Dependent pluractionality in Piipaash (Yuman)*

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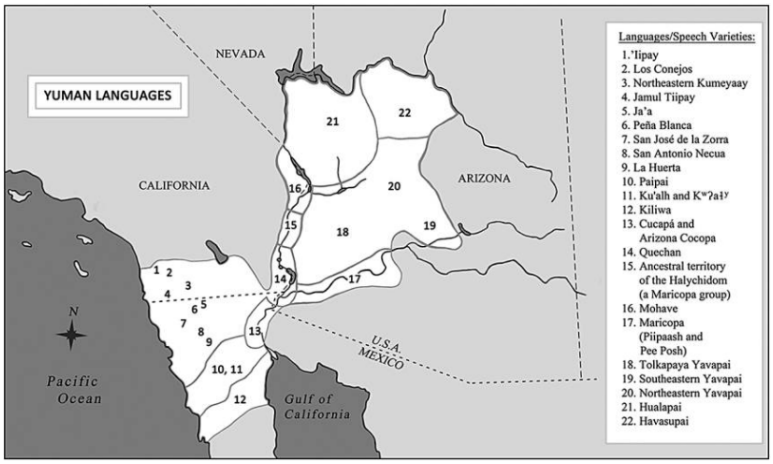
1 Introduction

Yuman is a family of Indigenous languages spoken in Arizona, Southern California, Baja California, and Northern Sonora.



Miller 2018, p. 387

Piipaash is an Indigenous language spoken in Arizona in two communities: Salt River Pima-Maricopa Indian Community (SRPMIC) and Gila River Indian Community (GRIC) along side the Akimel O'odham community, see circled in (3) for map of both nations.

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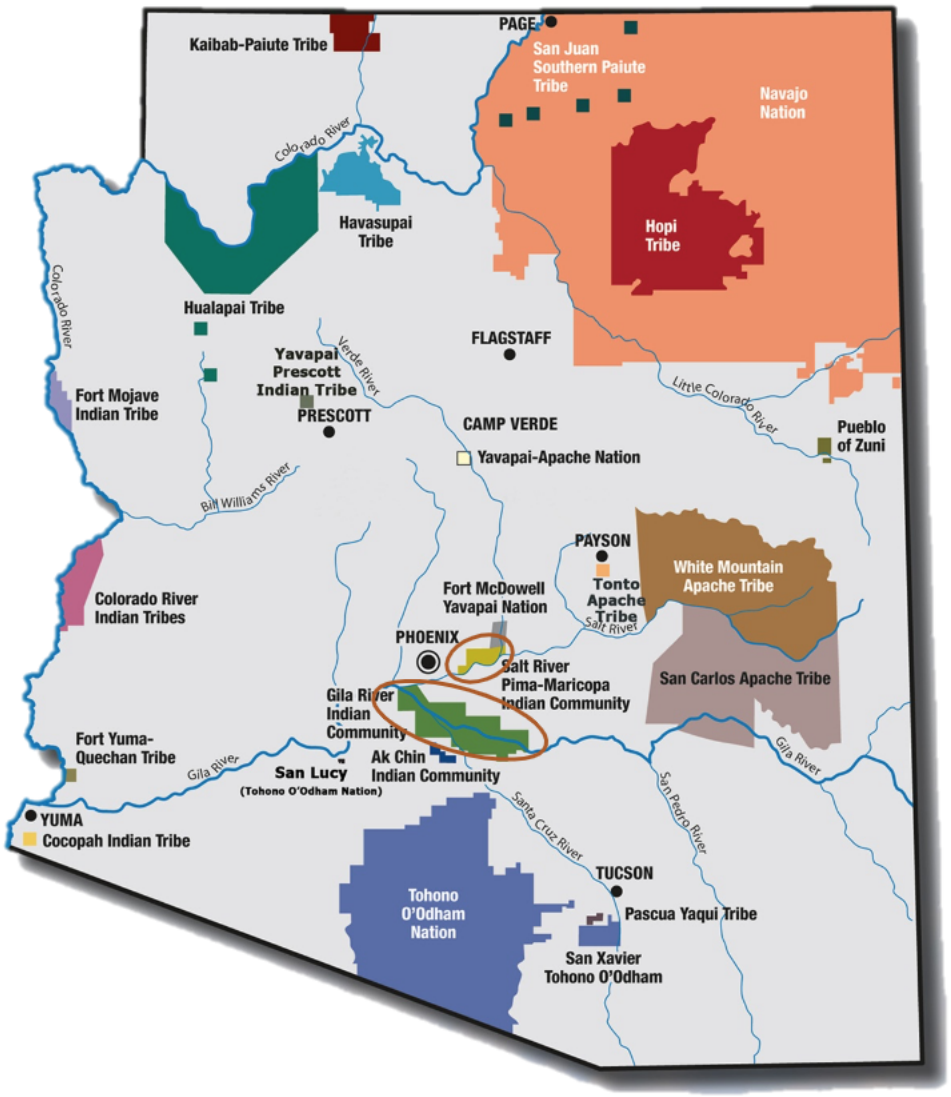


Piipaash has what, at first pass, look like standard dependent indefinites (e.g., Balusu 2006; Farkas 1997; Henderson 2014).

- In the following example, the affix *-xper-*, traditionally glossed 'each', occurs on a numeral that co-varies in the scope of a distributively interpreted subject—i.e., for each of Pam and Heather there is a distinct set of three pieces of bread she ate.

(1) Pam-sh Heather-m uudav-k paan xmuk-**xper**-m mash-k
Pam-NOM Heather-ASC accompany-ss bread three-**each**-DS eat.DU-REAL
'Pam and Heather each ate three pieces of bread.' (Gordon, 1986, p. 99)

Looking more broadly we see that *-xper-* has a wider distribution than markers of dependent indefinites in other languages discussed in the literature, and this introduces puzzles.

Puzzle 1: (1) shows that *-xper-* can mark dependent numerals. It can also mark verbs to yield the same effect. In (2) *-xper-* appears on *tuuwamp* 'turn' and marks the event argument as dependent. It must co-vary in the scope of the subject—i.e., for each there is a distinct event of turning it.

(2) mat-cham-k kwnyminy-m tuuwamp-**xper**-k
REFL-all-SS different-DS turn.PL-**each**-REAL
They all turned it around separately (Gordon, 1986, p. 144)

How do we account for this apparently cross-categorical effect in a unified way, given that most previous accounts of dependent indefinites in languages like Telugu, Hungarian, Kaqchikel, etc., involve morphology restricted to numerals / indefinite quantifiers? (though see Pasquereau (2019, 2021))

Puzzle 2 (Gil's Puzzle): In Gil's 1982 dissertation he correctly notes that *-xper-* marks distributive shares (i.e., expressions that co-vary in the scope of the distributive operator) across a variety of expressions.

- In that same work, Gil also notes an apparent counterexample to this generalization, which he never solves.
- In particular, *-xper-* can appear on certain coordinations, where the coordinated nominals are interpreted as the distributive key.

(3) John-sh Bill-sh nyi-dush-**xper**-k 'ii xmok-m paaysh-k
John-NOM Bill-NOM PL.OBJ-be.DU-each-SS stick three.SG-DS carry.DU-REAL
John and Bill each carried three sticks. (Gil, 1982, p. 281, ex. 35c)

Here the existential verb, embedded under the subject, bears *-xper-*.

- Such examples disturbed Gil because *-xper* is inside the subject DP, yet this sentence has a similar interpretation as (1), where *-xper-* marks the object DP.
- We should only mark the latter if *-xper-* marked expressions co-varying under a distributively interpreted expression, not distributively interpreted expressions themselves.

Solution: *-xper-* involves a novel kind of pluractionality that we dub *dependent pluractionality*

- In particular,
  - While in most previously discussed languages the relevant morphology marks an **individual variable** as dependent (i.e., the variable quantified over by a numeral or indefinite).
  - In Piipaash, *-xper-* marks an an **event variable** as dependent.
- We immediately solve Puzzle 1.

  - What accounts for this wide distribution of *-xper* compared to dependent indefinites in other languages is that in Piipaash, a wide variety of expressions are verbal, including numerals, coordination, etc., and have an event argument.

- A simple extensions solves Gil's puzzle.
  - If *-xper-* marks dependent pluractionality, it is not marking the nominal in (24), but the verb embedded under that nominal.
  - Thus, it can still be a species of share-marking where the distributively interpreted nominal subject has two shares (i) the *-xper*-marked VP it embeds as a relative clause, and (ii) the main clause VP.

2 *-xper-* as a maker of dependent pluractionality

Our core proposal, developed in this section, is that

- numerals in Piipaash can bear pluractionality (following Pasquereau (2019, 2021)'s work on Seri (isolate))
- *-xper-* is a marker of a novel species of pluractionality, which we call *dependent pluractionality*, on analogy with *dependent indefinites* (e.g., Henderson 2014; Farkas 1997, 2001, among others).

Henderson 2014 develops an account of dependent in indefinites in the Mayan language Kaqchikel (and other languages) based on the notion of post-suppositions.

(4) K-onojel x-Ø-ki-kanöj ju-jun wuj.
E3p-all CP-A3s-E3p-search-SS one-RED book
'All of them looked for a book (and at least two books were looked for).'
∗'There is a book and all of them looked for it.'

The proposal is that reduplicated indefinites like *jujun* 'one one' express two levels of cardinality in Dynamic Plural Logic (van den Berg, 1996), following ideas in Brasoveanu 2013.

(5) $\lambda P \lambda Q \exists x[\mathbf{one}(x) \wedge \overline{x > 1} \wedge P(x) \wedge Q(x)]$

H	...	x	x	...
h_1	...	$entity_1$	$entity_4 \oplus entity_5$	...
h_2	...	$entity_2$	$entity_4 \oplus entity_5$	...
h_3	...	$entity_3$	$entity_4 \oplus entity_5$	...
...	...	...	...	...

- **one**(x) requires that x denote an atomic individual, i.e., it speaks about cardinality in the domain of individuals.

- $\overline{x > 1}$, in contrast requires there be two output assignment functions that assign x to different entities, i.e., it is plural at the level of evaluation.

The latter condition can only be satisfied if the indefinite is interpreted in the scope of a distributivity operator. Why?

- Such operators introduce a plurality of plurality of assignment functions—one for each restrictor entity.
- Each of these assignments must individually make the scope formula true
- Providing an environment in which the dependent x can get multiple values.

> **Note:** We are not necessarily wedded to this particular dynamic postsuppositional account. We could, for instance, use a Charlow (to appear)-style higher order dynamic generalized quantifier approach to post-suppositions, or a completely different account of dependent indefinites. Our main goal here is to draw parallels between *-xper-* and other known kinds of dependent expressions.

We can run the same kind of analysis for *-xper-*, but recognizing that *-xper-* is a pluractional marker (following the analysis of a similarly transcategorial marker in Seri (isolate; Pasquereau 2019, 2021)).

- This means that *-xper-* should count events in output sets of assignments.
- Because events require a counting criterion, we add a parameter to the <-symbol.
- We let the Θ parameter be set contextually (because *-xper-* can target different theta roles, but we could set this compositionally if the pluractional were a theta role modifier.)

(6) $e >_\Theta 1 =_{def} |\{\Theta(e') : e' \in G(e\}| < 1$
'The variable e stores more than one event across a set of assignment G just in case it stores at least two events that differ on Θ.'

(7) *-xper-* $\rightsquigarrow \lambda V \lambda e[V(e) \wedge \overline{e >_\Theta 1}]$

- Note that counting verbs in this way predicts that *xper*-marked verbs should only involve participant pluractionality, which is the case—i.e., we don't *-xper-* being licensed by adverbial quantifiers over events.

Let's start with the case where *-xper-* targets a main-clause verb. This is the simplest case for the proposed analysis, which we can extend out to all the other cases to provide a unified analysis.

(8) mxaa-sh ashuuvar-xper-k
boys-NOM 3.sang.PL-each-REAL
'Some/the boys each sang.' (Gil, 1982, p.271 ex. 24)

If we take the stem *ashuuvar* 'sing' to denote a predicate of events, its *-xper-* form would be predicate of events that are evaluation plural.

(9) $\textit{ashuuvar-xper-k} \rightsquigarrow \lambda e[\textsc{sing}(e) \wedge \overline{e >_{\textsc{ag}} 1}]$

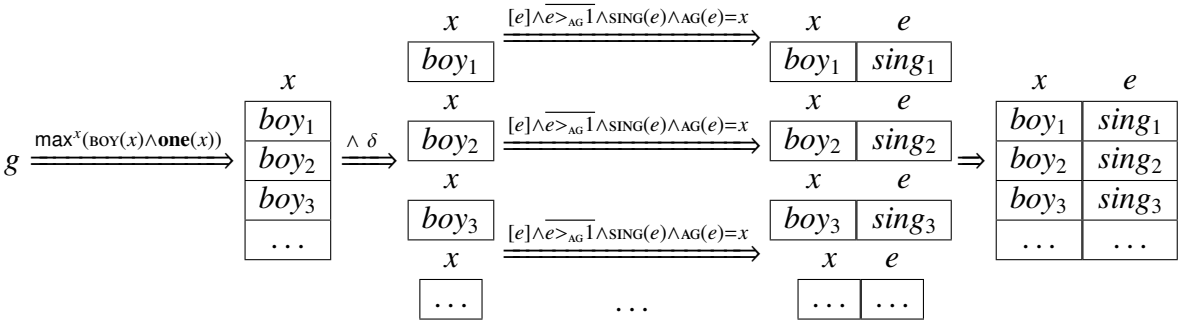
The result is a verb stem that must be existentially closed before being placed in the scope of a distributive operator. In this way, conditions like $\overline{e >_{\textsc{ag}} 1}$ act like powerful filters on representations.

- The filter can be met in sentences like (8) because Piipaash allows the covert distributive interpretation of subjects, like the following.

(10) kafe '-sish-k pastel '-mash-k
coffee 1-drink.DU-SS pie 1-eat.DU-REAL
'We (two) drank coffee and ate pie.' (Gordon, 1986, p. 116)

This means that (8) can be interpreted as in (11).

(11) $\forall x[x \leq \sigma y.{*}\textit{boy}(y) \wedge \textbf{one}(x) \rightarrow \exists e[\textsc{sing}(e) \wedge \overline{e >_{\textsc{ag}} 1} \wedge \textsc{ag}(e) = x]]$
'True just in case for every atomic boy, there is a singing event he is agent of, and at there are at least two such events (with different agents).'



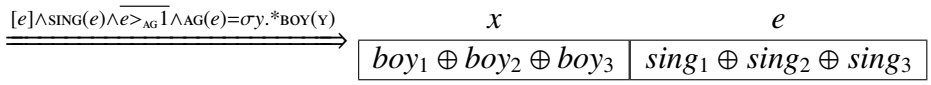
- The universal quantifier introduces a new variable assignment for each restrictor entity—i.e., atomic boy in the sum of *BOY. Each of those assignments is extended with a possibly different e by existential quantification over the event variable allowing $\overline{e >_{\textsc{ag}} 1}$ to be satisfied.[1]

[1] Distributivity in the "official" dynamic version of the semantics is treated by δ operator.

(i) $\delta(\phi)^{G,H} = \mathbb{T}$ iff there exists a partial function $\mathcal{F}$ from assignments g to sets of assignments K, i.e., of the form $\mathcal{F}(g) = K$, s.t.
a. $G = \mathsf{Dom}(\mathcal{F})$ and $H = \bigcup \mathsf{Ran}(\mathcal{F})$
b. for all $g \in G$, $\phi^{g,\mathcal{F}(g)} = \mathbb{T}$

Note that without an intervening distributive quantifier, a *xper*-marked verb is necessarily false—e.g.,

(12) $\exists e[\textsc{sing}(e) \wedge \overline{e >_{\textsc{ag}} 1} \wedge \textsc{ag}(e) = \sigma y.{*}\textsc{boy}(y)]$



- The problem is that even if e is an ontologically plurality—i.e., the variable assignment maps e to a sum—whose parts are mapped by AG to different boys, it cannot satisfy $\overline{e >_{\textsc{ag}} 1}$ because $\exists e$ only extends a single variable assignment rather than introducing a plurality of such assignments.

The result is that a main verb marked with *-xper-* must be interpreted in the scope of a distributive operator with existential closure introducing at least two events that scope.

- But? But? Why the runaround? Why not treat *-xper-* as the distributive operator itself?

First, this approach correctly predicts that *xper*-marked verbs should not clash with other bona fide distributivity operator on the distributive key. Consider the following.

(13) ’ny-ku-shiint nyaa xumar ku-shent ’-ashkyet-xper-k
1-REL-one.PL 1.NOM child REL-one 1-cut.DIST-each-REAL
Each of us spanked the child (Gordon, 1986, p. 144)

- It is perfectly fine for the distributively marked subject *’nykushiint nyaa* ‘each of us’ to co-occur with a *xper*-marked verb. As we have argued, *xper*-marked verbs, in fact, *must* be in the scope of a distributive operator.

- We explain then why *-xper-* patterns differently from doubling bona fide distributive operators which can produce clashes—e.g., ‘Each of us (#each) spanked the child (#each).’

Second, this approach to *-xper-* will permit a unified account when we move to other constructions in which it occurs. In particular, consider the case where *-xper-* marks DP-internal nominal.

(14) Pam-sh Heather-m uudav-k paan xmuk-xper-m mash-k
Pam-NOM Heather-ASC accompany-SS bread three-each-DS eat.DU-REAL
‘Pam and Heather each ate three pieces of bread.’ (Gordon, 1986, p. 99)

There are three critical things to see about this example:

- First, *-xper-* appears on the numeral *xmuk* ‘three’ inside the nominal constituent headed by *paan* ‘bread’.

- Second, the numeral is actually a verb, which we can tell from the fact that is marked DS for switch reference.

- Finally, in this example it is the subject 'Pam and Heather' that is interpreted distributively.

The last point, coupled with the first, shows why treating *-xper-* as a marker of dependent pluractionality is required.

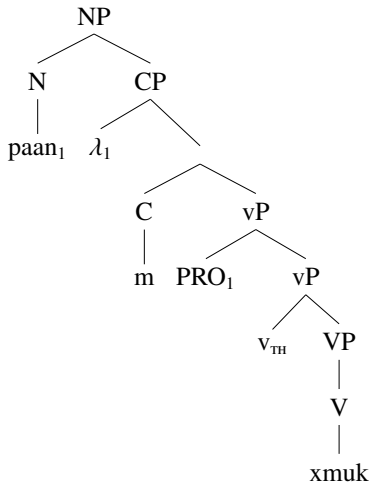
- While it plausible in example like (8) to let *-xper-* compose with the verb and quantify over the subject, a verbal argument, it is hard to imagine how *-xper-*, deeply embedded in an object numeral quantifies over the subject.
- In contrast, the numeral in examples like (14) look almost exactly like dependent numerals in languages like Kaqchikel—i.e., a numeral that must covary in the scope of another expression.
- We say almost because unlike dependent numerals in more familiar languages, in Piipaash, numerals are verbs.
- Ultimately, this supports our analysis of *-xper-* as a kind of pluractionality, namely dependent pluractionality, but we must first understand how verbal numerals could work.

Following Champollion 2016; Kuhn 2019; Pasquereau 2019 we can take numerals to be predicates of event(ualitie)s—events with *n* participants.

(15) $xmuk \rightsquigarrow \lambda e[|\text{TH}(e)| = 3]$

We assume the following LF based on work in Seri (Pasquereau, 2019, 2021), itself assuming the analysis of internally-headed relative clauses in Toosarvandani 2014.[2]

(16) LF of NP *paan xmukm* "three (pieces of) bread"



[2]We being loose with our use of the term relative clause in this work. There are a variety of subkinds of relative clauses in Piipaash, and we do not fully understand the syntax of all of them. The constructions we call relative clauses here all involve switch reference subordination.

The bottom-line truth conditions of a numerically quantified NP like *paan xmukm* 'three (pieces of) bread' would be as follows:

(17) *paan xmukm* $\rightsquigarrow \lambda x \exists e[|\textsc{th}(e)| = 3 \wedge \textsc{th}(e) = x \wedge \textsc{bread}(x)]$
'True of bread individuals that number three and participate in an event together.'

These type $\langle et \rangle$ expressions can then be further modified by standard quantifiers, definite articles, etc.

- Note that the numeral does not have existential force. Important for us, bare NPs in Piipaash most often get an existential interpretation—though such NPs are ambiguous with a definite interpretation.
- We assume this existential interpretation numerals often have is due to a null indefinite quantifier.

(18) $\emptyset_{ind} \rightsquigarrow \lambda P \lambda Q \exists x[P(x) \wedge Q(x)]$

We know have all the ingredients to show the dependent numeral effect familiar from languages like Kaqchikel or Hungarian, but through pluractionality.

- Because numerals in Piipaash are event-denoting, we predict that they can be subject to pluractional derivation.

(19) *paan xmukxperm* $\rightsquigarrow \lambda x \exists e[|\textsc{th}(e)| = 3 \wedge \textsc{th}(e) = x \wedge \overline{e >_{\textsc{th}} 1} \wedge \textsc{bread}(x)]$
'True of bread individuals that number three and participate in an event, where that event must co-vary across output assignments.'

If we assume a null indefinite quantifier takes this NP as an argument, we get the following quantificational DP.

(20) $\emptyset_{ind}$ *paan xmukxperm* $\rightsquigarrow \lambda Q \exists x \exists e[|\textsc{th}(e)| = 3 \wedge \textsc{th}(e) = x \wedge \overline{e >_{\textsc{th}} 1} \wedge \textsc{bread}(x) \wedge Q(x)]$

> **Note:** The fact that we have existential interpretation of the DP is what will allow both individuals and, critically, events to co-vary in the scope of some higher quantifier. We predict definite interpretations of nominals embedding *xper*-marked numerals to be infelicitous.

We now have the following VP translation for *eat three-plurc bread*:

(21) *paan xmukxperm mashk* $\rightsquigarrow \lambda x \exists y \exists e[|\textsc{th}(e)| = 3 \wedge \textsc{th}(e) = y \wedge \overline{e >_{\textsc{th}} 1} \wedge \textsc{bread}(y) \wedge \exists e'[\textit{eat}(e') \wedge \textsc{ag}(e') = x \wedge \textsc{th}(e') = y]]$

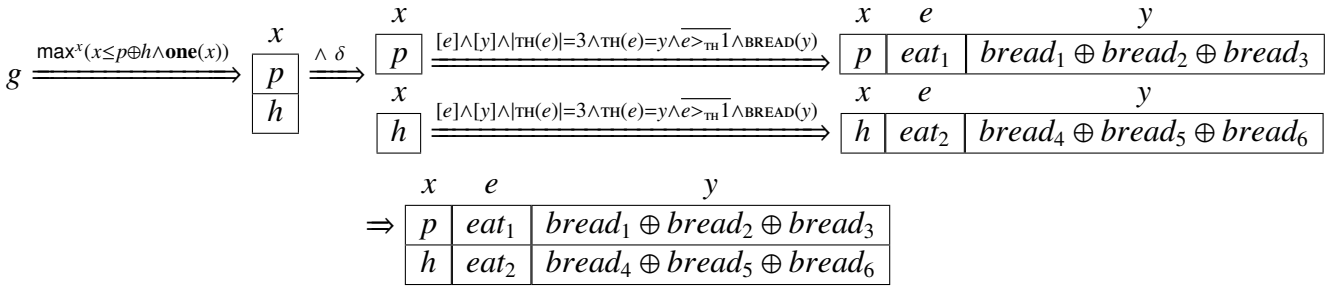
We are at the crucial step. If the subject of a sentence like (14), namely 'Pam and Heather', were fed as a type e argument to this verb phrase, the result would be infelicitous, a contradiction that could never be true.

- The problem is that there are only existential quantifiers in this sentence, and so $\overline{e >_{\text{TH}} 1}$ is interpreted relative to a single variable assignment, and so cannot be satisfied.
- We must instead have a distributive operator so that the variable e can co-vary in its scope.
- That is, the subject should receive a distributive interpretation, like it, in fact does, in the attested example.

Our final bottom-line truth conditions for a sentence like (14), repeated below, are thus:

(22) Pam-sh Heather-m uudav-k paan xmuk-xper-m mash-k
Pam-NOM Heather-ASC accompany-ss bread three-each-DS eat.DU-REAL
'Pam and Heather each ate three pieces of bread.' (Gordon, 1986, p. 99)

(23) $\forall x[x \leq p \oplus h \wedge \mathbf{one}(x) \rightarrow \exists y \exists e[|\text{TH}(e)| = 3 \wedge \text{TH}(e) = y \wedge \overline{e >_{\text{TH}} 1} \wedge \text{BREAD}(y) \wedge \exists e'[eat(e') \wedge ag(e') = x \wedge th(e') = y]]]$
'True if for each of Pam and Heather there is an event involving three bread participants y (and there must be at least two such events with different participants in the output), and there is a second event of eating in which she eats y.'



The fact that Piipaash and Kaqchikel both have dependent numerals that have a similar effect on the global truth conditions of the sentences in which they occur, but achieve that effect through different routes is, well, quite beautiful.

2.1 Solving Gil's puzzle

In Gil's dissertation 1982 he correctly notes that *-xper-* marks distributive shares.

- This follows from our analysis because the post-supposition introduced by *-xper-* can only be satisfied in the scope of a distributive operator.

In that same work, Gil also notes an apparent counterexample to this generalization, which he never solves.

- In particular, *-xper-* can appear on certain coordinations, where the coordinated nominals are interpreted as the distributive key.

(24) John-sh Bill-sh nyi-dush-**xper**-k 'ii xmok-m paaysh-k
John-NOM Bill-NOM PL.OBJ-be.DU-each-SS stick three.SG-DS carry.DU-REAL
John and Bill each carried three sticks. (Gil, 1982, p. 281, ex. 35c)

Here the existential verb, embedded under the subject, bears the *-xper-*.

- Such examples are initially disturbing, and disturbed Gil, because the subject is the distributive key.

Our analysis of *-xper-* as a marker of dependent pluractionality can immediately account for such examples.

- Crucially, the stem *dush* 'to be' is just a verb.
- Moreover, it is embedded in exactly the same kind of relative clause as dependent numerals.
- Thus, just like in the dependent numerals, it's the event argument of this embedded verb that *-xper-* marks as dependent!
- The head of the relative clause—the subject of the main clause—must be interpreted distributively to satisfy the dependency requirement of the *-xper*-marked verb in its relative clause complement.

But, if main clause subject is interpreted distributively to satisfy a requirement of a dependent-marked embedded clause, it will also be interpreted distributively for the main clause.

- Voilà, prima facie distributive key-marking without distributive key-marking.

We assume the following structure for *xper*-marked coordinated nominals in (24) (in Piipaash, nominative case marks (nominal) predicates)

(25) $[_{NP}$ pro$_i$ $[_{CP}$ John-sh Bill-sh$_i$ nyi-dush-**xper**-k]]
[pro [John-NOM Bill-NOM PL.OBJ-be.DU-each-SS]]
lit. 'Them being John, Bill'

Note that we assume the coordination is not contributed by the *dush* verb.

- coordination, both conjunction and disjunction, is more generally marked by juxtaposition in Piipaash. We have already seen examples of this—e.g., (14).
- Instead, we take the contribution of *dush* to support the equative interpretation.

Once marked pluractional (and after event closure and application of its external argument), we have the following denotation for *Johnsh Billsh nyidushxperk* 'being John, Bill'.

(26) *Johnsh Billsh nyidushxperk* $\rightsquigarrow \lambda x \exists e[\textsc{be}(e) \wedge \textsc{th}(e) = x \wedge x \leq \mathbf{j} \oplus \mathbf{b} \wedge \overline{e >_{\textsc{th}} 1}]$
'True of individuals that are less than or equal to John and Bill that participate in at least two events of being that have different themes.'

Crucially, the only way this can be satisfied is if it is interpreted in the scope of a distributive operator (and if we pass at least two individuals to x).

- Both constraints can simultaneously be satisfied if the head of the relative clause in which *Johnsh Billsh nyidushxperk* is embedded is interpreted distributively.
- This is precisely the observed interpretation of (24).

(27) $\forall x[x \leq_{\mathrm{i}} \wedge \mathbf{one}(x) \rightarrow$
$\exists e[\textsc{be}(e) \wedge \textsc{th}(e) = x \wedge x \leq \mathbf{j} \oplus \mathbf{b} \wedge \overline{e >_{\textsc{th}} 1} \wedge$
$\exists z \exists e'[sticks(z) \wedge \textsc{th}(e') = z \wedge |\textsc{th}(e')| = 3 \wedge$
$\exists e''[carry(e'') \wedge ag(e'') = x \wedge th(e'') = z]]]]$
'True if for each individual x in i, there is (i) an event of x being and x is John or Bill, (ii) a second event involving three stick participants z, and (iii) a third event of carrying in which x carries z.'

Note that here that the *xper*-marked verb does very little truth conditional work. It merely forces the subject to be interpreted distributively.

- But, this is exactly what we wanted. We want to understand why the nominal that is the distributive key contains a *xper*-marked verb, when in other cases it was the distributive key.
- Crucially, our account in terms dependent pluractionality allows us to get the correct truth conditions while maintaining a uniform denotation for *-xper-*.

3 Conclusions

The morpheme *-xper-* in Piipaash provides good evidence for a novel kind of pluractionality we call *dependent pluractionality*.

- Given that dependent indefinites are familiar from the literature, and predicates of events, like verbs, in virtue of undergoing existential closure, have a kind of indefinite flavor, perhaps this is expected!
- Once we make this move, we can solve two puzzles about *-xper-*:
  - it has a wide distribution—that's because lots of expressions can be predicates of events
  - it can, in cases look like it's marking distributive shares or keys—i.e., Gil's Puzzle—our solution is that it always marks shares, but in virtue of marking event predicates can appear inside a key that itself embeds a verbal predicate.

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