*}\text{fish}(x)\ \&\ {*}\text{caught}(e)\ \&\ {*}\text{Agent}(e) = \sigma_y.{*}\text{my.son}(y)\ \&\ {*}\text{Theme}(e) = x\ \&\ \langle e, x\rangle = \sigma_{\langle e', z\rangle}.\ z < x\ \&\ |z| = 3\ \&\ e' < e\ \&\ \text{Participant}(e',z)$

‘There are some fish x such that my sons (cumulatively) caught x, and x is the proper sum of triplets of things that took part in the catching.’

As before, we can read the truth conditions in 60c informally as follows: there is a (plural) event e of catching, whose agent is my sons and whose theme is a bunch of fish x, and the pair consisting of e and x is the sum of those pairs ⟨e′, z⟩ such that z is a triplet of fish, e′ is a part of e, and z participates in e′. Mulling this over a bit, we find that this is equivalent to the claim that my sons cumulatively caught a bunch of fish, and the fish they caught can be broken down into triplets, each of which is the theme of some subevent of the larger catching event.

Importantly, these predicted truth conditions will again hold in both participant-distributive and event-distributive scenarios. Consider first the participant-distributive scenario in 35a, repeated below.

(61) Participant-distributive scenario: My sons Tom and Ben went fishing. Tom caught three fish; Ben did too.

CATCHINGS	AGENT	THEME
e_1	Tom	$fish_1$ + $fish_2$ + $fish_3$
e_2	Ben	$fish_4$ + $fish_5$ + $fish_6$

Intuitively, in this scenario, there is indeed an event $e_1 + e_2$ of my sons cumulatively catching a bunch of fish, $fish_1 + fish_2 + fish_3 + fish_4 + fish_5 + fish_6$. Moreover, this sextuplet of fish can be broken down into triplets, each of which participated in some subevent of $e_1 + e_2$. Thus, under our informal characterization of the truth conditions in 60c, they indeed hold in scenario 61. We can also show the validity of 60c in 61 in more formal detail. As the reader can confirm, the event $e_1 + e_2$ witnesses the first subpart of the truth conditions in 60c: $\exists$e. $\exists$x. *fish(x) & *caught(e) & *Agent(e) = σ_y.*my.son(y) & *Theme(e) = x. Now consider the pair $\langle e_1{+}e_2,\ fish_1{+}fish_2{+}fish_3{+}fish_4{+}fish_5{+}fish_6\rangle$. This pair is indeed the sum of the pairs $\{\langle e_1,\ fish_1{+}fish_2{+}fish_3\rangle, \langle e_2,\ fish_4{+}fish_5{+}fish_6\rangle\}$. Moreover, the reader can confirm that this set of pairs is equal to the set $\{\langle e', z\rangle : z < fish_1{+}fish_2{+}fish_3{+}fish_4{+}fish_5{+}fish_6\ \&\ |z| = 3\ \&\ e' < e_1{+}e_2\ \&\ \text{Participant}(e',z)\}$. Thus, we find that the equation '$\langle e_1{+}e_2,\ fish_1{+}fish_2{+}fish_3{+}fish_4{+}fish_5{+}fish_6\rangle = \sigma_{\langle e',\, z\rangle}.\ z < x\ \&\ |z| = 3\ \&\ e' < e\ \&\ \text{Participant}(e',z)$' holds, and so the entire existential formula in 60c is witnessed by $e_1 + e_2$ and $fish_1 + fish_2 + fish_3 + fish_4 + fish_5 + fish_6$.

Having seen that we predict 60a to be true in participant-distributive scenarios, let us now consider the event-distributive scenario in 36a, repeated below.

(62) Event-distributive scenario: Every day last week, my sons went out fishing. Every day, they together caught a total of three fish.

CATCHINGS	AGENT	THEME
e_1	Tom + Ben	$fish_1$ + $fish_2$ + $fish_3$
…	…	…
e_7	Tom + Ben	$fish_{19}$ + $fish_{20}$ + $fish_{21}$

Again, in this scenario, there is indeed an event $e_1 + \ldots + e_7$ of my sons cumulatively catching a bunch of fish, $fish_1 + \ldots + fish_{21}$. Moreover, this plurality of fish can be broken down into triplets, each of which participated in some subevent of $e_1 + \ldots + e_7$. It is apparent that under our informal reading of 60c, those truth conditions hold in the event-distributive scenario above. We could again show in more formal detail that those truth conditions hold in 62, but in the interest of space, this is left aside here.

In summary, we have seen that our semantic analysis of distributive numerals in 55 and 59 correctly predicts the core pattern in 35 and 36: the syntactic attachment site of the distributive numeral has no effect upon whether the sentence can describe event-distributive or participant-distributive scenarios. Furthermore, it is important to note that under our analysis, the ability for sentences with distributive numerals to describe both kinds of distributive scenarios is NOT a case of ambiguity (cf. Gil 1982, Oh 2001, 2005, Zimmermann 2002, Balusu 2006, Champollion 2012). Rather, such sentences simply receive truth conditions that are general enough to hold in both kinds of distributive scenarios. To put the matter more acutely, our semantics in 55 and 59 predicts that a sentence containing the phrase *n-g̱áa NP* will be true if there is a plural event that can be divided up into (proper) subevents, each of which contains *n NP*s in it. Thus, our semantics most directly predicts the truth of such sentences in event-distributive scenarios. Crucially, however, participant-distributive scenarios can themselves actually be viewed as a special SUBCASE of event-distributive scenarios. That is, participant-distributive scenarios are simply event-distributive scenarios where each of the key subevents contains an atomic member of some other plural participant in the event. In this way, a semantics that guarantees that distributive numeral sentences are true in event-distributive scenarios will also capture their truth in participant-distributive ones. Consequently, the proposed analysis—unlike previous accounts—is able to capture the core facts in 3–4 without mapping sentences like 3b to multiple sets of truth conditions, and without having to appeal to a type ambiguity in the *DIST* operator (cf. Oh 2001, 2005) or give up the common assumption that events and entities are of distinct semantic types (cf. Zimmermann 2002, Champollion 2012).

Thus far, we have seen how the semantics in 55 and 59 operates, and how it derives the key facts in 35 and 36. In the following subsection, we see that this semantics can also capture a variety of other facts observed for Tlingit distributive numerals.

5.3. OTHER KEY FEATURES OF TLINGIT DISTRIBUTIVE NUMERALS. Although our semantics predicts that Tlingit sentences with distributive numerals can in principle describe both event-distributive and participant-distributive scenarios, we saw at the end of §4 that there are certain sentence types in the language that describe only event-distributive scenarios. Interestingly, our semantics in 55 and 59 predicts this range of facts.

First, let us consider sentences like 37 above, which contain only one plural NP. As shown below, our semantics predicts such sentences to have the truth conditions in 63c.

(63) Transitive sentence with a distributive numeral and only one plural argument

a. A<u>x</u> yéet **nás'gigáa** <u>x</u>áat aawasháat. (C)
my son **three.DIST** fish 3O.PFV.3S.catch
'My son caught three fish each time.'

b. LF: $[_S\ \exists e\ [_{vP}$ [a<u>x</u> yéet] $[_{vP}\ v\ [_{VP}$ [**nás'gigáa** <u>x</u>áat] aawasháat]]]]

c. Predicted truth conditions
$\exists e.\ \exists x.$ *fish(x) & *caught(e) & *Agent(e) = my.son & *Theme(e) = x &
$\langle e, x\rangle = \sigma_{\langle e', y\rangle}.\ y < x\ \&\ |y| = 3\ \&\ e' < e$ & Participant(e′,y)

As should now be familiar to the reader, the truth conditions in 63c state that there is a plural event e of my son catching some fish x, and the group of fish x can be divided into triplets, each of which participated in some subevent of e, the larger catching event. Clearly, these truth conditions will hold in an event-distributive scenario where there are multiple events of my son catching three fish. Moreover, it is also clear that there is no comparable participant-distributive scenario where these truth conditions hold, simply because the only participant in the plural event of catching besides the fish 'x' is the atomic individual 'my son'.

For similar reasons, our semantics predicts that intransitive sentences containing distributive numerals, such as 38 above, will only describe event-distributive scenarios.

(64) Intransitive sentence with a distributive numeral

a. **Dá<u>x</u>gaaná<u>x</u>** shaax'wsáani has aawal'é<u>x</u>. (C)
two.DIST.HUM girls PL.PFV.3S.dance
'Girls danced in twos.'

b. LF: $[_S\ \exists e\ [_S$ [**dá<u>x</u>gaaná<u>x</u>** shaax'wsáani] $[_{vP}\ v\ [_{VP}$ has aawal'é<u>x</u>]]]]

c. Predicted truth conditions
$\exists e.\ \exists x.\ {*}girl(x)\ \&\ {*}danced(e)\ \&\ {*}Agent(e) = x\ \&$
$\langle e, x\rangle = \sigma_{\langle e', y\rangle}.\ y < x\ \&\ |y| = 2\ \&\ e' < e\ \&\ Participant(e',y)$

As the reader can again confirm, the truth conditions in 64c state that there is a plural event e of some girls x dancing, and the group of girls x can be divided up into pairs, each of which participated in some subevent of e. As with 63c, these truth conditions will hold in an event-distributive scenario where there are multiple events of two girls dancing. However, given that there is no other participant in the plural event e besides the girls, it is not possible to imagine a participant-distributive scenario where 64c holds.

Finally, let us consider sentences like 39 above, which contain multiple distributive numerals. As shown below, such sentences are predicted to have the LF in 65b, and thus the truth conditions in 65c.

(65) Transitive sentence with two distributive numerals
a. **Dáx̲gaanáx̲** shaax'wsáani **nás'gig̲áa** keitl has aawashúch. (C)
two.DIST.HUM girls **three.DIST** dog PL.3O.PFV.3S.bathe
'Each time, two girls bathed three dogs.' *or* 'Girls in twos bathed dogs in threes.'
b. LF: $[_S\ \exists e\ [_{vP}$ [**dáx̲gaanáx̲** shaax'wsáani] $[_{vP}\ v\ [_{VP}$ [**nás'gig̲áa** keitl] has aawashúch] …]
c. Predicted truth conditions
$\exists e.\ \exists x.\ {*}girl(x)\ \&\ \exists z.\ {*}dog(z)\ \&\ {*}bathe(e)\ \&\ {*}Agent(e) = x\ \&\ {*}Theme(e) = z\ \&$
$\langle e, x\rangle = \sigma_{\langle e', y\rangle}.\ y < x\ \&\ |y| = 2\ \&\ e' < e\ \&\ Participant(e',y)$
$\langle e, z\rangle = \sigma_{\langle e', u\rangle}.\ u < z\ \&\ |u| = 3\ \&\ e' < e\ \&\ Participant(e',u)$

The predicted truth conditions in 65c are rather complex, but basically amount to the following informal statement: (i) there is a plural event e of a group of girls x (cumulatively) bathing a group of dogs z, and (ii) x can be divided up into pairs, each of which participated in some subevent of e, and (iii) z can be divided up into triplets, each of which participated in some subevent of e. Thus, as the reader can confirm, the truth conditions in 65c will hold in a scenario like the one sketched in 66.

(66) Event-distributive scenario validating 65c

BATHINGS	AGENT	THEME
e_1	Linda + Anne	Sparky + Rex + Spot
e_2	Sue + Jen	Fido + Lucky + Lassie
e_3	Peggy + Mary	Ruffles + Toto + Sparkles

In this scenario, there is a plural event $e_1 + e_2 + e_3$ whose agent is a group of girls (Linda + Anne + Sue + Jen + Peggy + Mary), and whose theme is a group of dogs (Sparky + Rex + Spot + Fido + Lucky + Lassie + Ruffles + Toto + Sparkles). Moreover, it is clear that the group of girls can be divided into pairs, each of which participated in some subevent of $e_1 + e_2 + e_3$, and that the group of dogs can be divided into triplets, each of which participated in some subevent of $e_1 + e_2 + e_3$. Thus, the truth conditions in 65c indeed hold in this event-distributive scenario. Furthermore, note that those truth conditions require each subevent of $e_1 + e_2 + e_3$ to contain a PLURALITY of girls and dogs. Consequently, it is not possible for each such subevent to contain an ATOMIC member of some participant in the larger event $e_1 + e_2 + e_3$, and so there is no participant-distributive scenario where 65c will hold true.

In this way, our semantics is able to predict the key facts in 37–39. It is also able to predict certain, more fundamental features of distributive numerals. First, given the lexical entries in 55 and 59, the inability of distributive numerals to modify demonstrative DPs (18) follows from simple type-theoretic considerations. Under the natural assumption that demonstrative DPs are of type *e*, the impossibility of 18b follows from the fact that adnominal distributive numerals must combine with an expression of type ⟨et⟩ (59). Similarly, under the assumption that demonstratives are themselves of type ⟨et, e⟩ the impossibility of 18a follows from the fact that NPs modified by distributive numerals are of type ⟨⟨e, εt⟩⟨εt⟩⟩. Finally, as the reader can confirm, the lexical entries in 55 and 59 both entail that the distributive suffix *-gáa* will affix only to numerals, and never to NPs (26b) or other cardinality predicates (26c).

Let us also consider again the very defining properties of distributive numerals.

(67) Distributive numeral: A morphosyntactic construction containing a numeral, whereby (i) the sentence as a whole receives a distributive reading, and (ii) under the allowable readings, the numeral contained within the construction must be interpreted as if it is within the scope of a distributive operator.

As we now see, this range of properties follows directly from our semantics in 55 and 59. First, let us consider the property in (i): sentences with distributive numerals must receive distributive readings. It is easy to see that our semantics predicts the contraposition of this statement: sentences with distributive numerals cannot receive collective or cumulative readings. To see why, consider again the contrast between 27a and 27b. Importantly, in the collective scenario under 27, there are exactly two dogs that are washed. However, sentence 27b, containing the distributive numeral, will receive the truth conditions in 68.

(68) Truth conditions of sentence 27b

$\exists e.\ \exists x.\ {}^*dog(x)\ \&\ {}^*bathe(e)\ \&\ {}^*Agent(e) = \sigma_y.{}^*girl(y)\ \&\ {}^*Theme(e) = x\ \&$
$\langle e, x\rangle = \sigma_{\langle e', z\rangle}.\ z < x\ \&\ |z| = 2\ \&\ e' < e\ \&\ Participant(e',z)$

'There are some dogs x such that those girls (cumulatively) bathed x, and x is the proper sum of pairs of things that took part in the bathing.'

Note that, according to these truth conditions, there is a plurality x that contains pairs of dogs z as proper parts. Consequently, the truth conditions above will only hold in scenarios that have more than two dogs, and so could not hold in a collective scenario like that in 27.

More generally, one can see that our semantics predicts that any sentence containing the distributive numeral '*n-gáa*' will only be true in scenarios where there are more than *n* things satisfying the associated NP. After all, as the reader can confirm, our semantics in 55 and 59 will entail that there is a plurality of NPs x with multiple proper subgroups y of cardinality *n*, each of which participate in some subevent e′ of a larger event e. Thus, there must be more than *n* NPs participating in the larger event e. However, a collective or cumulative reading of a sentence containing the plain numeral *n* will necessarily be true in scenarios containing only *n* such things. Therefore, it follows that a sentence with a distributive numeral '*n-gáa*' will not allow for the collective or cumulative readings observed for sentences with the plain numeral *n*.

For exactly these reasons, the second defining property under 67 also follows: a sentence containing the distributive numeral '*n-gáa*' will be interpreted as if the numeral *n* falls within the scope of a distributive operator. To begin, note that if a numeral *n* falls within the scope of a distributive operator—like the numeral *two* in 33—then the resulting truth conditions will hold if there are more than *n* things satisfying the associated NP. In this way, the interpretation yielded by our semantics is akin to one where the numeral modified by *gáa* falls within the scope of a distributive operator. Moreover, if a numeral *n* scopes above a distributive operator—like the numeral *three* in 33—then the resulting truth conditions hold if there are exactly *n* things satisfying the associated NP. For this reason, then, our proposed semantics predicts that distributive numerals will not have an interpretation akin to such wide-scope numerals. Finally, note that although our analysis predicts this core characteristic of distributive numerals, IT DOES NOT ACTUALLY MAKE USE OF THE DISTRIBUTIVE OPERATOR IN 2, unlike prior accounts (Oh 2001, 2005, Zimmermann 2002).[19] Consequently, this analysis avoids the key technical challenges surrounding the use of operators like 2 in the analysis of distributive numerals, that is, (i) the apparent mismatch between the surface location of the numeral and the scope of the distributive operator, and (ii) the need for a type ambiguity in the operator to obtain both the construals in 4.

To close this section, let us now consider the fact that, like many languages with distributive numerals, obtaining either a distributive or an inverse-scope reading in Tlingit requires the presence of such numerals (29, 30, 34). First, it is natural to assume that, like all people, speakers of Tlingit have a strong comprehension bias for 'surface-level' parses, and against parses that employ covert *DIST* operators like 2, or covert movement like quantifier raising (QR). Consequently, speakers will be inherently biased against distributive or inverse-scope readings of sentences with plain numerals. Furthermore, note that the inclusion of a distributive numeral can create structures that are true ONLY in the scenarios where the corresponding distributive or inverse-scope reading would hold (29, 30, 34). Therefore, if a Tlingit speaker ever wishes to unambiguously express such truth conditions, a sentence containing an overt distributive numeral is pragmatically preferable to a sentence containing plain numerals. As a result of this pragmatic pressure, speakers will be quite disinclined to interpret sentences with plain numerals as having either distributive or inverse-scope readings.

We have seen thus far that our formal semantics in 55 and 59 can account for all of the properties observed in §§3 and 4 for distributive numerals in Tlingit, as well as several fundamental characteristics of distributive numerals across languages. Furthermore, it successfully avoids the issues surrounding the approaches of Oh (2001, 2005), Zimmermann (2002), and Champollion (2012), without introducing the complex formal machinery of DPlL analyses such as Henderson 2011 and Dotlačil 2012. In §6, we see that this analysis might also offer novel treatments of certain puzzles observed in other languages containing distributive numerals. Before we come to this, however, there a few technical matters relating to the semantics in 55 and 59 that must be addressed.

5.4. SOME TECHNICAL MATTERS: PARTITIONS AND SUBPARTS. In addition to the works mentioned in n. 18, the semantics in 55 and 59 also builds upon the work of Balusu (2006) on the distributive numerals of Telugu, particularly his analysis of event-distributive construals in that language. Importantly, Balusu (2006) demonstrates that an analysis along these lines will overgenerate, unless one key addition is made. I illustrate the issue with Tlingit data parallel to the Telugu data discussed by Balusu.

To begin, our semantics in 59 will assign sentence 69a the truth conditions in 69b, which state merely that there is an event of 'girls jumping' that can be divided up into subevents of two girls jumping.

[19] It was, of course, for this reason that the definition in 1 was so carefully worded (n. 2).

(69) a. **Dá<u>x</u>gaa** shaax'wsáani kei has kawdik'én. (C)
two.DIST girls up.PL.PFV.3S.jump
'Girls jumped in twos.'

b. $\exists e.\ \exists x.\ {}^*girl(x)\ \&\ {}^*jump(e)\ \&\ {}^*Agent(e) = x\ \&$
$\langle e, x\rangle = \sigma_{\langle e', y\rangle}.\ y < x\ \&\ |y| = 2\ \&\ e' < e\ \&\ Participant(e',y)$

Balusu (2006) points out that truth conditions along these lines will be too weak. That is, they will hold in all three of the scenarios in 70 below. However, speakers report that sentence 69a is true only in scenarios 70a,b; it is rejected for scenario 70c.

(70) Events of girls jumping that can be divided into subevents of two girls jumping

a. GIRLS JUMPING TWO AT A TIME: The girls are playing a funny sort of game. They are standing in a line, and every ten seconds or so, two girls in the line jump up at the same time.
JUDGMENT: Sentence 69a is true in this scenario.

b. GIRLS JUMPING IN GROUPS OF TWO: 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.
JUDGMENT: Sentence 69a is true in this scenario.

c. GIRLS PAIRED ONLY IN TERMS OF CLOTHING: 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 who are dressed similarly are not necessarily standing anywhere near each other. Finally, the girls all count together in unison 'one, two, three'. At 'three', all the girls together jump at the same time.
JUDGMENT: Sentence 69a is NOT true in this scenario.

Readers familiar with the semantic literature on distributivity will no doubt have noticed that the basic issue here is one widely discussed throughout that literature: without some 'brakes' on how pluralities can be divided into subgroups, distributive sentences are predicted to have weaker truth conditions than they appear to have (Lasersohn 1995:134–41, Schwarzschild 1996:63–68). The solution proposed by Balusu (2006), which I also adopt here, is again one that is common in the wider literature on distributivity. In brief, Balusu proposes that the division of the event e into subevents e′ must be made relative to a contextually supplied PARTITION, and some such partitions are simply more cognitively natural than others.[20]

To begin, a partition of an event e is an exhaustive division of e into subevents e′, NONE OF WHICH OVERLAP. Stated more formally, let us introduce the notion of a 'partition function', which maps an event e into some partition of e.

(71) DEFINITION OF PARTITION FUNCTION: Let *Part* be a function from events to sets of events. *Part* is a 'partition function' if for any event e:

a. $e = \sigma_{e'}.\ e' \in Part(e)$, and

b. for any $e', e'' \in Part(e)$, there is no e''' such that $e''' \leq e'$ and $e''' \leq e''$.

[20] It should be noted, however, that most of the literature on distributivity makes use of the weaker concept of a 'cover', rather than a 'partition' (Schwarzschild 1996:64). But as we see in a moment, there are some empirical advantages to following Balusu's use of strict partitions, rather than covers.

Condition 71a states that the function *Part* maps an event e to a set of events that summed together equal e, while condition 71b states that *Part* maps e to a set of events, none of which overlap another. Thus, such a function *Part* will map events into partitions of those events.

We now assume that the meaning of a distributive numeral makes reference to some contextually salient, cognitively natural partition function. That is, like distributive operators more generally (Schwarzschild 1996:63–71), distributive numerals have a context-dependent meaning and are interpreted relative to some (cognitively natural) partition function *Part*, as roughly sketched below for adnominal *-g̱áa*.[21]

(72) Augmented semantics for adnominal distributive numerals

$[\![\text{-g̱áa}_{\text{ADN}}]\!]^{Part} =$

$[\lambda n_n : [\lambda Q_{\langle et\rangle} : [\lambda P_{\langle e,\, \varepsilon t\rangle} : [\lambda e_\varepsilon : \exists x.\ Q(x)\ \&\ P(x)(e)\ \&$
$\langle e, x\rangle = \sigma_{\langle e', y\rangle}.\ y < x\ \&\ |y| = n\ \&\ e' \in \mathit{Part}(e)\ \&\ \text{Participant}(e',y)]\ \ldots]$

The key difference between 72 and 59 above is that in 72, the pair ⟨e, x⟩ must be divisible into pairs ⟨e′, y⟩ where (crucially) e′ is a member of the partition that *Part* yields for e. Thus, 72 places a more stringent condition on the pairs ⟨e′, y⟩ making up ⟨e, x⟩ than is found in 59. To illustrate, sentence 69a is now mapped to the truth conditions in 73.

(73) Truth conditions that 72 predicts for sentence 69a

$\exists e.\ \exists x.\ {*}\text{girl}(x)\ \&\ {*}\text{jump}(e)\ \&\ {*}\text{Agent}(e) = x\ \&$
$\langle e, x\rangle = \sigma_{\langle e', y\rangle}.\ y < x\ \&\ |y| = 2\ \&\ e' \in \mathit{Part}(e)\ \&\ \text{Participant}(e',y)$

Consequently, our semantics in 72 now predicts that 69a can be interpreted as true ONLY IF there is some contextually salient, cognitively natural partition function *Part* that maps an event e of girls jumping to (nonoverlapping) subevents e′ of two girls jumping. Following Balusu (2006), we can now understand the data in 70 in the following terms. First, in scenario 70a, the function *Part* must map the event e to subevents e′, which are distinguished in terms of their time. Similarly, in 70b, *Part* must map e to subevents that are distinguished in terms of their location. It is not implausible to suppose that such partitions are rather cognitively natural, and so also generally contextually salient. In scenario 70c, however, the subevents of e that contain two girls jumping are neither temporally nor spatially distinguishable. Instead, these subevents are distinguished in terms of the style of clothes worn by participants in the event. It is not implausible to suppose that such a partition—though logically possible—is neither cognitively natural nor contextually salient. Consequently, there is no (cognitively/contextually available) function *Part* that will allow the truth conditions in 73 to hold in scenario 70c, and so sentence 69a will be rejected for this scenario.[22]

In addition to accounting for the contrasts in 70, our augmentation in 72 also resolves another related problem for the semantics in 59, noted by a referee. First, consider the scenario in 74, where my daughter bathes three dogs, one at a time.

(74) Problematic scenario for semantics in 59

INDIVIDUAL BATHINGS	AGENT	THEME
e_1	Hazel	Sparky
e_2	Hazel	Spot
e_3	Hazel	Rex

[21] Adverbial *-g̱áa* will require parallel changes in its denotation.

[22] Again, readers familiar with the broader literature on distributivity will see clear parallels to analyses making use of 'covers' in the semantics of *DIST* (Schwarzschild 1996:92–98, 123–31).

As noted by the referee, in this scenario there is an event of my daughter bathing dogs—$e_1 + e_2 + e_3$—that can be divided up into subevents of my daughter bathing two dogs. After all, $e_1 + e_2 + e_3$ is made up of the subevents $e_1 + e_2$ and $e_2 + e_3$. Consequently, the truth conditions in 75b below will hold in scenario 74. Finally, since our semantics in 59 assigns those truth conditions to sentence 75a, our account predicts that 75a should be true in scenario 74. Although I have not yet actually tested this prediction with speakers, I concur with the referee's suspicion that it is false.

(75) Semantic predictions of 59[23]

a. Ax̲ sée **dáx̲gaa** keitl aawashúch.
my daughter two.DIST dog 3O.PFV.3S.bathe
'My daughter bathed dogs in twos/two at a time.'

b. $\exists e. \exists x.$ *dog(x) & *bathe(e) & *Agent(e) = my.daughter & *Theme(e) = x &
$\langle e, x\rangle = \sigma_{\langle e', z\rangle}.\ z < x\ \&\ |z| = 2\ \&\ e' < e\ \&\ \mathrm{Participant}(e',z)$

Fortunately, however, our augmented semantics in 72 is able to avoid this (possibly) problematic prediction. Note that 72 requires the subevents e', e'' making up e to be members of a PARTITION of e. Consequently, e' and e'' cannot overlap. In scenario 74, however, all of the events of bathing two dogs overlap (e.g. $e_1 + e_2$ and $e_2 + e_3$). Therefore, there is not in 74 a PARTITION of $e_1 + e_2 + e_3$ containing events of bathing two dogs. As the reader can confirm, it thus follows that our semantics in 72 will predict 75a to be false in scenario 74, which I suspect is the case.[24]

In summary, several empirical problems for our semantics can be circumvented by tying the denotation of the distributive numeral suffix *-g̲áa* to a contextually salient partition function. Having shown the need for this addition, I nevertheless suppress it in the following sections, employing the simpler (but less accurate) semantics in 55 and 59. Before we leave this section, however, a few additional technical remarks are in order regarding the nature of the (proper) subpart relation '<' appealed to in 55, 59, and 72. First, it should be noted that, following Link (1983), this relation holds only between a plurality and the individual entities constituting the plurality. Crucially, this relation does NOT hold between an individual and its material parts (Link 1983). After all, as noted by a referee, our semantics in both 59 and 72 would otherwise wrongly predict that 75a could be true in a scenario where my daughter bathed a SINGLE dog, but did so by washing two of its body parts at a time (e.g. the left legs, then the right legs, then the ears, etc.).

Of course, this remark itself raises the question of what renders a particular collection of matter an 'individual' rather than a 'plurality'; for example, why should a particular dog count as an atomic entity rather than as a plurality of dog parts? This is an ex-

[23] I have not yet confirmed the well-formedness of sentence 75a. However, given its parallels to 37, I am confident that it is well formed.

[24] Given this line of explanation, one might well wonder about a scenario akin to 74, but where there are FOUR events of my daughter bathing a (single) dog. As the reader can confirm, even our semantics in 72 predicts 75a to be true in such a scenario. For such scenarios, however, I suspect that this is indeed an accurate prediction. Suppose, for example, that bathings e_1 and e_2 are close together in time, as are bathings e_3 and e_4, while bathings e_2 and e_3 are quite separated in time. I strongly suspect—but have not confirmed—that 75a would be true in such a scenario. Given the temporal separation between e_2 and e_3, there would be a contextually salient partition function that would map $e_1 + e_2 + e_3 + e_4$ to the partition $\{e_1{+}e_2, e_3{+}e_4\}$, and so our predicted truth conditions would hold. Finally, without the temporal separation of e_2 and e_3, we might suppose that such a partition function would no longer be cognitively natural, and so 75a would again come out false. To repeat, I have not tested any of this with speakers, but I do strongly suspect that these predictions are accurate, and I invite the reader to share that suspicion.

tremely difficult, foundational question in the semantics of plurals, and any attempt to tackle it seriously would take us too far afield. I would, however, like to quote at length a passage from Kratzer (2008), since it relates to one final matter worth discussing:

> Any serious semantics relies on domains for the basic entities that provide the building blocks for the whole repertoire of denotations … For the domains of individuals and events, the subdomains containing the atoms play a special role … Among the atoms in the domain of individuals are the cups in my cupboard, for example. Those cups have parts, of course, and sometimes we want to quantify over those parts too. Sometimes. USUALLY, WE DO NOT RECOGNIZE THE PARTS OF A CUP AS SEPARATE INDIVIDUALS … THE PARTS OF AN EVENT BEHAVE NO DIFFERENTLY. True, the individuation conditions for events are a bit looser than those of most individuals, BUT THAT DOESN'T MEAN THAT ANYTHING GOES. WE CAN'T ASSUME THAT WEIRDNESS OF PARTS SHOULD NOT PLAY A ROLE FOR EVENTS AT ALL. (Kratzer 2008:293, emphasis added)

Again, space precludes a full summary of the context for these remarks, but in brief, these comments by Kratzer are in reference to the intuitive falsity of sentence 76 in the scenario given, a fact first discussed by Winter (2000).

(76) [Scenario: Dave and Bill together are holding wheel A. At the same time, Bill and Tom together are holding wheel B.]
The boys are (each) holding a wheel.

As Kratzer (2008) notes, it is possible for the analyst to 'carve up' the scenario in 76 into subparts, one where Dave is holding wheel A, one where Bill is holding wheel A, one where Bill is holding wheel B, and one where Tom is holding wheel B. However, this need not entail that sentence 76 should be construed by speakers as TRUE in this scenario. After all, the division in question seems rather unnatural, and so the subparts in question are not likely to be recognized by speakers as separate events in the domain of events.

The reason for my mentioning Kratzer's (2008) discussion is that a referee raises a very similar issue for our semantics in 59. To begin, consider a scenario where my daughter bathes four dogs all at the same time. That is, she has Sparky, Spot, Rex, and Fido all in the tub at the same time, and she washes a bit of Sparky, then a bit of Spot, then a bit of Rex, then a bit of Fido, on and on like that until they all get clean. Following our assumptions from §5.1, we would want to say that in this scenario, there is a single event of bathing e, whose agent is my daughter and whose theme is Sparky + Spot + Rex + Fido. Furthermore, it is quite likely that speakers of Tlingit would reject sentence 75a in this scenario (though I have not yet tested this). However, as the referee points out, it seems that we can carve up the event e into subevents e′, where two dogs participate. For example, consider summing together a subevent of washing Sparky for a bit and an event of washing Rex for a bit. Consequently, it seems that our semantics in 59—and even that in 72—might wrongly predict 75a to be true in this scenario of collective bathing.

There are, though, two imaginable responses to this challenge. The first is simply to posit, following our discussion of 70c, that such a partition of this event e into such subevents e′ is not cognitively natural (nor contextually salient), and so the truth conditions predicted by our augmented semantics in 72 will fail to hold. However, we might also imagine a stronger response, akin to that of Kratzer's (2008) treatment of the facts in 76. That is, although we as analysts can 'carve up' such events of collective dog bathing into pieces where two dogs participate, such 'carvings up' do seem as unnatural as the one required to get sentence 76 true in the scenario given. Consequently, there may simply be NO subevents of such collective dog bathings where two dogs participate. If this is indeed the case, then even our semantics in 59 will continue to make the correct predictions for such scenarios. It should also be noted here that—whether or not the reader finds any of these proposed solutions entirely adequate—the issues discussed in this section are by no means peculiar to the analyses proposed in 55, 59, and 72. Rather, these are specific instances of much more general and foundational problems in the theory of plurality and event semantics.

One final issue for the analysis in 55–72 concerns the key notion that distributive numerals involve quantification over events. Under the semantics in both 55 and 59, distributive numerals must combine semantically with a relation between entities and events. Consequently, our analysis predicts that distributive numerals should only be compatible with eventive verbs like *bathe*, *catch*, *eat*, *buy*, and so forth. This raises the question of whether our account rightly—or wrongly—predicts that distributive numerals are incompatible with stative predicates, such as *know*, *love*, and *enjoy*. The compatibility of distributive numerals with statives seems to be an empirically delicate matter, and the answer may well vary from language to language (Gil 1982, Zimmermann 2002, Oh 2005). Consequently, I do not in this article address this issue head on. However, if it turns out that distributive numerals are indeed compatible with statives (in some languages), it is possible to augment the semantics in 55–72 accordingly. We could, for example, follow Bach (1986) and Parsons (2002) by introducing the notion of an 'eventuality', a type that covers both events and states. We could then trivially revise 55 and 59 so that distributive numerals combine semantically with a relation between entities and eventualities. Whether this is indeed a viable approach to distributive numerals in some languages must remain a matter for future research, but it should be clear that the semantics in 55–72 need not predict a crosslinguistic incompatibility between statives and distributive numerals.

6. CONSEQUENCES FOR DISTRIBUTIVE NUMERALS IN OTHER LANGUAGES. It has often been reported that distributive numerals and other 'distance distributives' appear to be subject to certain locality conditions. For example, Choe (1987) and Oh (2001, 2005) observe that Korean sentences like 77a, which contain a distributive numeral inside a subordinate clause, do not admit of a reading akin to 77b, and so cannot describe a scenario like 77c.

(77) Locality conditions on distributive numerals (Choe 1987, Oh 2005)

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. $\forall x.\ x \leq$ the.store.clerks & atom(x) $\rightarrow$
x said that $\exists y$. **one.balloon**(y) & the.kids bought y
'Each of the store clerks 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.'

Note that in order to obtain such a meaning, the distributive numeral would need to be interpreted as if it scoped below a distributive operator sitting within the MATRIX clause. In other words, under the impossible reading in 77b, the understood restrictor of the distributive operator is separated from the distributive numeral by a clause boundary. Put even more informally, the data in 77 show that in Korean, an NP marked by a distributive numeral can only 'distributive over' a clausemate. Zimmermann (2002) reports similar facts for parallel sentences in German.

This set of facts follows directly from our analysis in §5.2, if we assume that the Korean distributive suffix *-ssik* has the semantics of adnominal *-gáa* in 59. To begin, our account would assign to sentence 77a the LF in 78a, and so would derive the truth conditions (roughly) in 78b.[25]

(78) Predicted structure and meaning for 77a

a. $[_{S1}$ $[_{vP1}$ chemwentuli $[_{vP1}$ v $[_{VP1}$
   $[_{S2}$ ∃e $[_{vP2}$ aituli $[_{vP2}$ v $[_{VP2}$ [phwungsen **hana-ssik**] saessta] …]
   malhaessta] …]

b. said (σ_z.*store.clerk(z),
   ∃e. ∃x. *balloon(x) & *buy(e) & *Agent(e) = σ_y.*kid(y) & *Theme(e) = x
   & ⟨e, x⟩ = $\sigma_{\langle e', u\rangle}$. u < x & |u| = 1 & e′ < e & Participant(e′,u))
   'The store clerks said that
   there is an event e of the kids buying some balloons x and
   x is the sum of the individuals y that participated in some subevent of e.'

Thus, the LF in 78a will be assigned a meaning where the distributive numeral *hanassik* 'one.DIST' scopes within the subordinate clause. The resulting truth conditions will hold in either of the following scenarios: (i) the store clerks said that the kids (together) several times bought one balloon, or (ii) the store clerks said that each kid bought a balloon. Note, though, that these truth conditions will NOT hold in the scenario in 77c, where each store clerk says that the kids bought (just) one balloon.

One might wonder, however, whether 77c could be described by an LF where the NP *phwungsen hanassik* 'one.DIST balloon' undergoes QR into the matrix clause, as in 79.

(79) Impossible LF for 77a
   $[_{S1}$ [phwungsen **hana-ssik**] $[_{S1}$ 1 [chemwentuli $[_{vP1}$ v $[_{VP1}$
   $[_{S2}$ ∃e $[_{vP2}$ aituli $[_{vP2}$ v $[_{VP2}$ t_1 saessta] …] malhaessta] …]

Note, though, that the QR assumed in 79 would violate the general condition that QR is clause-bound (May 1985, 1988). Furthermore, as the reader can confirm, the truth conditions assigned to 79 would still fail to hold in 77c. Such an LF would necessarily be assigned a 'transparent' or 'de re' reading, where there is a SPECIFIC group of balloons x such that the store clerks said that the kids bought x, a condition that does not hold in scenario 77c or fit the reading sketched in 77b. In summary, then, we find that our semantics correctly predicts that 77a will not allow for a 'nonlocal' reading akin to 77b,c.

Our semantics also predicts a fascinating interaction between pluractional morphology and distributive numerals in the Mayan language Kaqchikel. As first observed by Henderson (2011), distributive numerals in Kaqchikel appear to have the exceptional ability to scope below pluractional verbal suffixes. First, consider sentences like 80a, where an NP marked by a plain numeral is argument to a verb bearing the pluractional suffix. Speakers report that such sentences are true only if the SAME book is searched for multiple times.

[25] The truth conditions in 78b obviously abstract away from the more complex intensional semantics of 'say'.

(80) Distributive numerals, pluractional morphology, and scope in Kaqchikel

a. Xinkan**ala'** jun wuj.
1sgS.searched.PA one book
'I looked for a book (various times).' (Henderson 2011)
SPEAKER JUDGMENT: True only if I looked for the SAME book multiple times.

b. Xinkan**ala'** **ju-jun** wuj.
1sgS.searched.PA **one.DIST** book
'I looked for books (various times).' (Henderson 2011)
SPEAKER JUDGMENT: True only if I looked for a different book each time.

This contrasts strikingly with a sentence like 80b, which differs only in that the NP is modified by a distributive numeral. Unlike 80a, speakers report that 80b is true only if a DIFFERENT book is searched for each time. Thus, with the plain numeral (80a), there is one book for every event of searching, whereas with the distributive numeral (80b), each event of searching involves a different book. In this sense, it seems that the numeral in 80a must 'scope above' the pluractional suffix, while in 80b it must scope below.

Henderson (2011) puts forth a detailed analysis of these and related facts in Kaqchikel, one making use of the DPlL framework (§1). According to this analysis, distributive numerals in sentences like 80b do not truly 'scope below' the pluractional affix, or differ at all in their scope from plain numerals in sentences like 80a. Rather, the semantics of the pluractional affix and the distributive numeral simply interact to produce the effect in question. While space precludes a detailed discussion of Henderson's account, it is worth noting that our semantics in 55 and 59 provides a similar explanation for the facts in 80, without making recourse to the special assumptions and complex formal machinery of the DPlL framework.

Following Lasersohn (1995) and much subsequent work, I assume the following semantics for pluractional morphology.

(81) Lasersohnian analysis of pluractional morphology (Lasersohn 1995)
$[\![\mathrm{PA}]\!] =$
$[\lambda P_{\langle \varepsilon t\rangle} : [\lambda e : |e| > n.\ \forall e'.\ e' \leq e\ \&\ \mathrm{atom}(e') \rightarrow P(e')$
$\&\ \forall e', e''.\ e', e'' \leq e\ \&\ \mathrm{atom}(e')\ \&\ \mathrm{atom}(e'') \rightarrow \neg\tau(e') \circ \tau(e'')]$

According to this semantics, a pluractional affix takes a predicate of events P as argument, and returns a predicate of events that (i) is restricted to plural events ($|e| > n$), and (ii) is true of an event e iff e is composed of many atomic events that satisfy P and do not overlap in their time.

Of course, this semantics in 81 assumes that, contrary to what is stated in 44 above, lexical verbs are pure predicates of events, as sketched in 82a. Consequently, the internal arguments of verbs must also be introduced via special syntactic heads akin to little-*v*. For our discussion here, I assume the head in 82b.[26]

(82) Slight changes to background semantic assumptions

a. Verbs are predicates of events: $[\![\mathrm{search}]\!] = [\lambda e : {*}\mathrm{search}(e)]$
b. Head introducing theme: $[\![\mathrm{Th}]\!] = [\lambda x : \lambda e : {*}\mathrm{Theme}(e) = x]$

With these semantic assumptions in place, the plain numeral sentence in 80a will receive the LF in 83a, and thus the truth conditions in 83b.

[26] The reader is invited to confirm that these changes in no way impact the results from §5.

(83) Truth conditions derived for sentence 80a

a. LF structure

$[_S \exists e\ [_S\ [\text{jun wuj}]\ [_S\ 1\ [_{vP}\ \textit{pro}_{1sg}\ [_{vP}\ v\ [_{VP}\ [_V\ \text{xinkan PA}]\ [_{ThP}\ \text{Th}\ t_1]\ \ldots]$

b. Truth conditions

$\exists e.\ \exists x.\ {}^*\text{book}(x)\ \&\ |x| = 1\ \&\ {}^*\text{Agent}(e) = \text{speaker}\ \&\ {}^*\text{Theme}(e) = x\ \&$
$|e| > n\ \&\ \forall e' \leq e\ \&\ \text{atom}(e') \rightarrow {}^*\text{search}(e')\ \&$
$\forall e', e''.\ e', e'' \leq e\ \&\ \text{atom}(e')\ \&\ \text{atom}(e'') \rightarrow \neg\tau(e') \circ \tau(e'')$

'There is a (plural) event e, whose agent is the speaker, and whose theme is a book x,
and e is composed of many atomic events e′ of searching,
and these atomic events of searching do not overlap in their time.'

The truth conditions in 83b state that there is a plurality of searching events e whose cumulative theme is a single book x. It follows, then, that this book x must also be the theme of the individual searching events contained in e. Therefore, we correctly predict that 80a will be true only if the same book is searched for multiple times.

Now let us consider the distributive numeral sentence in 80b. Given our assumptions above, it will receive the LF structure in 84a and so the truth conditions in 84b.

(84) Truth conditions derived for sentence 80b

a. LF structure

$[_S \exists e\ [_{vP}\ \textit{pro}_{1sg}\ [_{vP}\ v\ [_{VP}\ [_V\ \text{xinkan PA}]\ [_{ThP}\ \text{Th}\ [\text{jun-}\textsc{dist}\ \text{wuj}]]\ \ldots]$

b. Truth conditions

$\exists e.\ \exists x.\ {}^*\text{book}(x)\ \&\ {}^*\text{Agent}(e) = \text{speaker}\ \&\ {}^*\text{Theme}(e) = x\ \&$
$|e| > n\ \&\ \forall e' \leq e\ \&\ \text{atom}(e') \rightarrow {}^*\text{search}(e')$
$\&\ \forall e', e''.\ e', e'' \leq e\ \&\ \text{atom}(e')\ \&\ \text{atom}(e'') \rightarrow \neg\tau(e') \circ \tau(e'')$
$\&\ \langle e, x\rangle = \sigma_{\langle e', y\rangle}.\ y < x\ \&\ |y| = 1\ \&\ e' < e\ \&\ \text{Participant}(e', y)$

'There is a (plural) event e, whose agent is the speaker, and whose theme is a group of books x,
and e is composed of many atomic events e′ of searching,
and these atomic events of searching do not overlap in their time,
and x is the sum of all the individuals y that participate in a subevent of e.'

As the informal paraphrase in 84b indicates, the predicted truth conditions will hold if there is a plurality of searching events e, whose cumulative theme is a group of books x, and x can be divided up into individuals, each of which is theme to some subevent of e. Therefore, these truth conditions will hold in a scenario like 85a, where many different books are searched for.

(85) Scenarios verifying and falsifying 80b

a. Verifying scenario

SEARCHINGS	AGENT	THEME
e_1	speaker	book_1
e_2	speaker	book_2
e_3	speaker	book_3

b. Not a verifying scenario

SEARCHINGS	AGENT	THEME
e_1	speaker	book_1
e_2	speaker	book_1
e_3	speaker	book_1

Furthermore, these truth conditions will NOT hold in a scenario like 85b, where the same book is searched for multiple times. The issue is that the cumulative theme x of

$e_1 + e_2 + e_3$ is just the individual $book_1$. Therefore, since $book_1$ is an atom, there is no y such that $y < book_1$ & $|y| = 1$, and so the condition '$\langle e, x\rangle = \sigma_{\langle e', y\rangle}.\ y < x\ \&\ |y| = 1\ \&\ e' < e$ & Participant(e′,y)' in 84b will fail to hold in 85b.

Taking these results together, we find that our semantics in 55 and 59 can derive the intriguing pattern in 80 from a Lasersohnian treatment of pluractionals (81–82). Furthermore, as in the work of Henderson (2011), we do not actually view the distributive numeral in 80b as scoping below the pluractional morphology. Rather, as the LFs and truth conditions in 83–84 make clear, our account treats both the plain numeral and the distributive numeral in 80 as scoping ABOVE the pluractional affix. However, the meaning of the distributive numeral *ju-jun* 'one.DIST' in 80b independently serves to distribute 'one book' to each subevent of the larger plural event. Consequently, each such subevent will have a distinct book as its theme, which is akin to the numeral scoping below the pluractional.

We have thus seen that the analysis of Tlingit distributive numerals in §5 offers viable, novel analyses of distributive numerals in other languages as well. In the following section, we see that this analysis might also advance our understanding of the broader category of 'distance distributivity', in that it could offer a novel approach to English's binominal *each* construction.

7. A POSSIBLE EXTENSION TO 'BINOMINAL *each*' IN ENGLISH. The term 'binominal *each*' refers to the construction in 86a, where the distributive marker *each* is appended postnominally to an NP modified by a numeral (Safir & Stowell 1988, Zimmermann 2002, Champollion 2012, Dotlačil 2012).

(86) Binominal *each* in English
   a. My sons caught [three fish **each**].
   b. Apparent truth conditions
      $\forall x.\ x \leq \text{my.sons}\ \&\ \text{atom}(x) \rightarrow \exists y.\ \textbf{three.fish}(y)\ \&\ x\ \text{caught}\ y$
      'Each of my sons caught three fish.'

As has long been observed (Gil 1982), English binominal *each* seems to have all of the defining properties of a distributive numeral construction (1). After all, sentences like 86a only allow for distributive readings, ones in which the numeral participating in the construction scopes below a distributive operator (86b). However, as has also long been observed (Gil 1982), English binominal *each* differs in one key way from canonical distributive numeral constructions. As shown below, binominal *each* sentences can only describe participant-distributive scenarios like 87a; in event-distributive scenarios like 87b, such sentences are judged to be false.

(87) a. Verifying scenario for 86a

CATCHINGS	AGENT	THEME
e_1	Tom	$fish_1 + fish_2 + fish_3$
e_2	Bill	$fish_4 + fish_5 + fish_6$

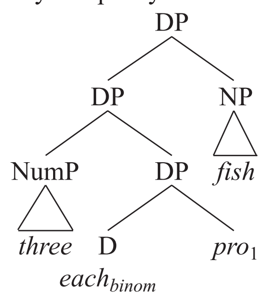
   b. Not a verifying scenario

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	$fish_7 + fish_8 + fish_9$

Ideally, an analysis of canonical distributive numerals, such as those found in Tlingit, should offer some perspective upon the semantics of English binominal *each*, as well as an explanation for the key difference between the two constructions. Let us therefore consider how our semantics in 55 and 59 might be augmented to apply to English sentences like 86a.

First, following prior authors (Zimmermann 2002, Champollion 2012, Dotlačil 2012), I assume that the binominal *each* construction contains a null pronoun, which must be bound by some higher argument within the clause (§1). That is, the phrase *three fish each* is assumed to have the structure in 88.

(88) Key morphosyntactic assumption[27]



Next, let us assume that the *each* of the binominal *each* construction has the semantics in 89b, which makes use of the ternary sum operator in 89a (cf. 43b, 53).

(89) The semantics of binominal *each*

a. Ternary sum operator

(i) Triple addition

$\langle x_1, x_2, x_3\rangle + \langle y_1, y_2, y_3\rangle =_{df} \langle x_1{+}y_1, x_2{+}y_2, x_3{+}y_3\rangle$

(ii) Ternary sum operator

$\sigma_{\langle x,\, y,\, z\rangle}.\ Q(x)(y)(z) =_{df}$

the triple $\langle \alpha, \beta, \gamma\rangle$ such that $\langle \alpha, \beta, \gamma\rangle \in {}^*\{\langle x, y, z\rangle : Q(x)(y)(z)\}$, and if $\langle \delta, \zeta, \psi\rangle \in {}^*\{\langle x, y, z\rangle : Q(x)(y)(z)\}$, then $\delta \leq \alpha$, and $\zeta \leq \beta$, and $\psi \leq \gamma$

b. Semantics for binominal *each*

$[\![\text{each}_{\text{binom}}]\!] = [\lambda z_e : [\lambda n_n : [\lambda Q_{\langle et\rangle} : [\lambda P_{\langle e,\, \varepsilon t\rangle} : [\lambda e_\varepsilon : \exists x.\ Q(x)\ \&\ P(x)(e)\ \&$
$\langle e, x, z\rangle = \sigma_{\langle e',\, y,\, s\rangle}.\ y < x\ \&\ |y| = n\ \&\ s < z\ \&\ |s| = 1\ \&$
$e' < e\ \&\ \text{Participant}(e',y)\ \&\ \text{Participant}(e',s)]\ \ldots]$

Note that the lexical entry in 89b is rather close to that given in 59 for adnominal *-gáa* in Tlingit. The key difference is that '$\text{each}_{\text{binom}}$' first takes as argument the entity z denoted by the null pronoun. Furthermore, having taken this entity z as argument, '$\text{each}_{\text{binom}}$' adds the condition that the event e can be divided into subevents e′ each of which contains n things satisfying the modified NP, and A SINGLE ATOMIC SUBPART OF THE ENTITY Z. To see the effect of this condition in greater detail, let us examine the meaning we derive for sentence 86a.

(90) Predicted truth conditions for sentence 86a

a. LF structure

$[_S\ \exists e\ [_{vP}\ [\text{my sons}]\ [_{vP}\ 1\ [_{vP}\ t_1\ [_{vP}\ v\ [_{VP}\ \text{caught [three fish each } pro_1]\ \ldots]$

b. Predicted truth conditions

$\exists e.\ \exists x.\ {}^*\text{fish}(x)\ \&\ {}^*\text{catch}(e)\ \&\ {}^*\text{Agent}(e) = \text{my.sons}\ \&\ {}^*\text{Theme}(e) = x\ \&$
$\langle e, x, \text{my.sons}\rangle = \sigma_{\langle e',\, y,\, s\rangle}.\ y < x\ \&\ |y| = 3\ \&\ s < \text{my.sons}\ \&\ |s| = 1\ \&$
$e' < e\ \&\ \text{Participant}(e',y)\ \&\ \text{Participant}(e',s)$

'There is a (plural) event e of my sons catching a group of fish x, and
e can be broken down into subevents e′ such that
three fish from x participate in e′ and ONE SON PARTICIPATES IN e′.'

[27] I remain agnostic as to how the surface order *three fish each* is to be derived from this structure.

To begin, I assume that sentence 86a can receive the LF in 90a, where the null pronoun within the binominal *each* construction is bound by the subject *my sons* (Heim & Kratzer 1998). Given this structure, our semantics in 89 yields the truth conditions in 90b. As noted above, these truth conditions can be read informally as follows: (i) there is a (plural) event e of my sons catching a group of fish x, and (ii) the event e can be broken down into subevents e′ where three fish participate AND WHERE ONE SON PARTICIPATES.

Given these truth conditions, we correctly predict that 86a will be judged true in a participant-distributive scenario like 87a above. Note that in 87a, the plural event $e_1 + e_2$ will witness the existential truth conditions in 90b. After all, this is a plural event of catching, with my sons as the (cumulative) agent, and a group of fish ($fish_1 + \ldots + fish_6$) as the (cumulative) theme. Moreover, $e_1 + e_2$ can be divided up into subevents where one son and three fish participate. Thus, our semantics captures the truth of 86a in participant-distributive scenarios. We also predict the falsity of 86a in event-distributive scenarios like 87b. Note that in that scenario, there is no subevent containing both three fish and one son, and so the truth conditions in 90b will fail to hold.

In addition to capturing the core facts in 86–87, our analysis also predicts the related fact in 91a. As has often been noted, binominal *each* in English differs from distributive numerals in that it requires there to be at least TWO plural NPs within the sentence (cf. 37).

(91) Binominal *each* requires two plural NPs
a. Ill-formed sentence: *My son caught three fish each.
b. Predicted truth conditions

$$\exists e.\ \exists x.\ {*}fish(x)\ \&\ {*}catch(e)\ \&\ {*}Agent(e) = my.son\ \&\ {*}Theme(e) = x\ \&\ \langle e, x, my.son\rangle = \sigma_{\langle e', y, s\rangle}.\ y < x\ \&\ |y| = 3\ \&\ s < my.son\ \&\ |s| = 1\ \&\ e' < e\ \&\ Participant(e',y)\ \&\ Participant(e',s)$$

As the reader can confirm, our analysis in 88–89 predicts that 91a will have the truth conditions in 91b. Importantly, the truth conditions in 91b are contradictory. Given that the singular subject *my son* denotes an atom, it follows that there is no s such that $s < my.son\ \&\ |s| = 1$, and so the truth conditions in 91b could never be satisfied. It follows, then, that speakers will perceive sentences like 91a to be anomalous (Gajewski 2009).

One final difference between binominal *each* and canonical distributive numerals concerns the possibility of inverse-scope readings. While such readings are possible for sentences containing distributive numerals (e.g. 34 above) (Zimmermann 2002, Oh 2005), binominal *each* strongly resists inverse scope, as illustrated in 92.

(92) No inverse scope with binominal *each*
a. Two flagpoles stood in front of every house. (inverse scope possible)
b. *Two flagpoles each stood in front of the houses. (inverse scope impossible)

Interestingly, this fact can be seen to follow from our core syntactic assumption in 88. Given the null pronominal within the binominal *each* construction, the only way to obtain an inverse-scope reading for 92b would be to QR the phrase *the houses* above *two flagpoles each*. However, as shown in 93, such movement would lead to a WEAK CROSSOVER configuration, and so would violate general, well-known conditions on QR.

(93) Inverse scope with binominal *each* leads to weak crossover

$[_S\ \exists e\ [_S$ [the houses] $[_S$ 1 $[_{vP}$ [two flagpoles each pro_1] $[_{vP}\ v\ [_{vP}$ stood in front of t_1] …]

weak crossover configuration

8. Conclusion. The principal empirical focus of this article has been the distributive suffix *-gáa* of Tlingit. We have seen that the expressions derived by this suffix are aptly labeled as 'distributive numerals' or 'distance distributives'. Moreover, we have seen that such expressions can, like distributive numerals in other languages, attach either adnominally or adverbially. Furthermore, sentences containing distributive numerals appear at first glance to be ambiguous, in that they can describe either participant-distributive or event-distributive scenarios.

While similar facts in other languages have been treated as cases of ambiguity, we have seen that it is possible to provide a univocal semantics for Tlingit *-gáa*, one that yields truth conditions broad enough to cover both participant- and event-distributive scenarios. This semantics also captures a number of additional features of Tlingit distributive numerals, ones that have been widely observed for distributive numerals in other languages. Importantly, the proposed semantics makes no actual use of distributive operators akin to that in 2, and thereby avoids several key problems that arise for analyses making use of such operators (Oh 2001, 2005, Zimmermann 2002, Champollion 2012). Furthermore, the proposed semantics is based entirely on relatively simple and commonplace assumptions about the syntax-semantics interface (§5.1), in contrast to prior accounts making use of the DPlL framework (Henderson 2011, Dotlačil 2012). It should therefore be noted that the proposed semantics in turn provides additional, indirect support for those assumptions, which have proven so crucial to our broader understanding of the semantics of plurality (Kratzer 2003, 2008).

It seems, then, that the general approach taken here might also yield viable analyses of distributive numerals across many languages. In support of this, we have seen that our semantics can offer novel answers to puzzles surrounding distributive numerals in Korean, German, and Kaqchikel. For Korean and German, our account straightforwardly predicts certain 'locality effects' observed for distributive numerals. In the case of Kaqchikel, the proposed semantics provides an elegant explanation for the observed interactions between distributive numerals and pluractional morphology. Finally, we have seen that a slight augmentation of our semantics can capture the distinctive properties of the English binominal *each* construction, including its intolerance for inverse-scope readings.

Of course, much work remains to be done before the semantics developed here could be viewed as a general theory of distance distributivity. One difficult puzzle for future research concerns a phenomenon that might be labeled 'distributive concord'. As documented by Oh (2005), it is possible for distributive numerals in Korean to appear within the scope of the distributive marker *kakkak* 'each'. As illustrated in 94, in such sentences, the presence of the distributive suffix *-ssik* is felt to contribute nothing to the overall truth conditions, but in some sense simply 'reinforces' the distributivity contributed by *kakkak* 'each'.

(94) 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.'

A similar phenomenon can be observed in English, as noted by Brasoveanu and Henderson (2009), Szabolcsi (2010), and Dotlačil (2012). Note that in sentences like the following, the distributive determiner *each* is somewhat redundant, and seems only to reinforce the distributive contribution of *one by one*.

(95) Interaction between *one by one* and *each* in English
One by one, each student read a poem.

Like most other theories of distance distributivity (Zimmermann 2002, Champollion 2012, Dotlačil 2012; but cf. Oh 2001, 2005, Brasoveanu & Henderson 2009), the semantics developed here cannot directly account for the reported meanings of 94 and 95. However, the failure here need not necessarily lie in the proposed semantics for distance distributives, but could instead indicate that a more sophisticated semantics is needed for the distributive markers *kakkak* and *each*. At any rate, the exact consequences that such 'distributive concord' holds for the account proposed here constitute an important problem for future research along these lines.

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