Learning (im)possible number syncretisms: investigating innate featural representations

Naomi Lee

How are number features organized?

- At issue for mental representations for phonological and morphosyntactic distinctions alike:
  - **valence**: binary? privative?
  - **organization**: cross-classifying? hierarchical?

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  - organization: **cross-classifying**? hierarchical?

	$+\alpha$	$-\alpha$
$+\beta$	$+\alpha,+\beta$	$-\alpha,+\beta$
$-\beta$	$+\alpha,-\beta$	$-\alpha,-\beta$

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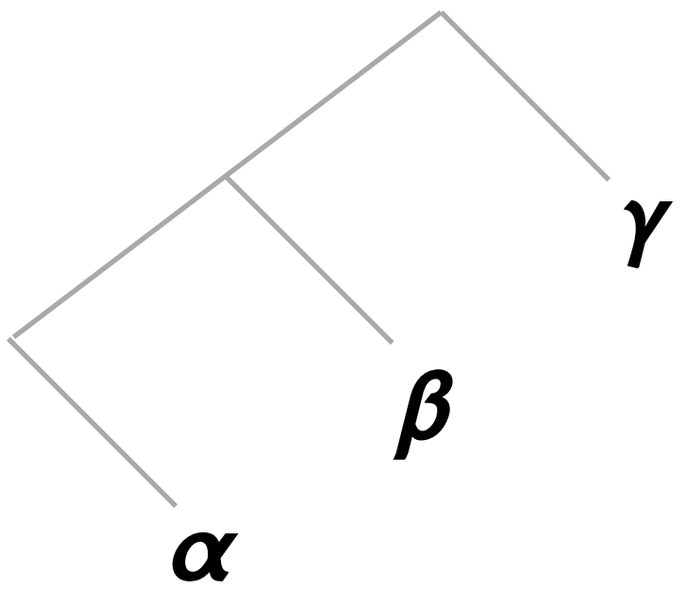
  - **organization**: cross-classifying? **hierarchical**?

	$+\alpha$	$-\alpha$
$+\beta$	$+\alpha,+\beta$	$-\alpha,+\beta$
$-\beta$	$+\alpha,-\beta$	$-\alpha,-\beta$



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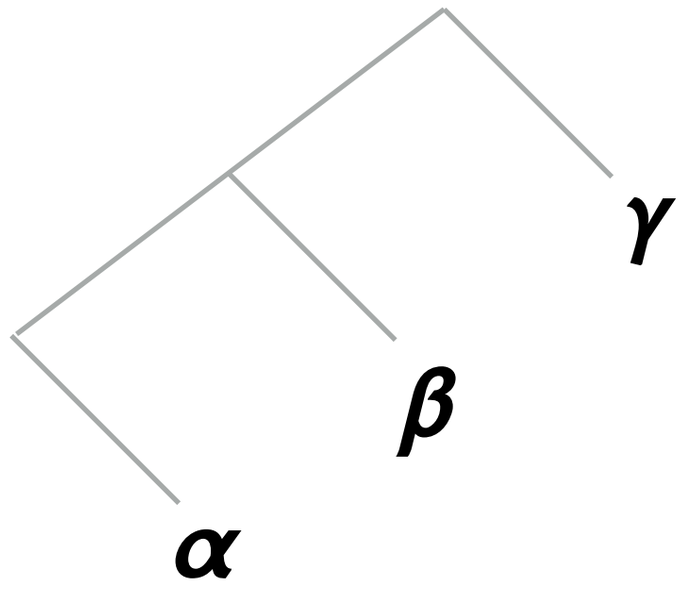
$-\beta$	$+\alpha,-\beta$	$-\alpha,-\beta$



How are number features organized?

- Different predictions for possible patterns
  - neutralized to a **syncretic** form
  - triggers in common for **suppletive** allomorph

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representable → learnable

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representable → learnable

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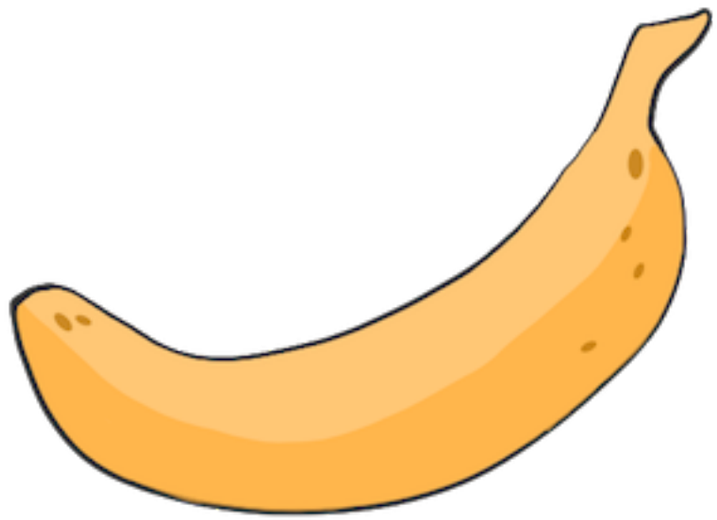
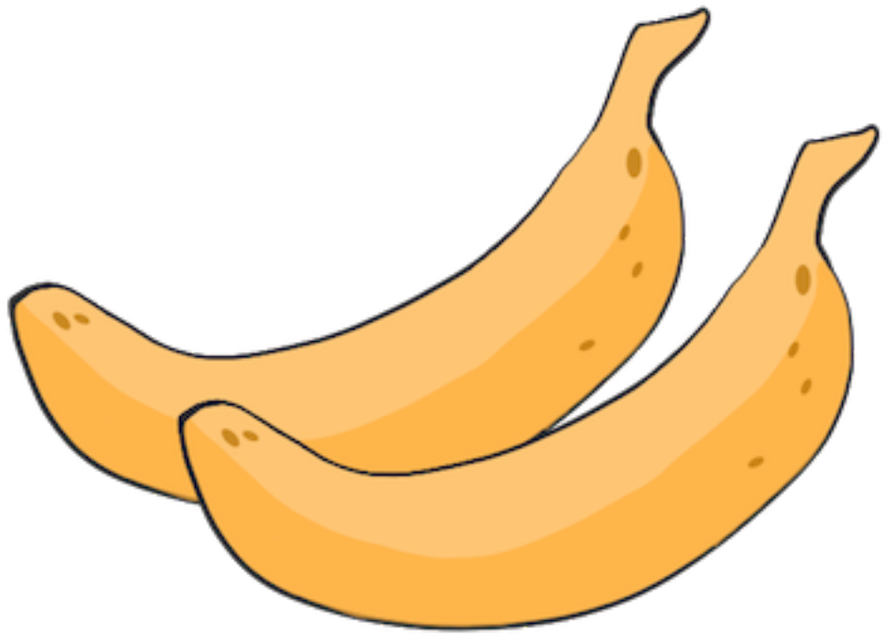
- An experimental method for learning artificial language natural classes active in **syncretism**

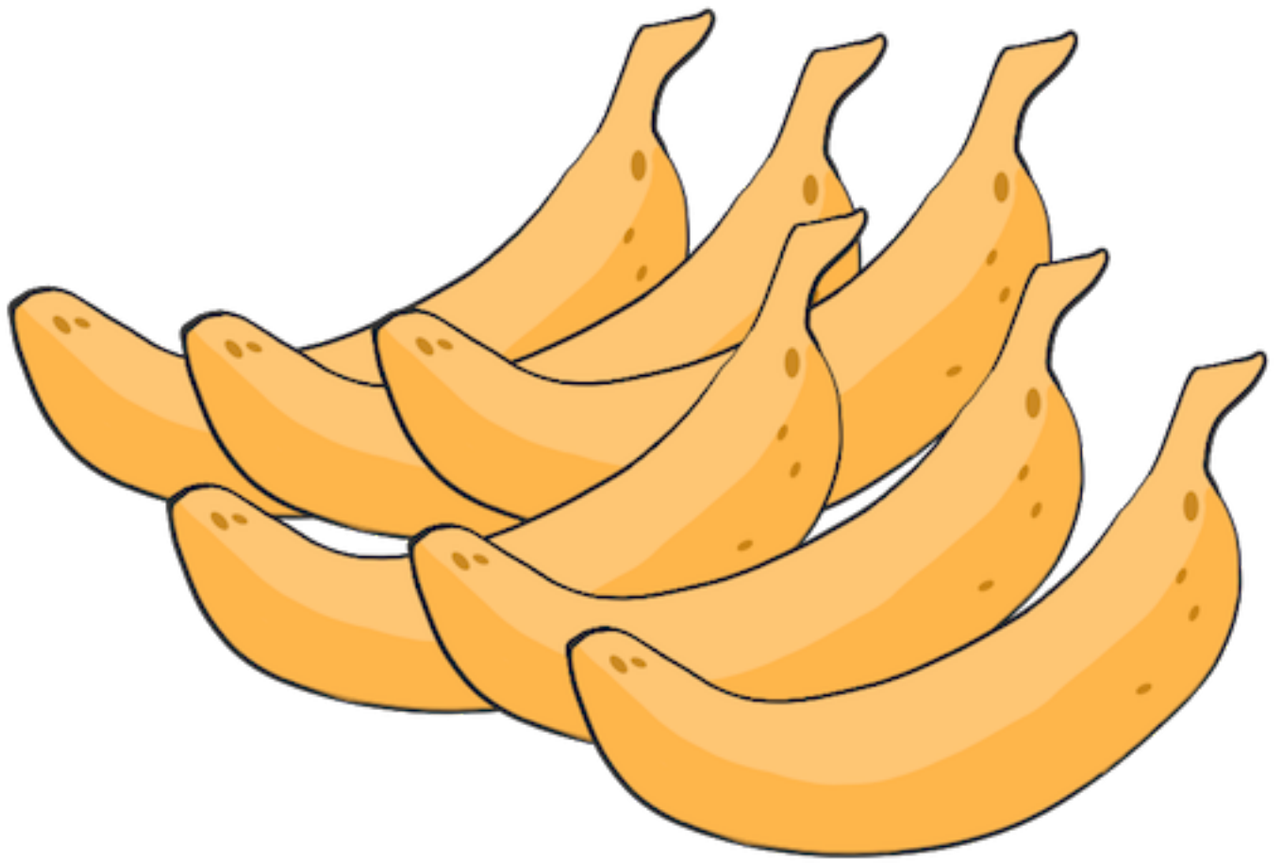
→ possible support for representing number as a privative containment hierarchy



dite.cha



dite.po



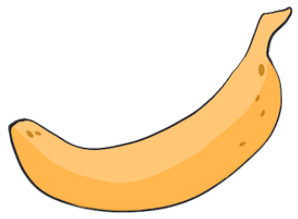
dite.fi

A - B - C

sg-du-pl nominal number

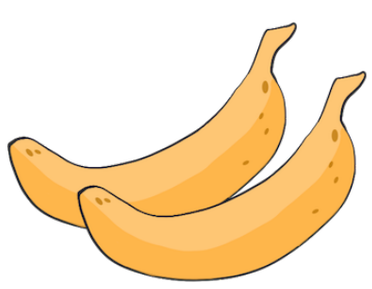
dite-cha

banana-SG



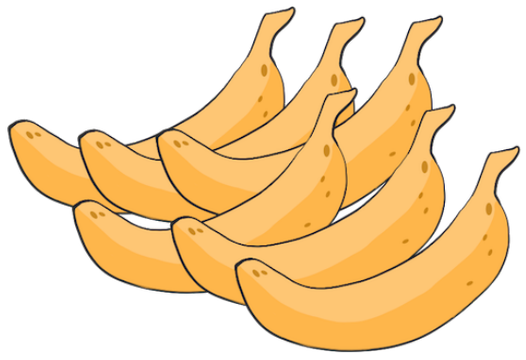
dite-po

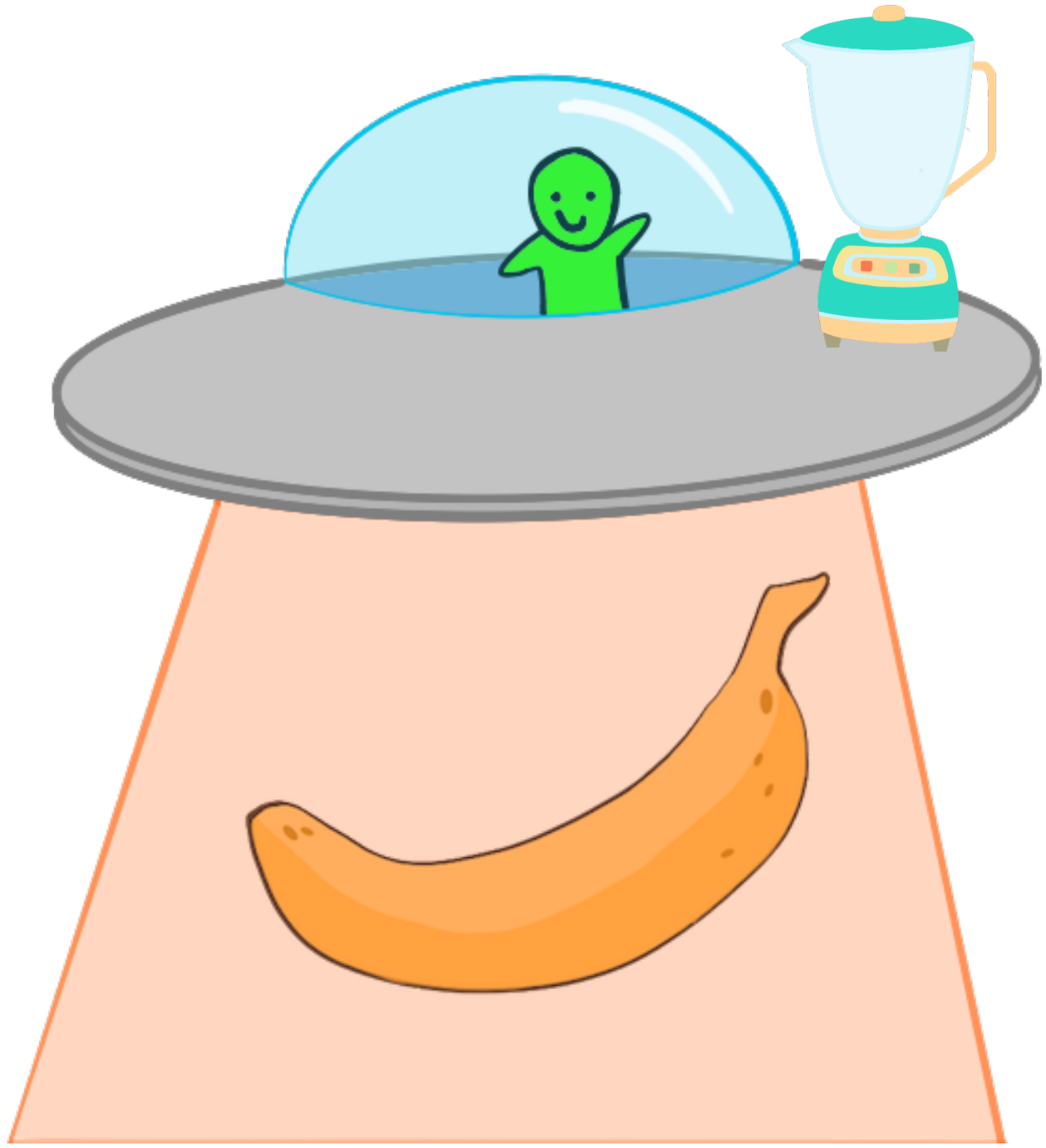
banana-DU



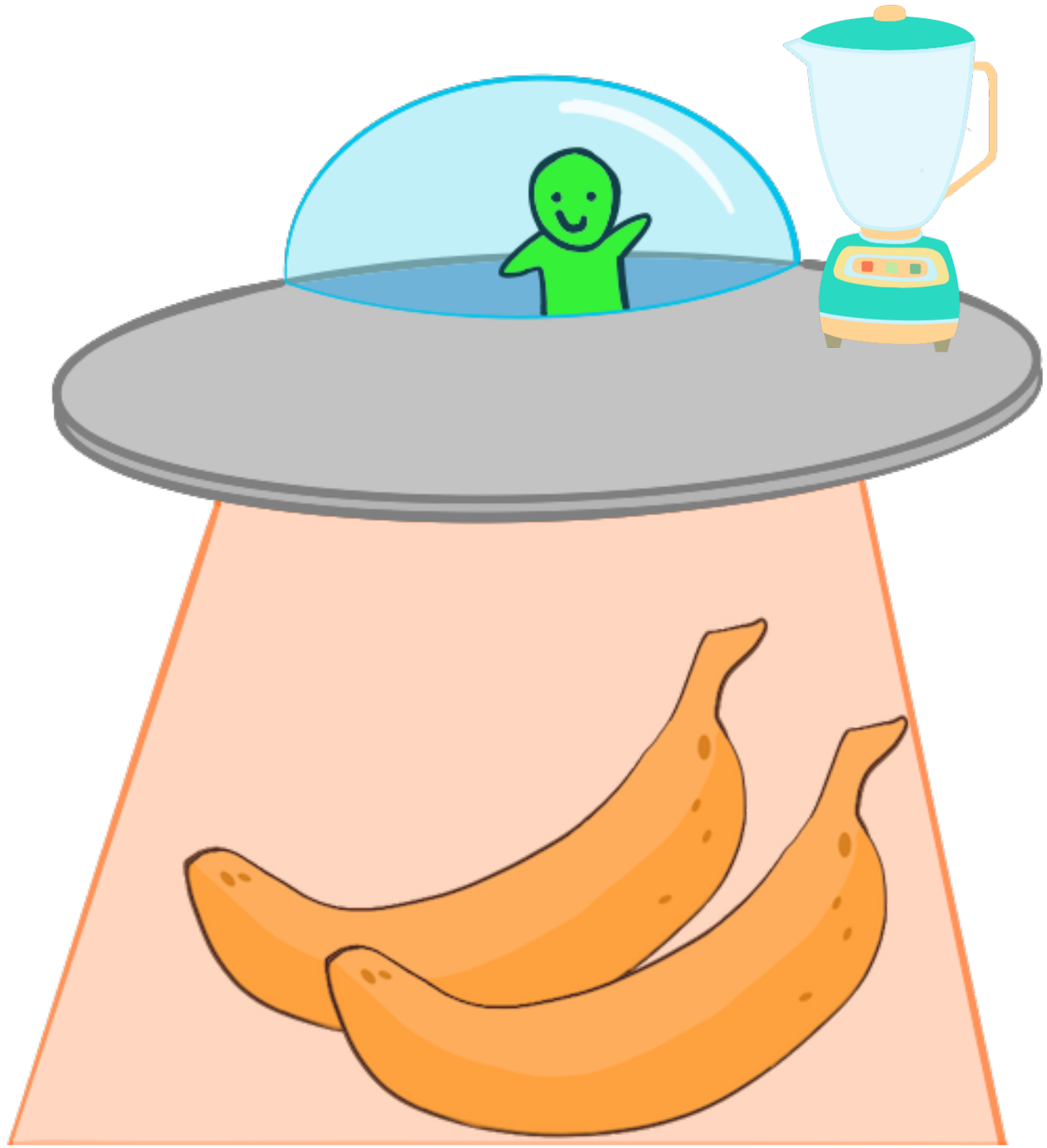
dite-fi

banana-PL

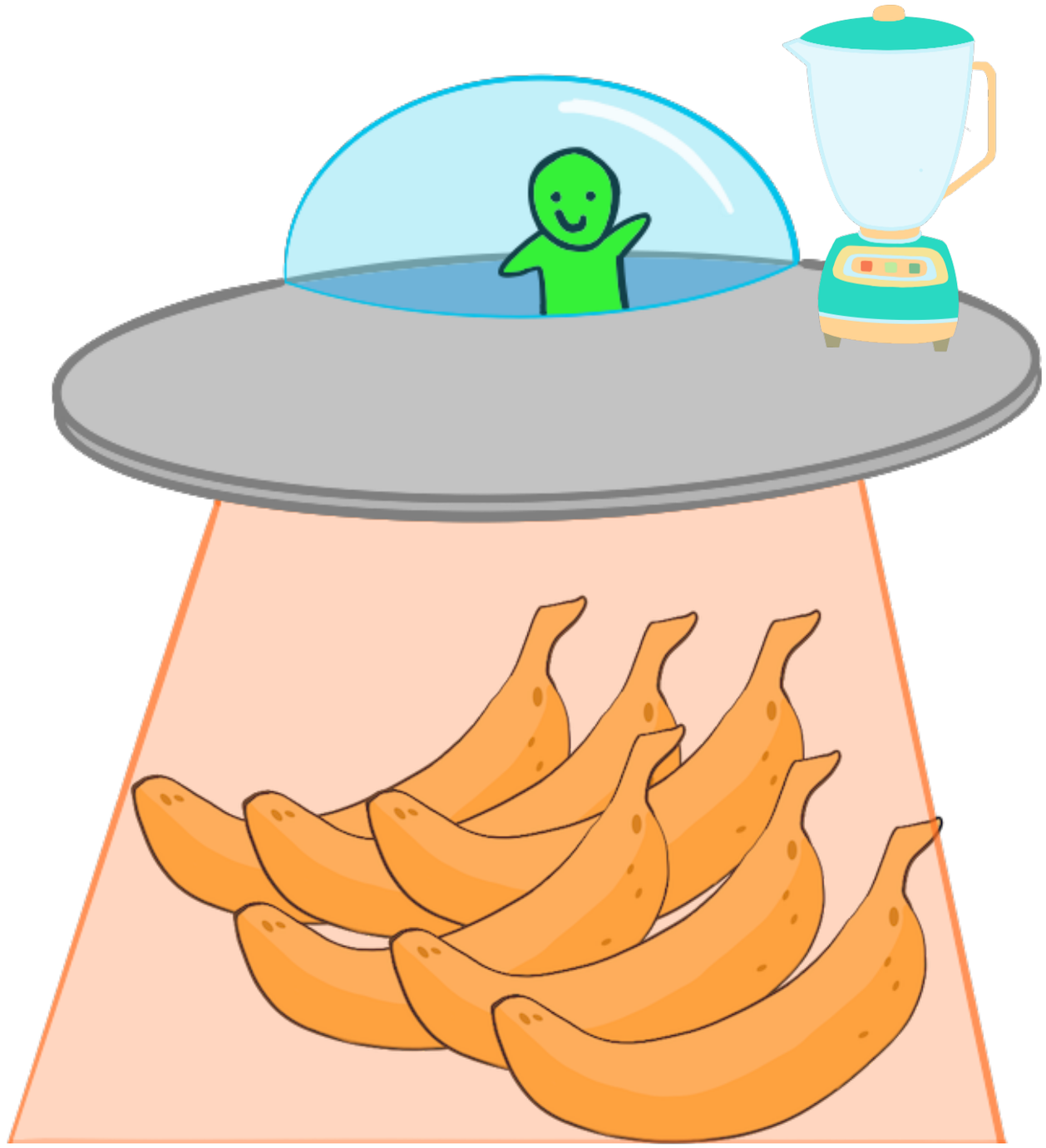




bice.**te** dite.cha!



bice.**ku** dite.po!

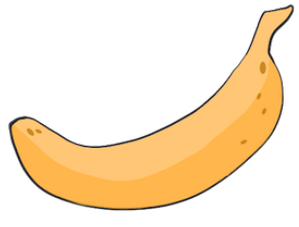


bice.**ku** dite.fi!

A - B - B
sg-**du-pl** **verbal syncretism**

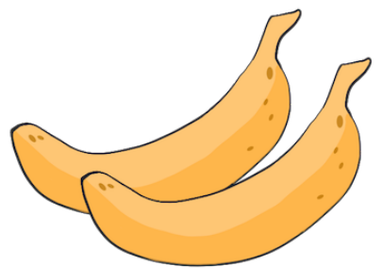
bice-te dite-cha

beam.up-SG banana-SG



bice-ku dite-po

beam.up-DU.PL banana-DU



bice-ku dite-fi

beam.up-DU.PL banana-PL

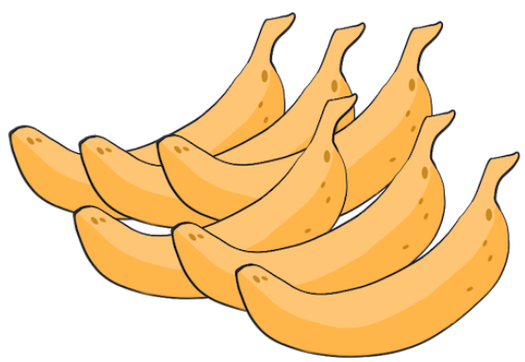


ABB artificial language

nouns		verbs	
sg	*-cha*	A	*-te*
du	*-po*	B	*-ku*
pl	*-fi*	B	

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a. **binary, cross-classifying**
b. privative, linear containment

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sg	*-cha*	A	*-te*
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pl	*-fi*	B	

	+α	**-α**
+β	+α,+β	-α,+β
-β	+α,-β	-α,-β

a. **binary, cross-classifying**
b. privative, linear containment

Binary, cross-classifying: Harbour 2014, 2016

	+α +atomic	**-α** -atomic
+β +minimal	sg +α,+β	du -α,+β
-β -minimal		pl -α,-β

Binary, cross-classifying: Harbour 2014, 2016
semantically (not just morphologically) binary

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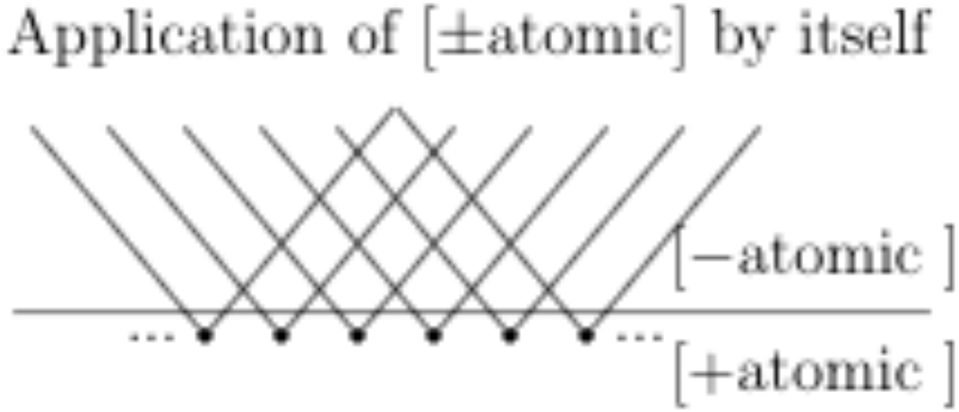

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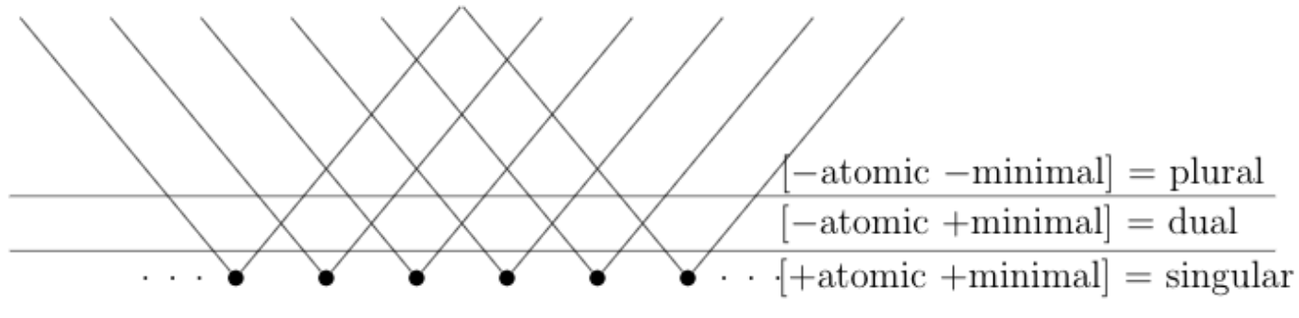
Application of [±atomic] and [±minimal] to derive sg-du-pl
(simplified Hasse diagram, adapted from Harbour 2007: 70)



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[−atomic] ⟷ *-ku*

Binary, cross-classifying: Harbour 2014, 2016

[+atomic,+minimal] ⟷ *-te*

[−atomic] ⟷ *-ku*

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Binary, cross-classifying organization is consistent with du-pl syncretism

nouns	verbs
sg	A
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Binary, cross-classifying: Harbour 2014, 2016

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[+minimal] ⟷ *-te*

Binary, cross-classifying: Harbour 2014, 2016

	+α +atomic	**-α** -atomic
+β +minimal	sg +α,+β	du -α,+β
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[+minimal] ⟷ *-te*

[−a, −m] ⟷ *-ku*

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Binary, cross-classifying organization is not consistent with sg-pl syncretism

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✅ ✅ ❌

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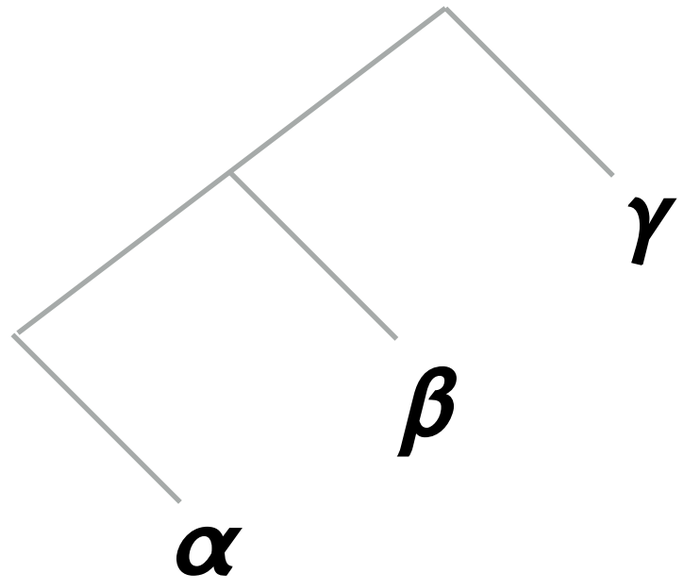
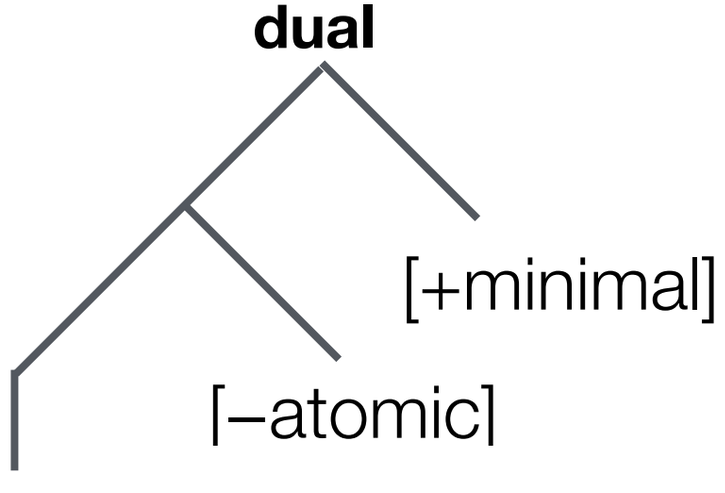


a. binary, cross-classifying

b. privative, linear containment

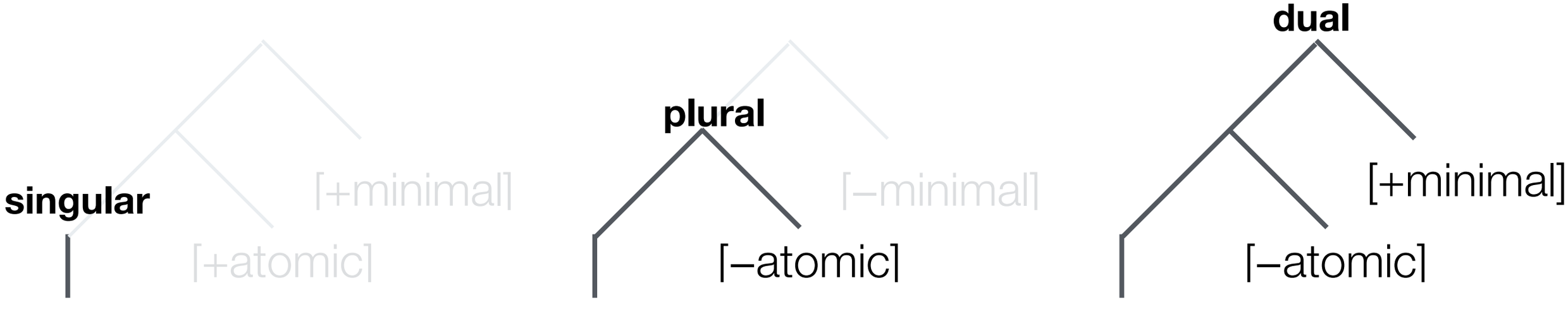
Privative, linear containment: Smith et al. 2019



Privative, linear containment: Smith et al. 2019

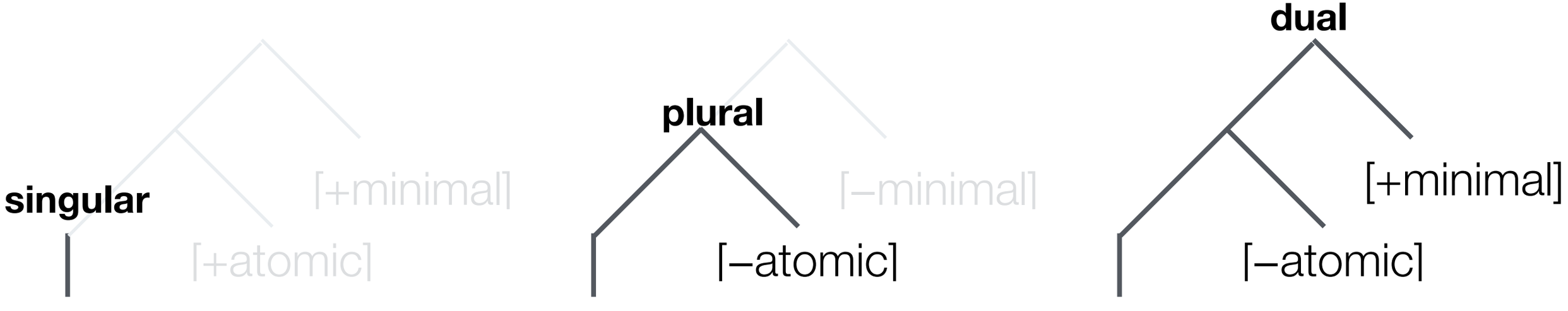
- Only one value of each feature is present in the morphosyntactic representation

Privative, linear containment: Smith et al. 2019



- Only one value of each feature is present in the morphosyntactic representation
- Dual, with its marked [+minimal] feature, is more marked as a value than plural: **sg < pl < du**

Privative, linear containment: Smith et al. 2019 morphological markedness as syntactic hierarchy



Manam demonstratives show "plural" contained by "dual" (Smith et al.'s (28))

a. **singular**

áine ŋára
woman that

that woman

b. **plural**

áine ŋára-**di**
woman that-~~PL~~
woman that-[−atom]
those women

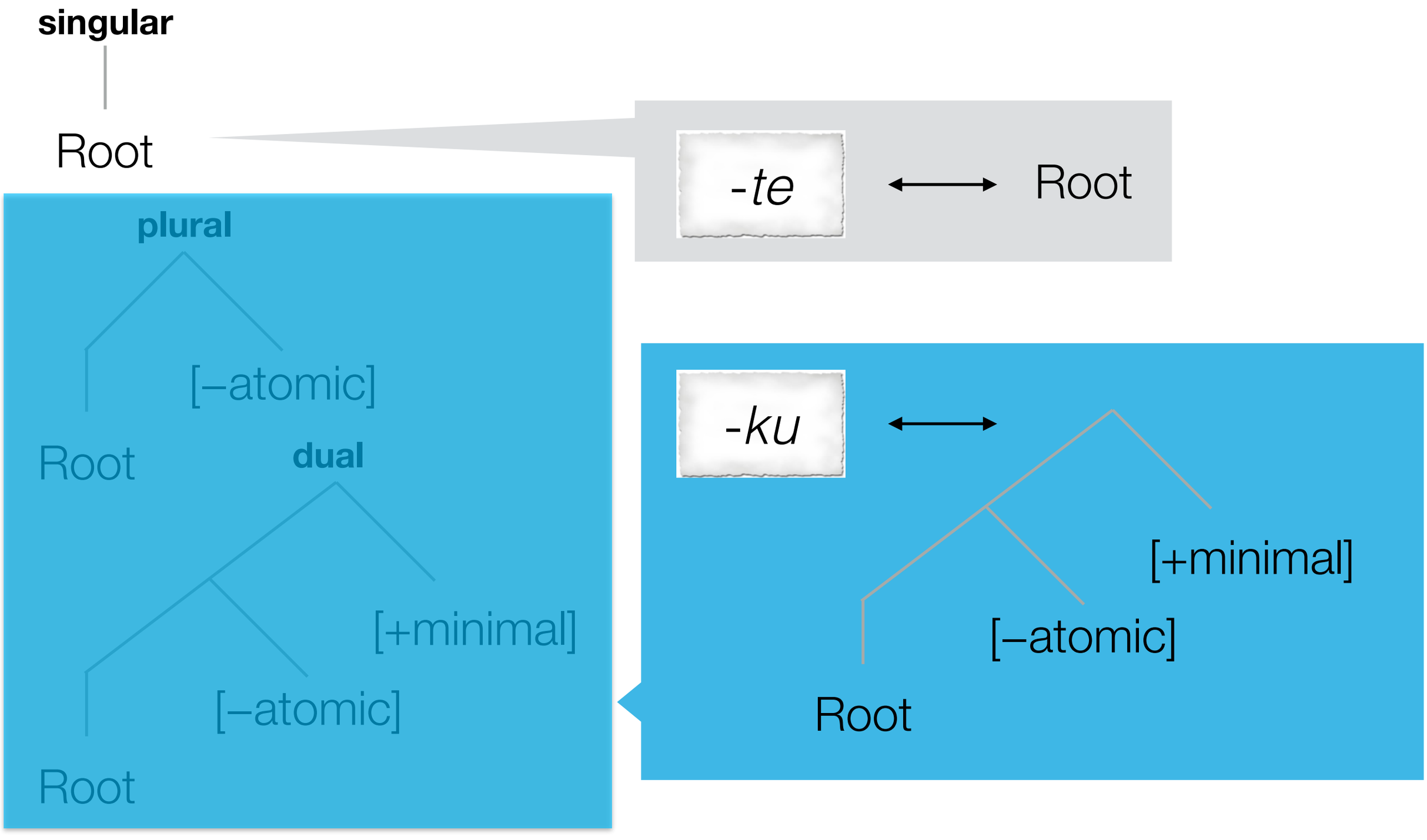
c. **dual**

áine ŋára-**dí**-a-**ru**
woman that-~~PL~~-L-~~DU~~
woman that-[−atom]-L-[+min]
those (two) women

Privative, linear containment: Smith et al. 2019

- **Superset Principle**: any lexical subtree that **contains** the morphosyntactic tree matches & can be inserted
- **Minimize Junk**: the candidate with the least unused nodes wins

Privative, linear containment organization derives du-pl syncretism from a single large subtree



Privative, linear containment organization is consistent with du-pl syncretism

nouns	verbs
sg	A
du	B
pl	B

nouns	verbs
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pl	B

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du	B
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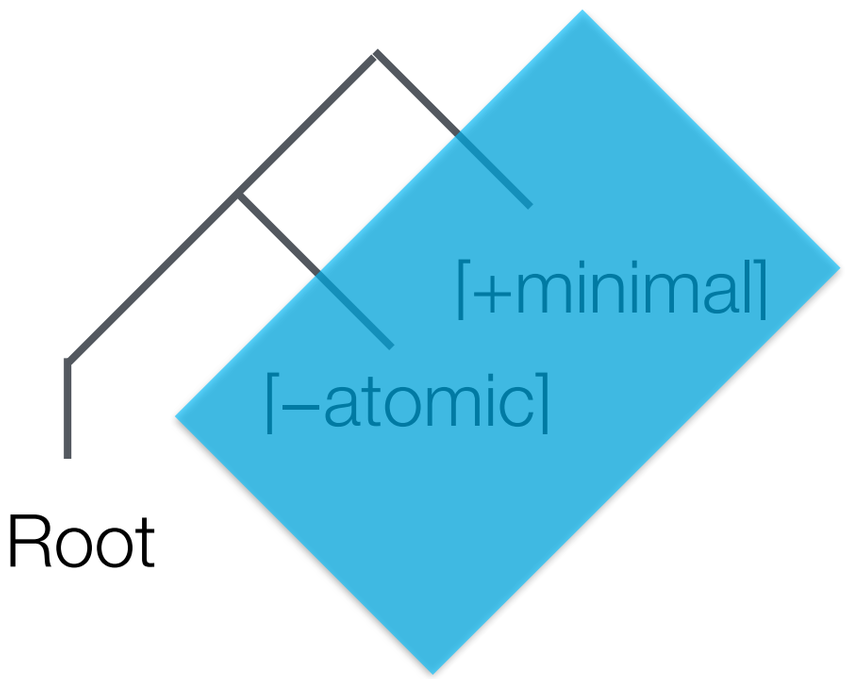

✅

Privative, linear containment organization is not consistent with sg-du syncretism

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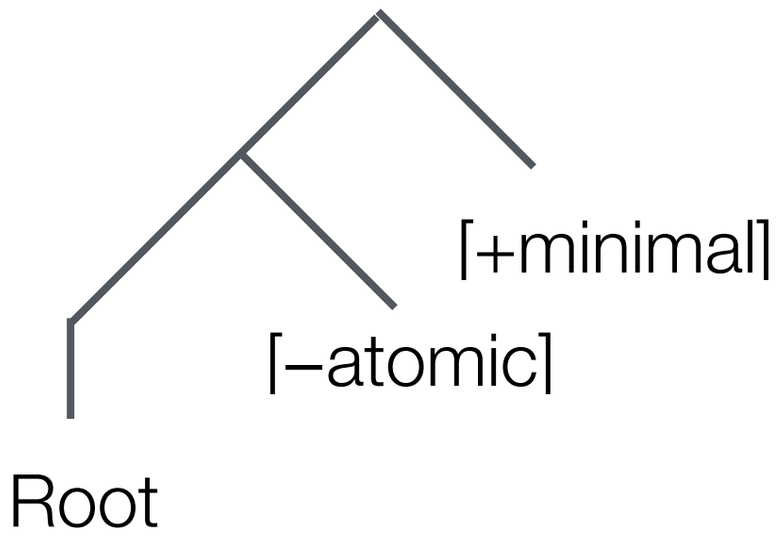

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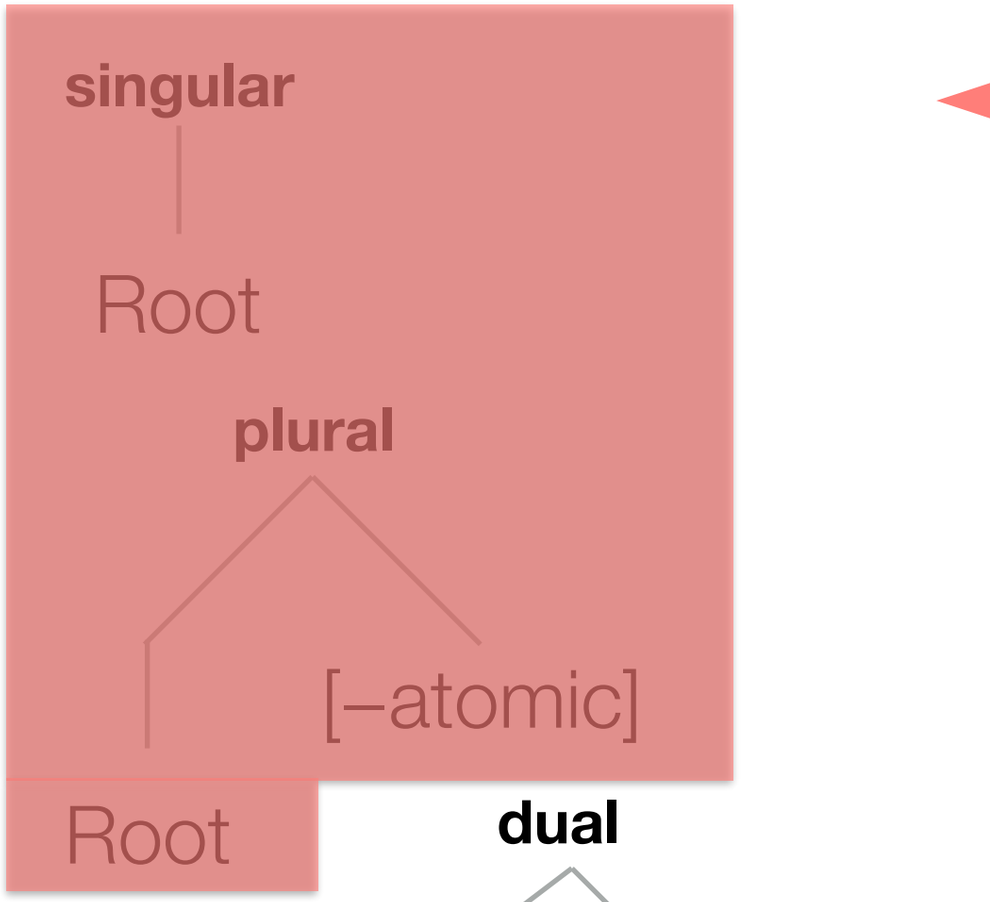
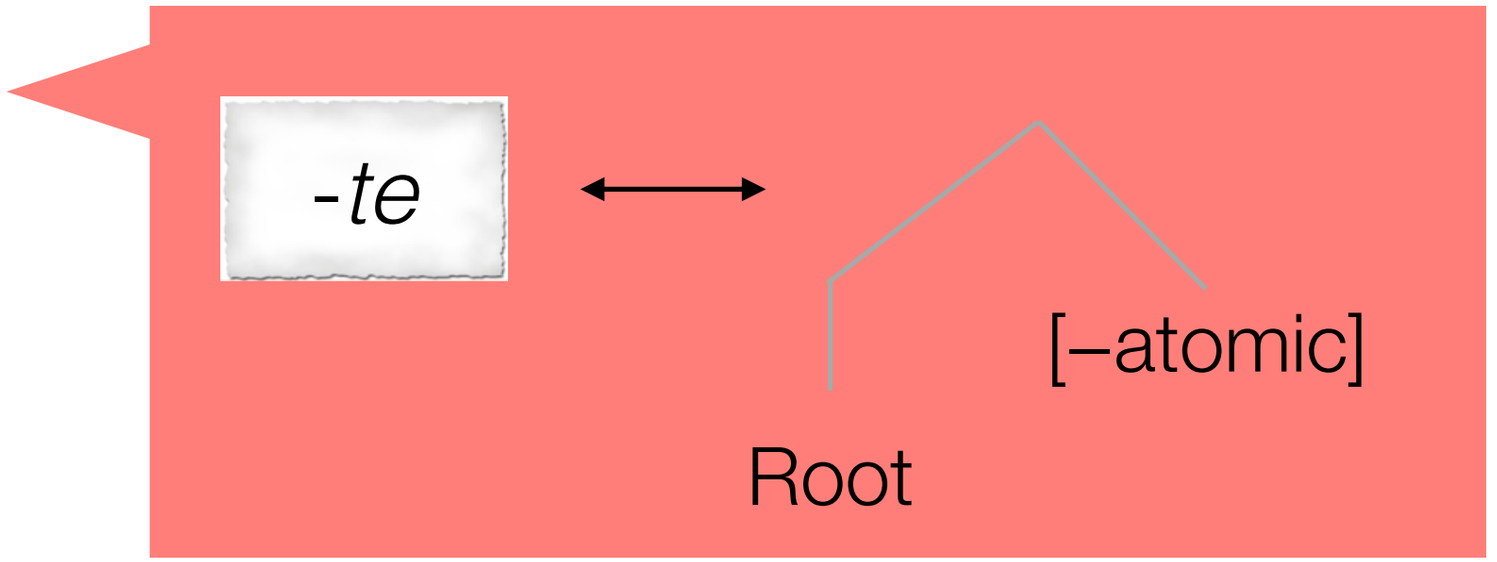
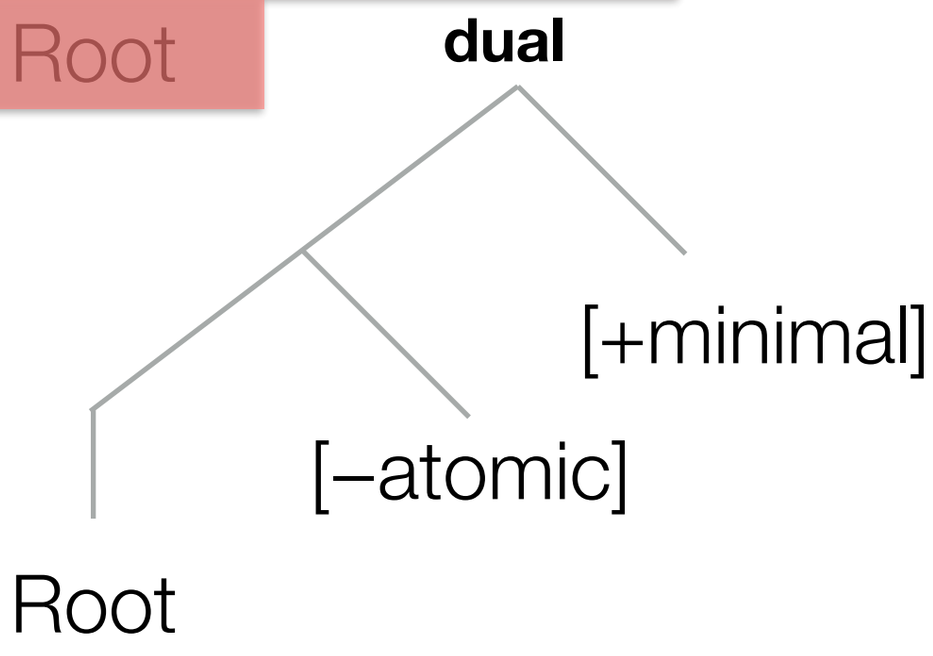
❌

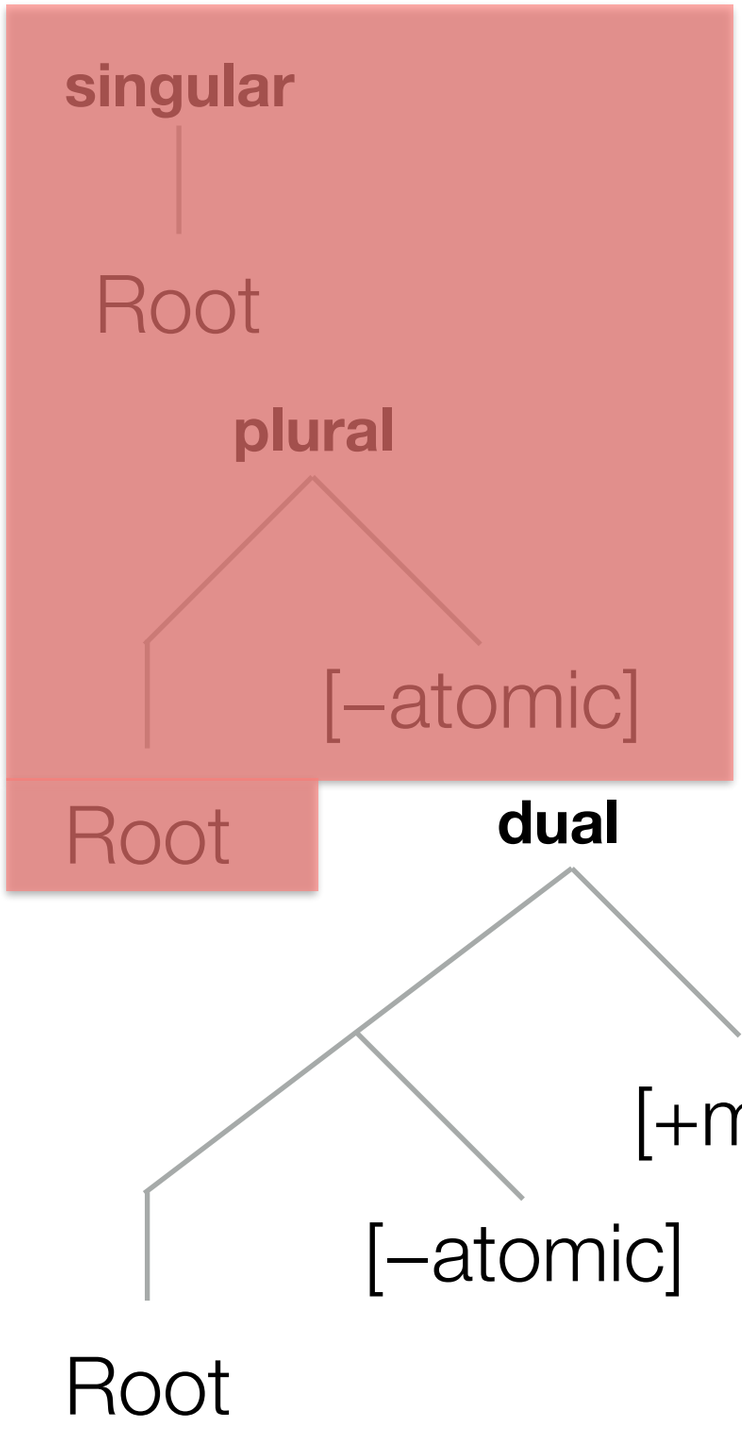
Privative, linear containment organization is consistent with sg-pl syncretism

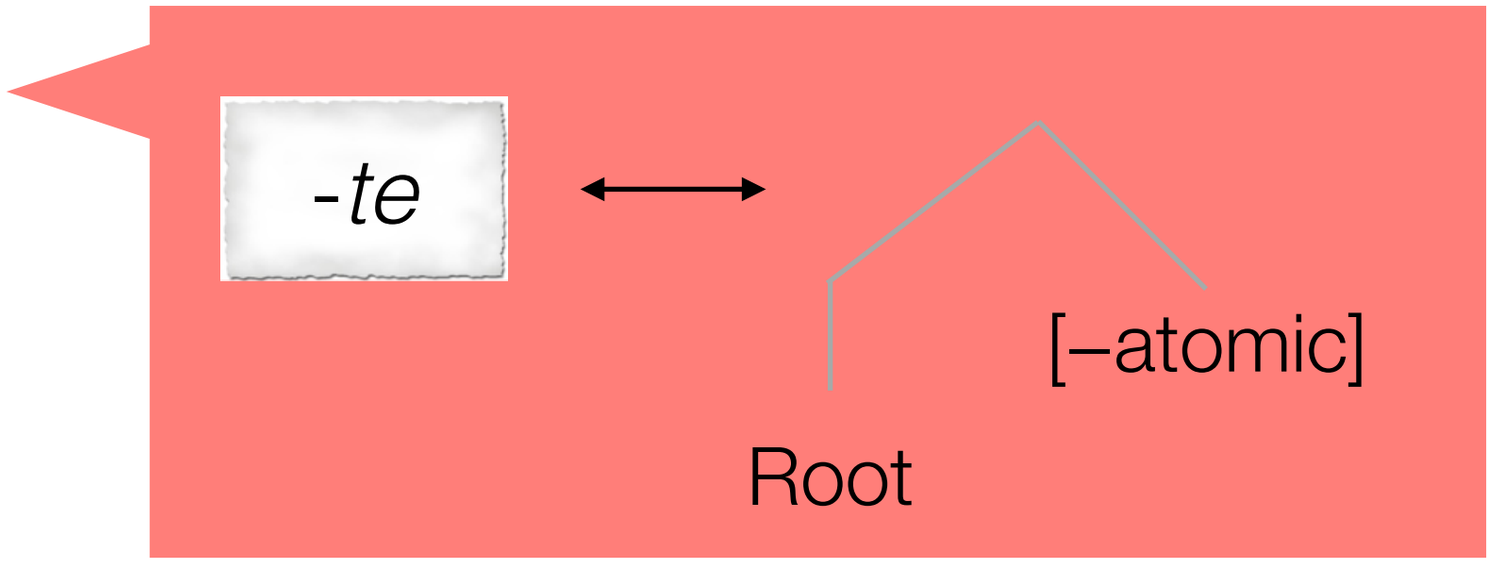


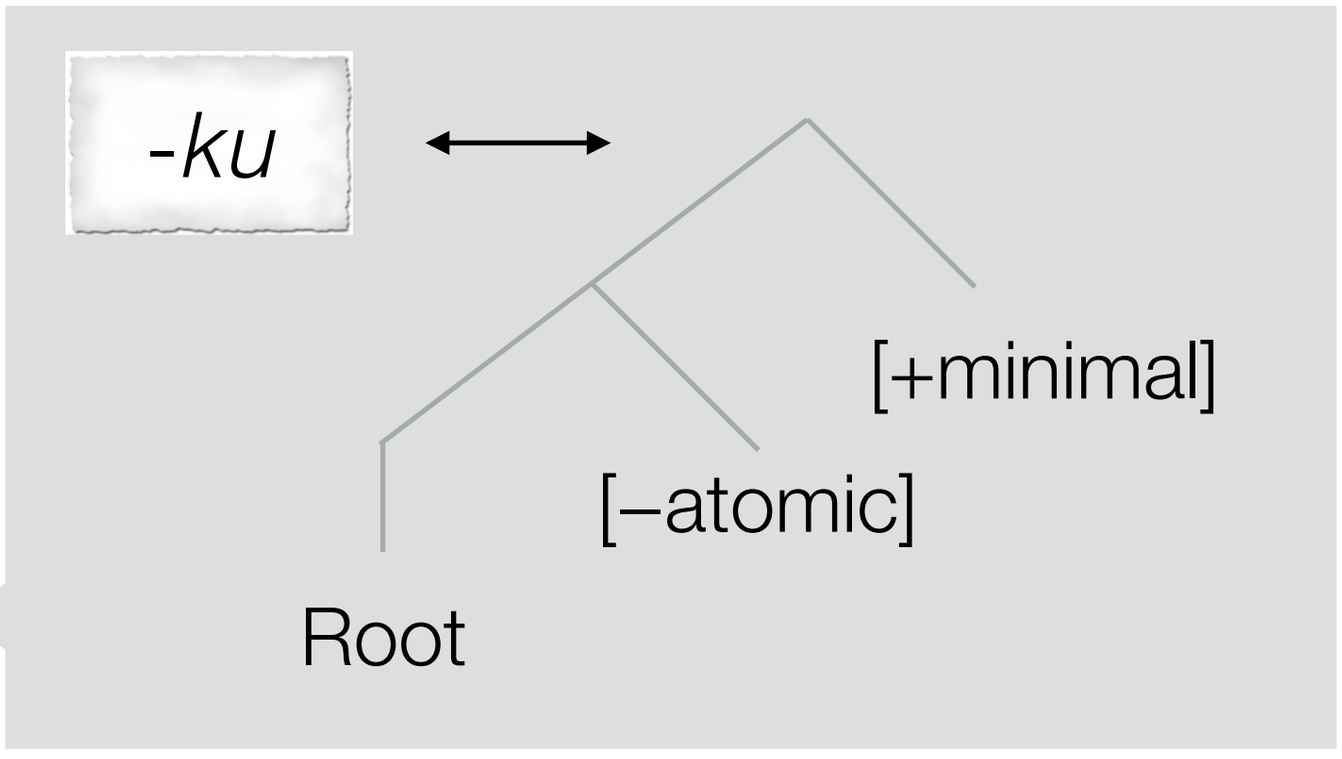




Privative, linear containment organization is consistent with sg-pl syncretism







Privative, linear containment organization is consistent with sg-pl syncretism

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du	B
pl	B

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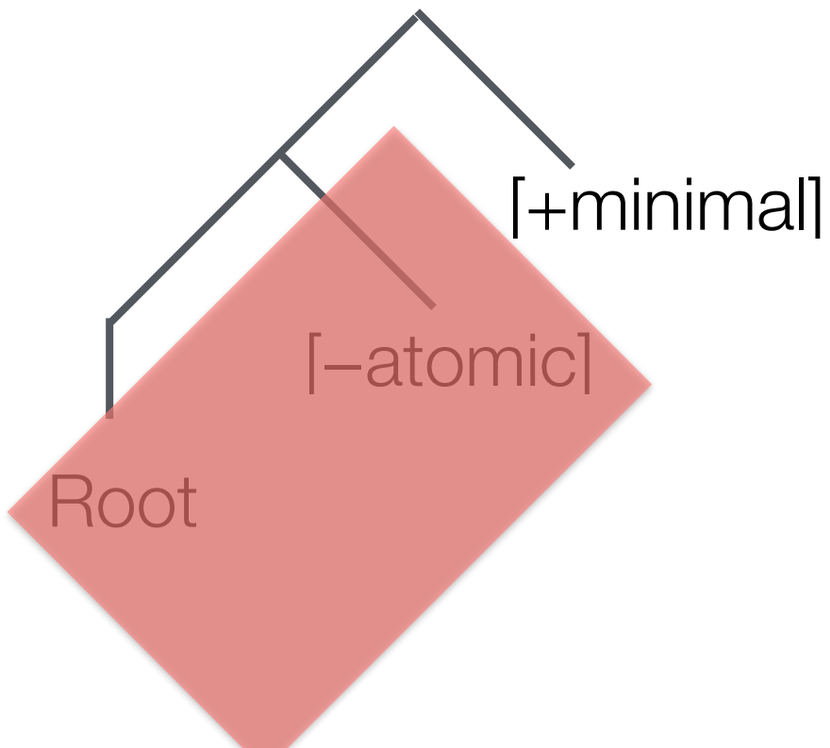

To be learnable, a neutralization must be representable

nouns	verbs
sg	A
du	B
pl	B

nouns	verbs
sg	A
du	A
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Binary, cross-classifying (Harbour 2014, 2016)	✅	✅	❌
Privative linear containment (Smith et al. 2019)	✅	❌	✅

design

nouns	verbs
sg	A
du	B
pl	B

nouns	verbs
sg	A
du	A
pl	B

nouns	verbs
sg	A
du	B
pl	A

- between-subjects
- ease-of-learning paradigm
- tripartition with syncretism, not conflation
- nominal number, with verbal number agreement
- referent selection based on neutralized suffixes

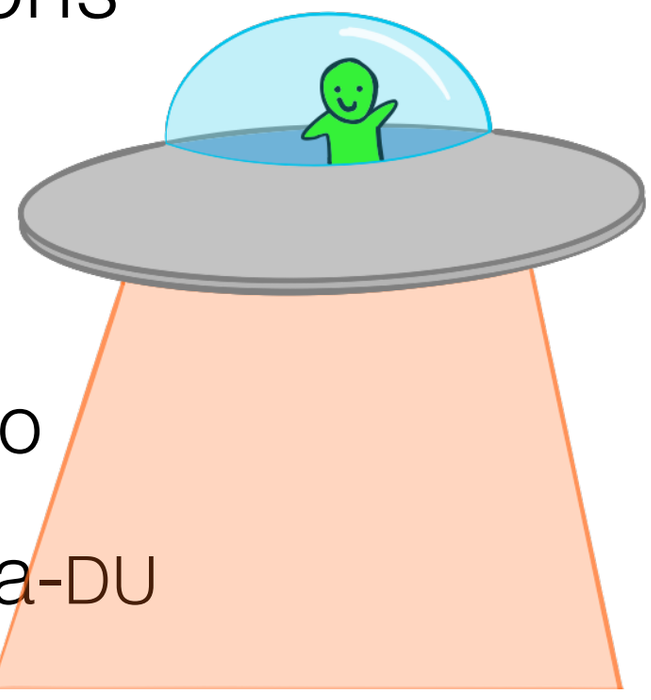
materials: language

- suffixing language
- CVC noun and verb stems (Vitevitch & Luce 1998,1999)
- 3 -CV nominal number suffixes
- 2 -CV syncretic verbal number agreement suffixes

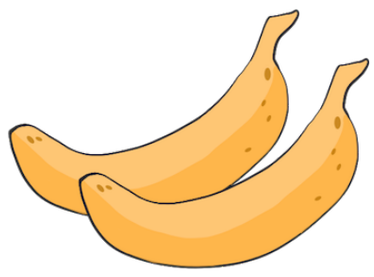
noun	**imperative**	
seeg-po	bice-ku	seeg-po
pear-DU	beam.up-DU.PL	pear-DU

materials: images

- color drawings of 8 kinds of produce
- between 7 and 9 for plural representations



noun



deet-po

banana-DU

imperative

bice-ku

beam.up-DU.PL

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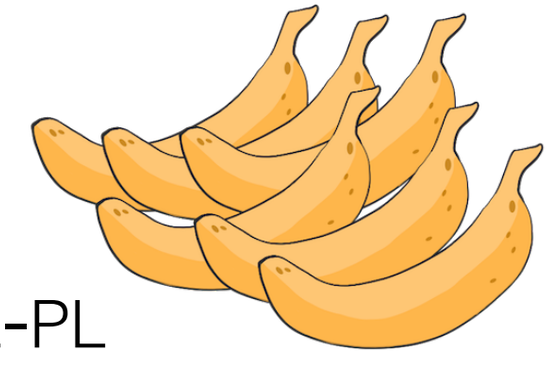

deet-fi

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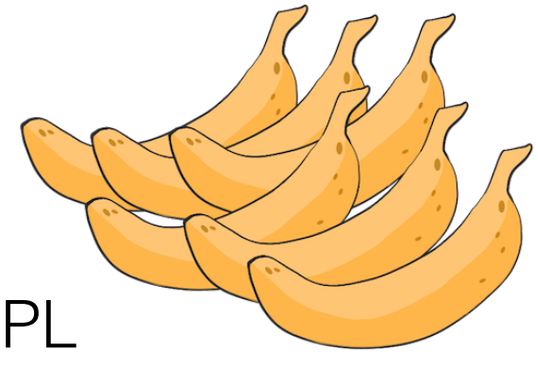
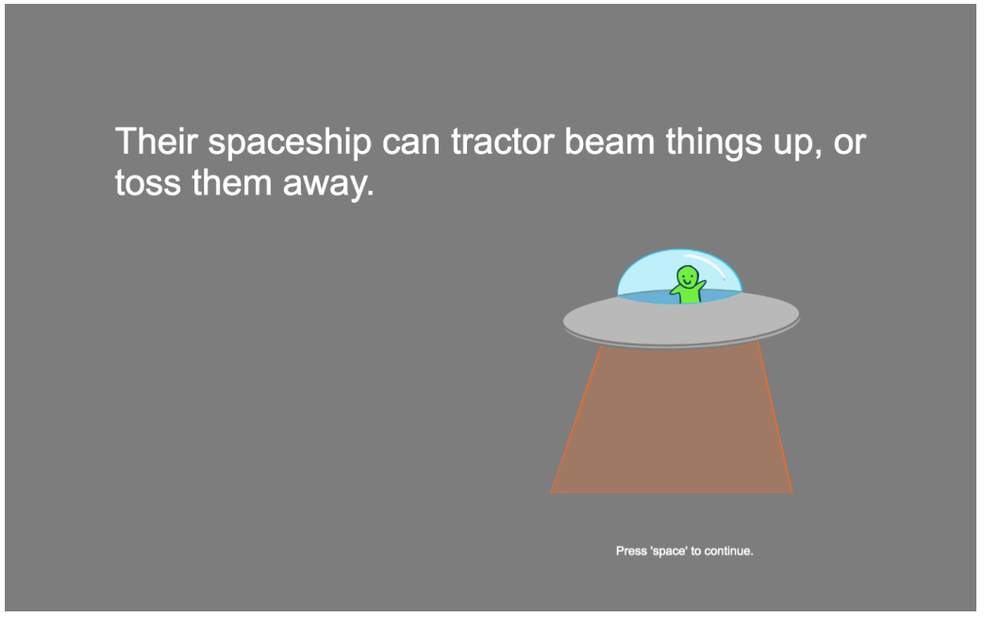


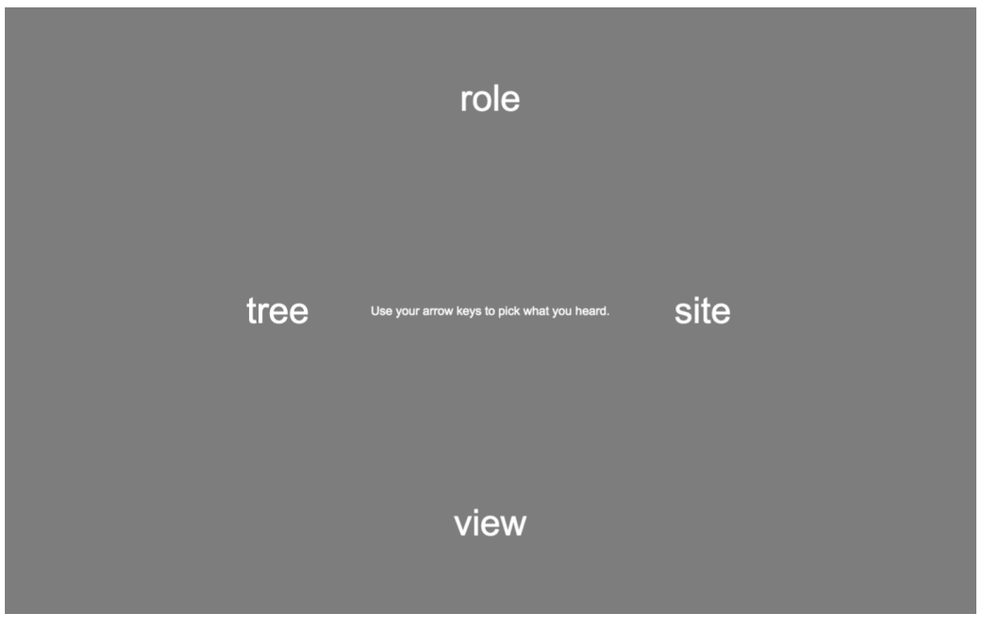
deet-fi

banana-PL

procedure

- PsychoPy, converted to PsychoJS, on Pavlovia
- **instructions & setup**
- **sound check**
- training: nominal number
  - exposure / repetition
  - referent selection with feedback
- validation: nominal number
- attention check
- training: verbal number agreement
  - exposure / repetition
  - referent selection with feedback
- test: verbal number agreement
- truth value judgment





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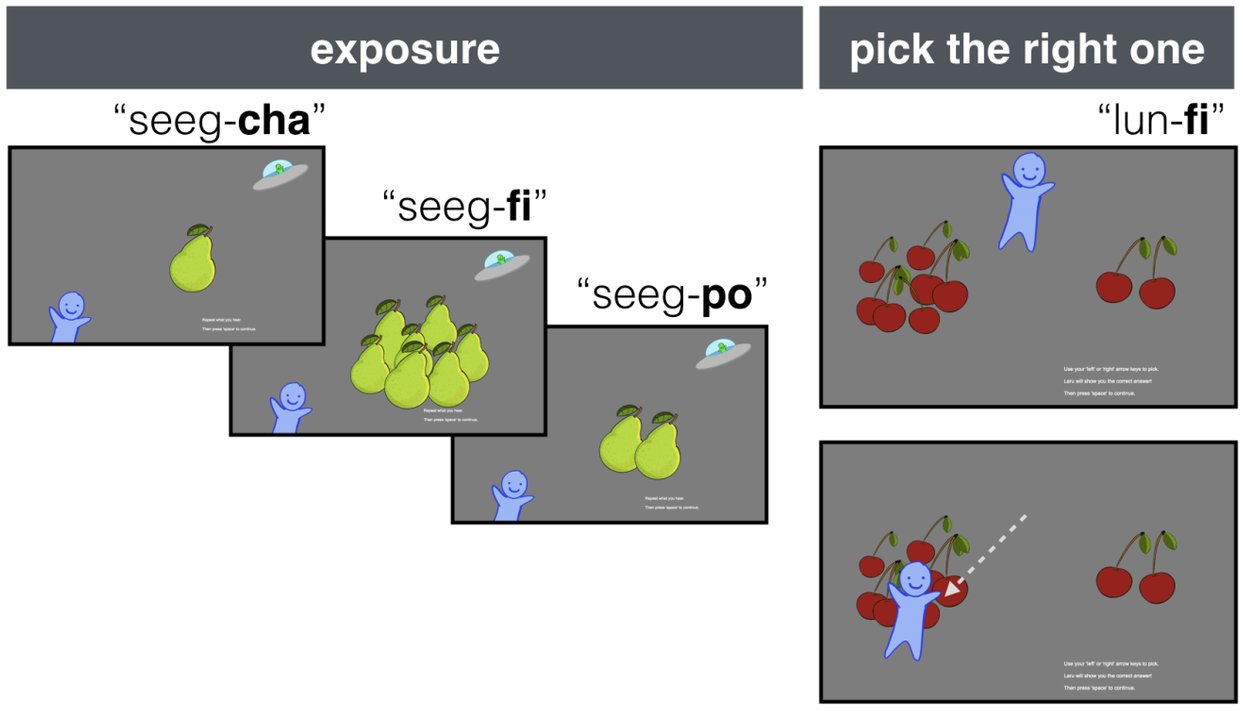
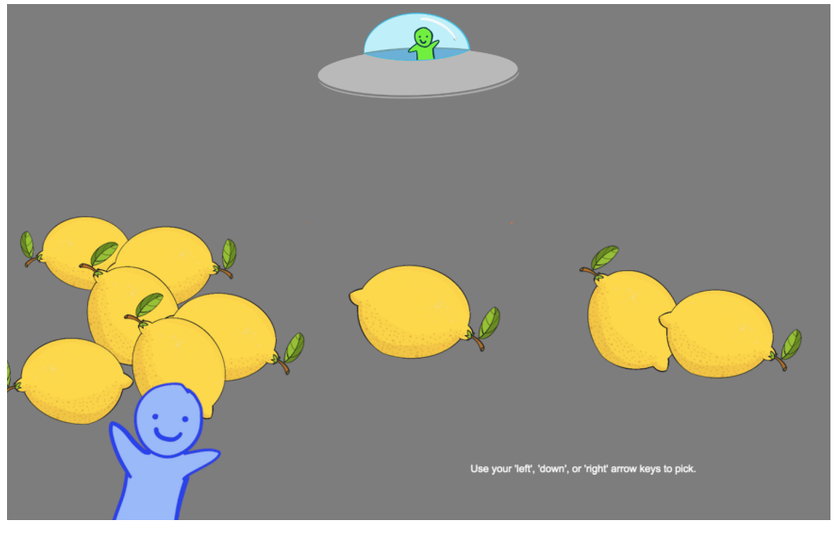
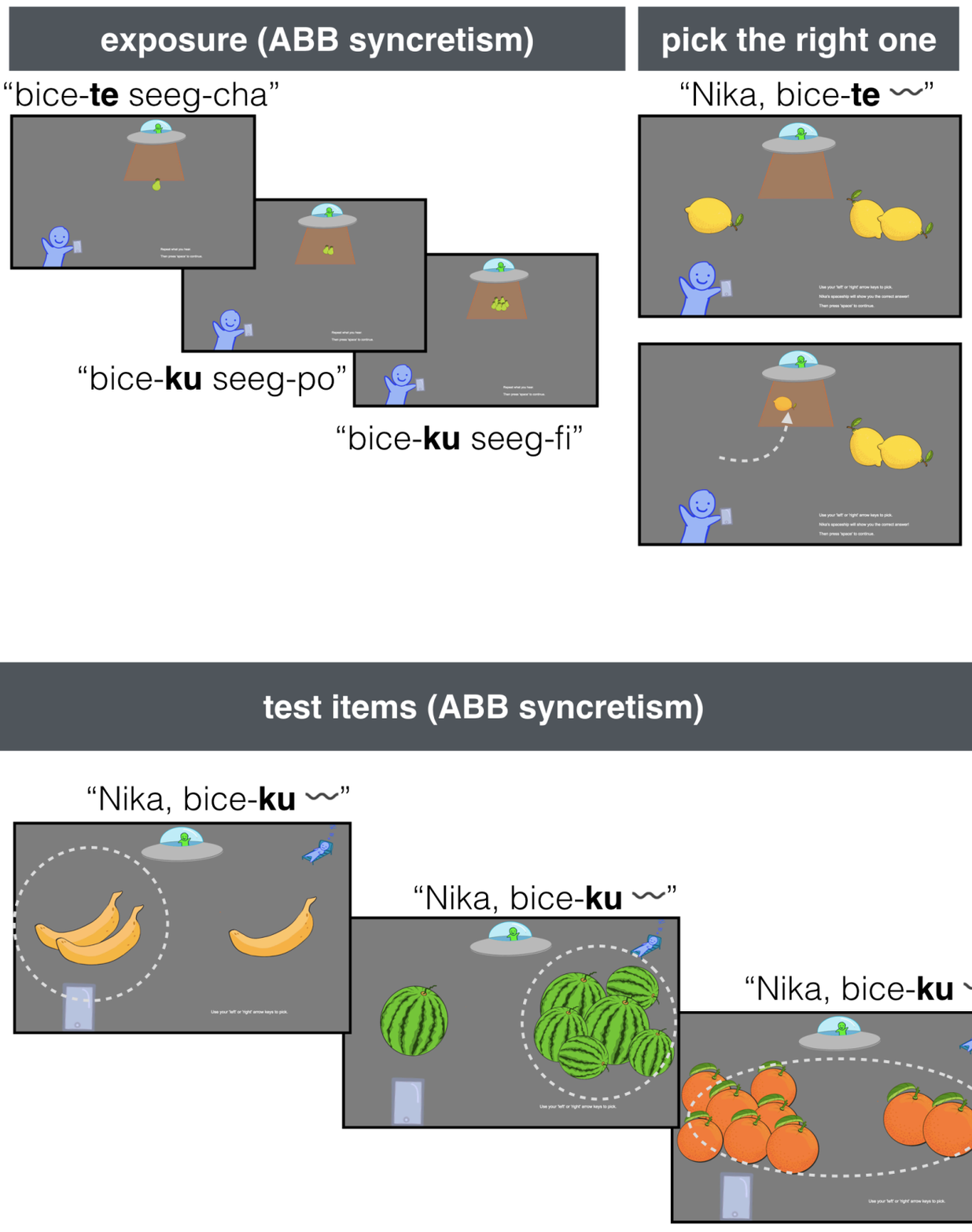
- truth value judgment





procedure

- PsychoPy, converted to PsychoJS, or
- instructions & setup
- sound check
- training: nominal number
  - exposure / repetition
  - referent selection with feedback
- validation: nominal number
- attention check
- **training: verbal number agreement**
  - exposure / repetition
  - referent selection with feedback
- **test: verbal number agreement**
- truth value judgment

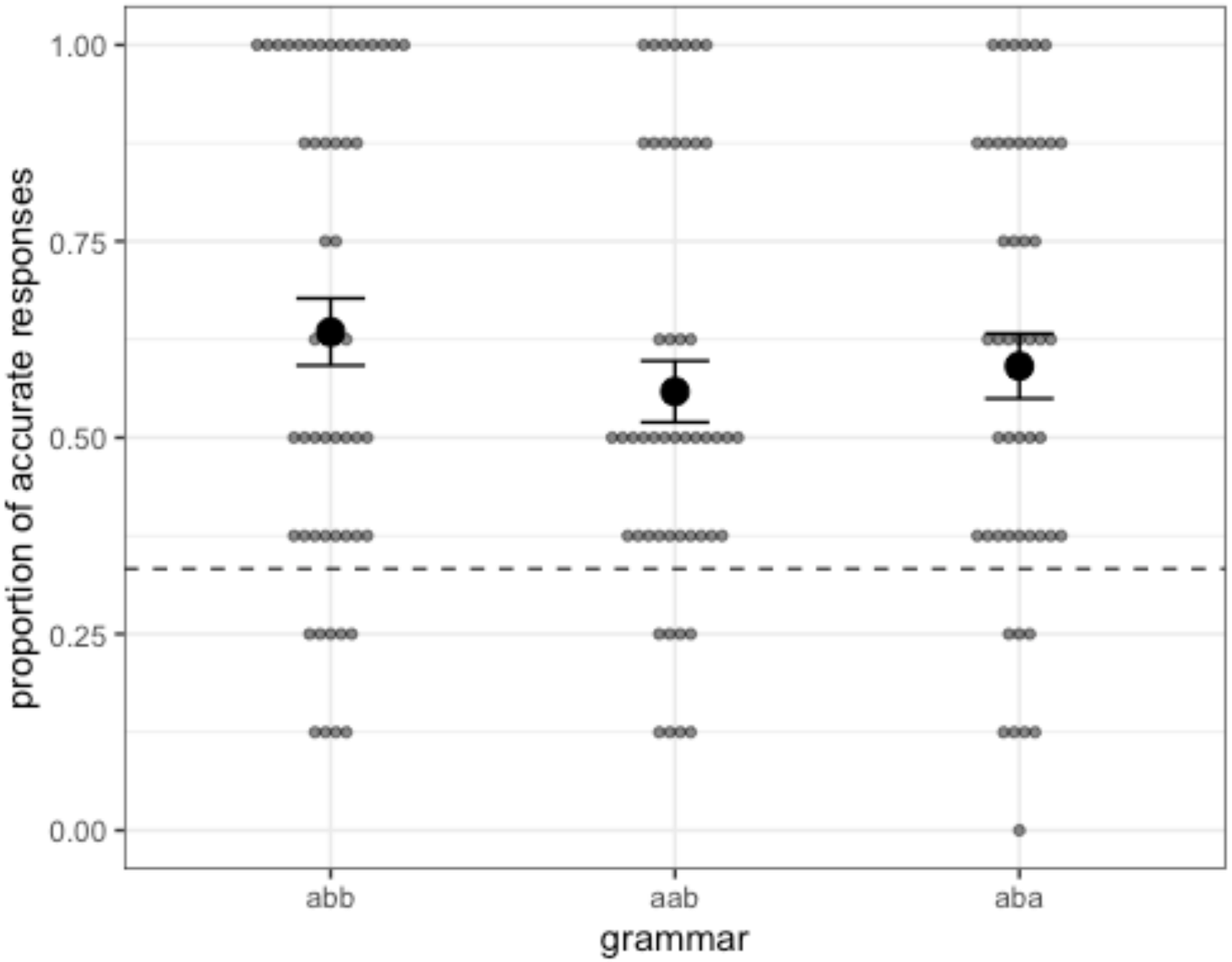


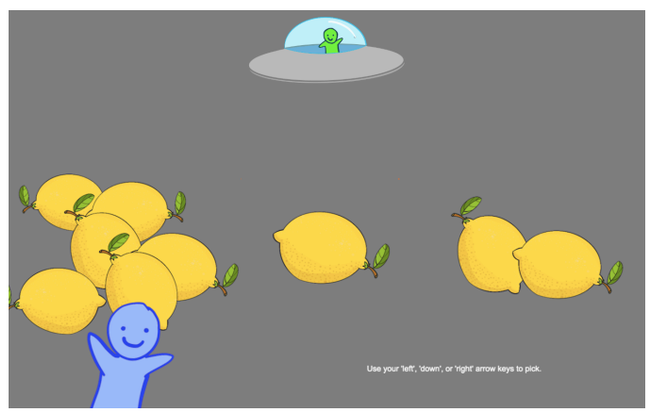
participants

- 325 total AMT workers recruited
- 257 (79%) completed the task (others had missing/no data)
- 149 (46% of total, 58% of participants) qualified for inclusion:
  - both sound checks
  - at least 2 of the 4 attention checks
  - all but 3 reported speaking English growing up

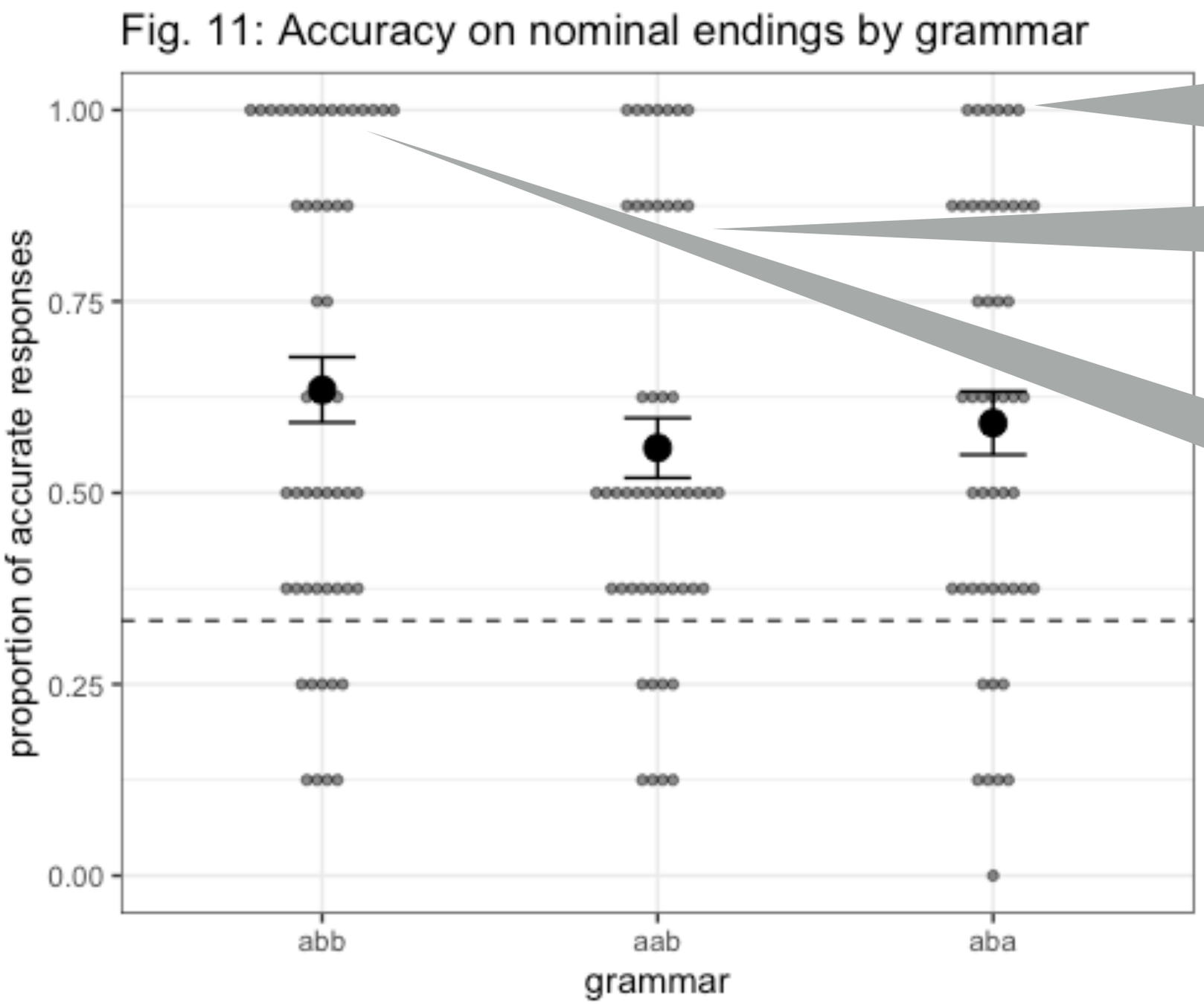
results: referent selection - nominal number

Fig. 11: Accuracy on nominal endings by grammar





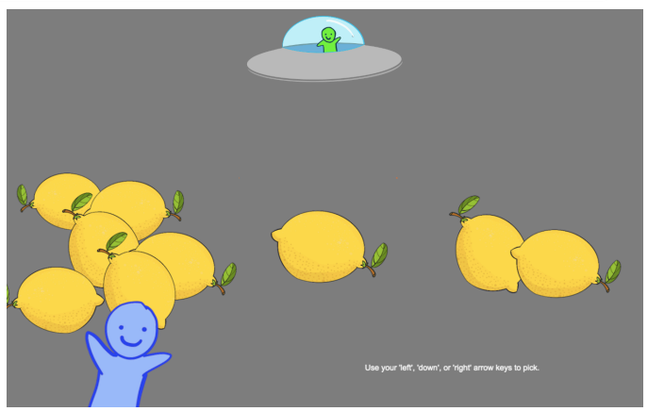
results: referent selection - nominal number



"It looks like the endings of the words denote quantities. Cha = 1, Fi = many, po = 2."

"I think they have different endings for singular, two, and more than two quantities of items."

"The suffix of each word determines the number of items you're trying to describe. Po refers to two items, cha to one item and fi for several item.

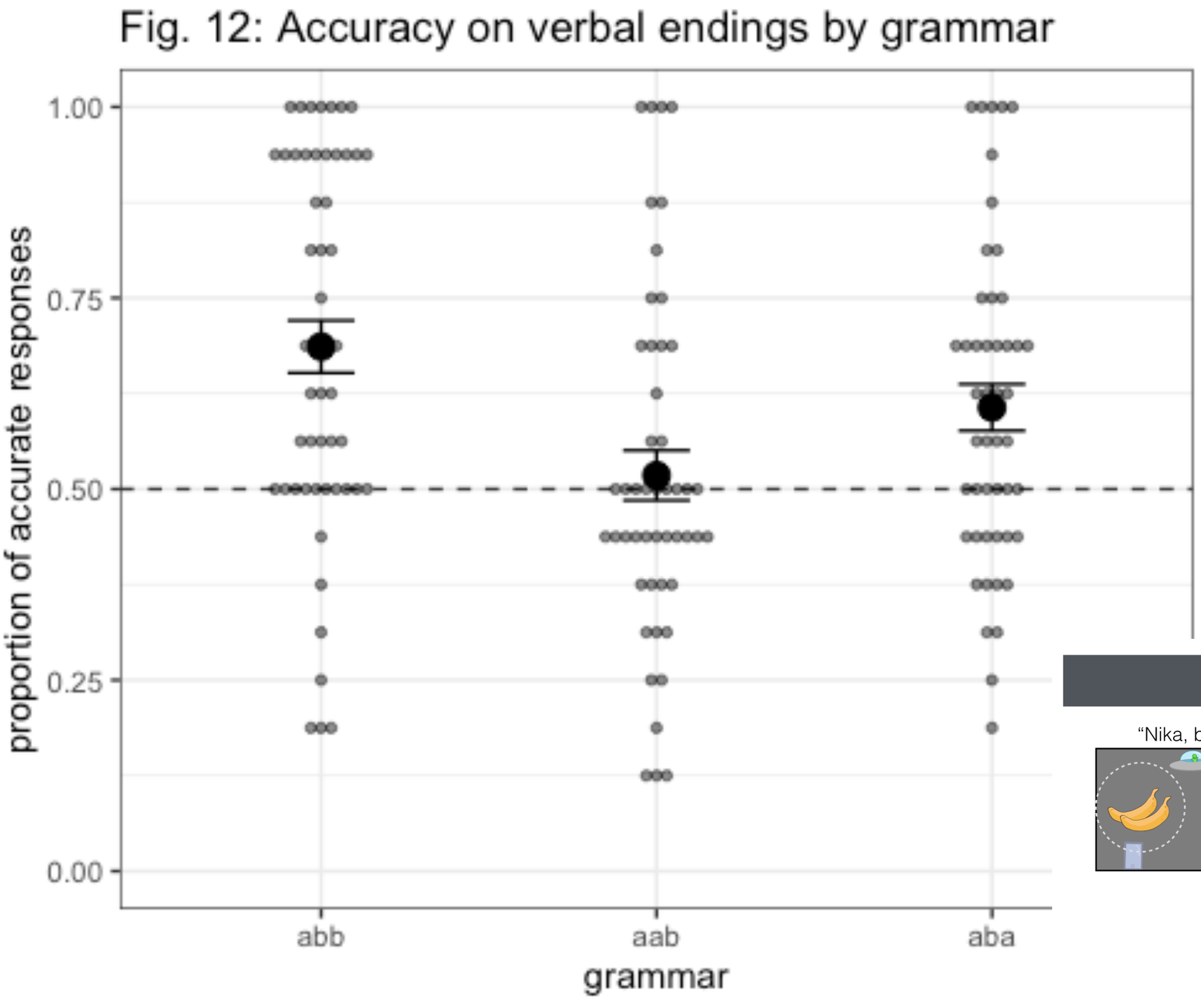


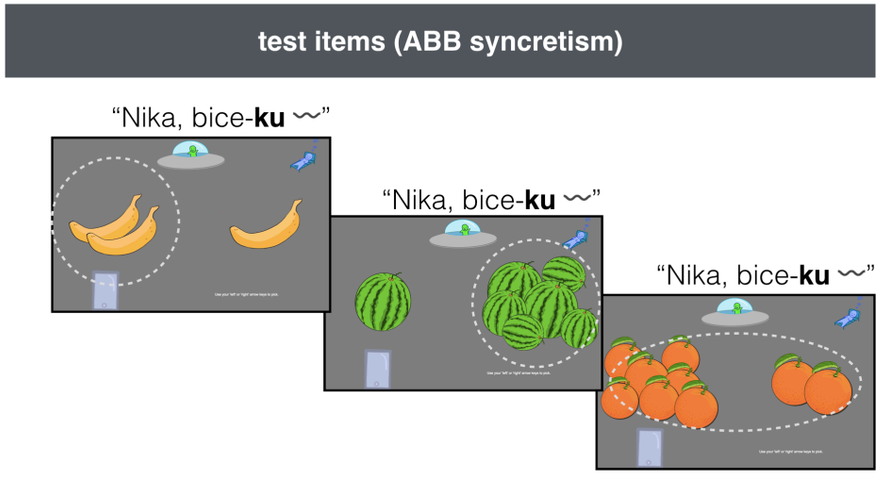
results: referent selection - nominal number

Output of logit model for nominal number validation items

Formula: validation.corr ~ grammar + (1 | participant)					
Fixed effects	Estimate	Std. Error	z-value	p-value	
(Intercept)	0.8173	0.2269	3.602	0.000316	***
grammar:aab	−0.4623	0.3190	−1.449	0.147293	n.s.
grammar:aba	−0.3093	0.3217	−0.961	0.336316	n.s.

results: referent selection - verbal number agreement





results: referent selection - verbal number agreement

Output of logit model for crucial verbal test items

Formula: trial.corr ~ grammar + (1 | participant)					
Fixed effects	Estimate	Std. Error	z-value	p-value	
(Intercept)	1.0304	0.1770	5.823	5.78e−09	***
grammar:aab	−0.9077	0.2484	−3.654	0.000258	***
grammar:aba	−0.4765	0.2500	−1.906	0.056668	n.s.

results: referent selection - verbal number agreement

Output of logit model for crucial verbal test items

Formula: trial.corr ~ grammar + (1 | participant)					
Fixed effects	Estimate	Std. Error	z-value	p-value	
(Intercept)	1.0304	0.1770	5.823	5.78e−09	***
grammar:aab	−0.9077	0.2484	−3.654	0.000258	***
grammar:aba	−0.4765	0.2500	−1.906	0.056668	n.s.

"The prefix either describes the specific action or object, such as "bic" for "give" and "pim" for "drop." The suffix describes whether the action/object referred to is singular or plural. "Cha" is singular, while "po" and "fe" were for "two" and "many." The suffix of the verb ("bic" or "pim) changes depending on whether the object is singular or plural. "Bicete" is for one, while "biceku" was for more than one."

results: referent selection - verbal number agreement

Output of logit model for crucial verbal test items

Formula: trial.corr ~ grammar + (1 | participant)					
Fixed effects	Estimate	Std. Error	z-value	p-value	
(Intercept)	1.0304	0.1770	5.823	5.78e−09	***
grammar:aab	−0.9077	0.2484	−3.654	0.000258	***
grammar:aba	−0.4765	0.2500	−1.906	0.056668	n.s.

"I think they have different endings for singular, two, and more than two quantities of items. They have a different ending to verbs when used with the more than two quantity ending of nouns."

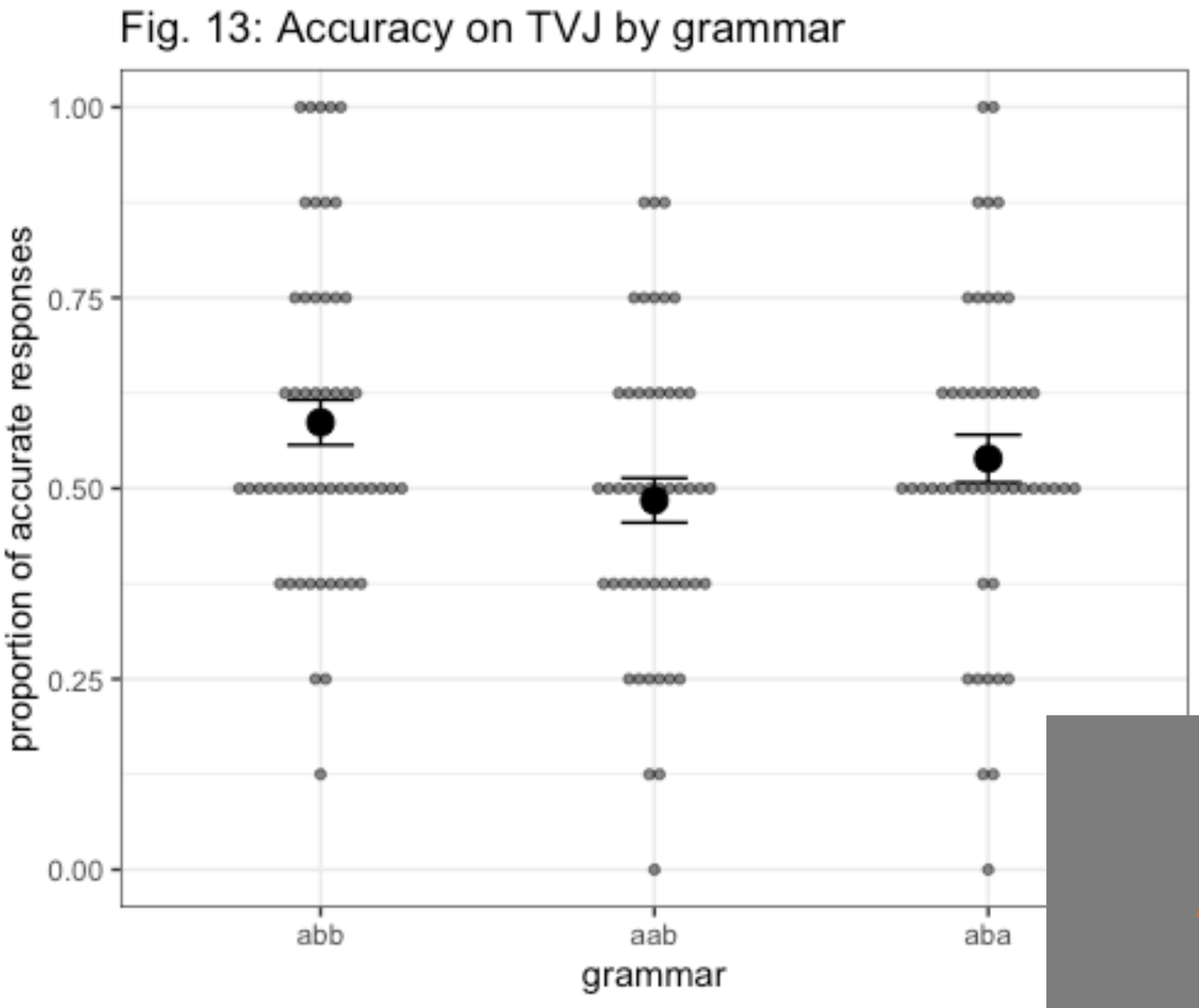
results: referent selection - verbal number agreement

Output of logit model for crucial verbal test items

Formula: trial.corr ~ grammar + (1 | participant)					
Fixed effects	Estimate	Std. Error	z-value	p-value	
(Intercept)	1.0304	0.1770	5.823	5.78e−09	***
grammar:aab	−0.9077	0.2484	−3.654	0.000258	***
grammar:aba	−0.4765	0.2500	−1.906	0.056668	n.s.

“It looks like the endings of the words denote quantities. Cha = 1, Fi = many, po = 2. The start of the word is the actual verb/ noun, so like sig was pear, bice was take, etc. For verbs, the ending was different, so Ku meant 2, whereas te meant either 1 or many depending on context “

results: truth value judgment



results

- high accuracy on three-way sg-du-pl distinction on nouns, in all grammars (no significant difference)

→non-native grammatical contrasts are learnable

- highest accuracy on du-pl syncretism on verbs (ABB)
- slightly worse (n.s.) performance on sg-pl (ABA)
- significantly worse (p<0.001) on sg-du (AAB)

→support for Smith et al.'s linear containment over Harbour's bundles

A typological survey of 30 sg-du-pl languages' number neutralization patterns

	ABB	**AAB**	**ABA**
syncretism	22	6	1
suppletion	14	5	1
total languages	26 (87%)	10 (33%)	2? (7%)

To be learnable, a neutralization must be representable

nouns	verbs
sg	A
du	B
pl	B

nouns	verbs
sg	A
du	A
pl	B

nouns	verbs
sg	A
du	B
pl	A

Binary, cross-classifying (Harbour 2014, 2016)	✅	✅	❌
Privative linear containment (Smith et al. 2019)	✅	❌	✅
Typological survey	87%	33%	7%
Average participant performance by grammar	0.68	0.52	0.61

- an experimental method for learning artificial language natural classes active in **syncretism**

→ possible support for representing number as a privative containment hierarchy rather than bundles of cross-classifying features

- an experimental method for learning artificial language natural classes active in **syncretism**

→ possible support for representing number as a privative containment hierarchy rather than bundles of cross-classifying features

→ *Is the internal organization of features the same across grammatical categories?: gender*

→ *How does the architecture of morphosyntactic features constrain which diachronic innovations may arise?*

Thank you!

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Appendix

ruling out other interpretations

- good performance on ABA: default exponence?

	$+\alpha$	$-\alpha$
$+\beta$	A	B
$-\beta$	B	A

- Smith et al. *AAB or *ABA: parametric variation in containment?

sg < pl < du (main Smith et al. containment)

a. **ABB**

	nouns	**verbs**
sg	cha	A
du	fi-po	B
pl	fi	B

b. ***AAB**

nouns	**verbs**
cha	A
fi-po	A
fi	B

c. **ABA**

nouns	**verbs**
cha	A
fi-po	B
fi	A

sg < du < pl (alternate Smith et al. containment)

a. **ABB**

	nouns	**verbs**
sg	cha	A
du	po	B
pl	po-fi	B

b. **AAB**

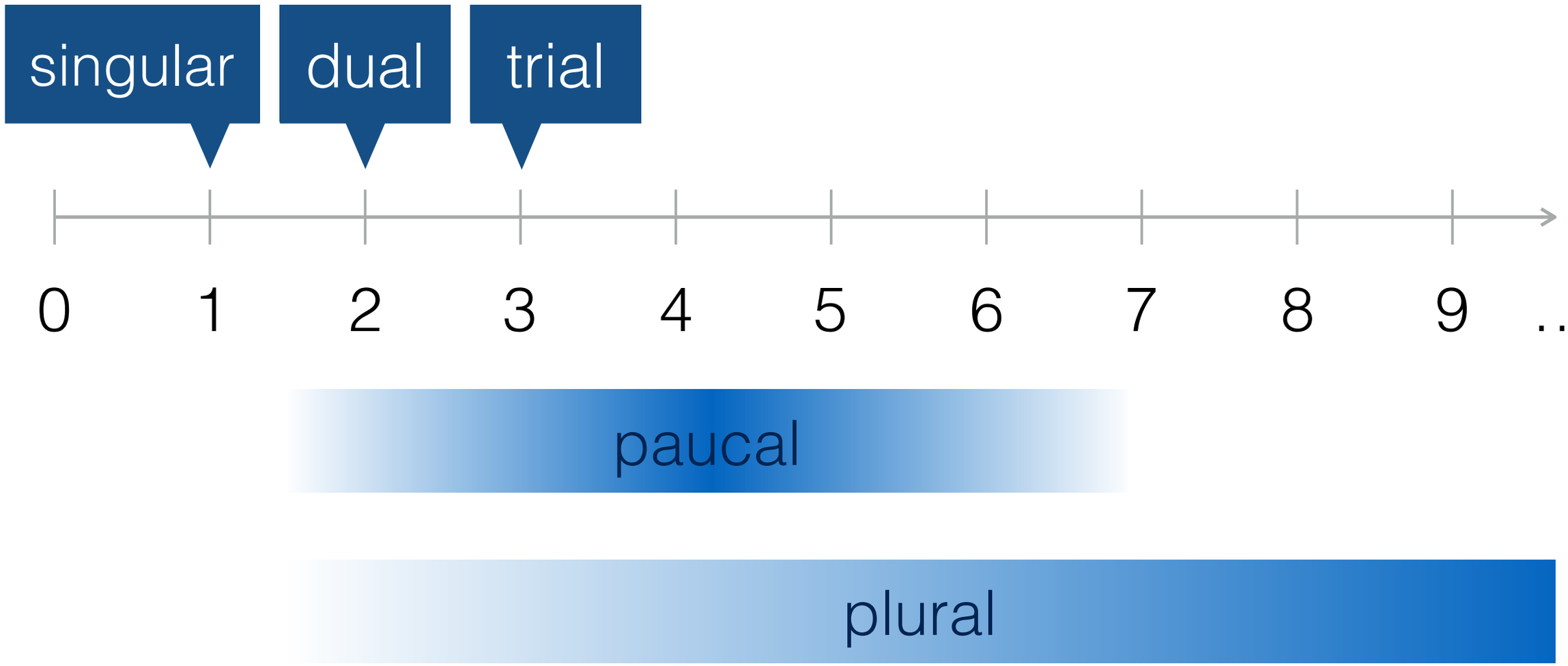
nouns	**verbs**
cha	A
po	A
po-fi	B

c. ***ABA**

nouns	**verbs**
cha	A
po	B
po-fi	A

- ABA > AAB: salient two, not grammatical dual?

Attested number values



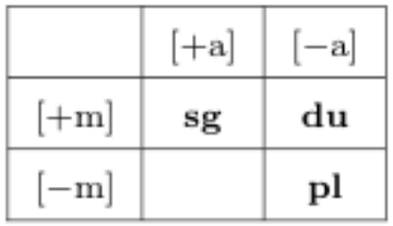
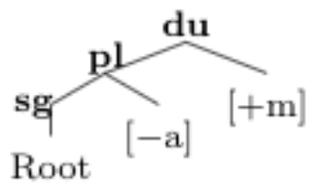
Corbett 2000

Attested number systems: 6, not ~32

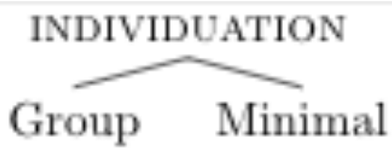
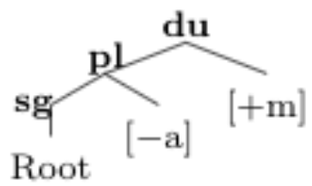
<table>
<tr><th>sg-pl</th><th>sg-du-pl</th><th>sg-du-tri-pl</th><th>sg-pc-pl</th><th>sg-du-pc-pl</th><th>sg-du-tr-pc-pl</th></tr>
<tr><td>singular</td><td>singular</td><td>singular</td><td>singular</td><td>singular</td><td>singular</td></tr>
<tr><td rowspan="4">plural</td><td rowspan="4">plural</td><td>dual</td><td rowspan="2">paucal</td><td>dual</td><td>dual</td></tr>
<tr><td rowspan="3">plural</td><td rowspan="2">paucal</td><td>trial</td></tr>
<tr><td rowspan="2">plural</td><td rowspan="2">plural</td><td rowspan="2">paucal</td></tr>
<tr><td>plural</td><td>plural</td></tr>
</table>

Corbett 2000

Different representational systems for organizing features

Theory	feature inventory	syntactic organization	natural class for spellout	prediction (sg-du-pl)
Harbour 2014, 2016	{±atomic, ±minimal} 	binary values in a bundle	all bundles that share a feature	*ABA
Smith et al. 2019	{±atomic, ±minimal} 	privative, on separate heads	contiguous linear spans	*AAB

Different representational systems for organizing features

Theory	feature inventory	syntactic organization	natural class for spellout	prediction (sg-du-pl)
Harbour 2014, 2016	{±atomic, ±minimal} <table><tr><td></td><td>[+a]</td><td>[−a]</td></tr><tr><td>[+m]</td><td>**sg**</td><td>**du**</td></tr><tr><td>[−m]</td><td></td><td>**pl**</td></tr></table>	binary values in a bundle	all bundles that share a feature	*ABA
Harley & Ritter 2002	{Group, Minimal} 	privative, in a structured bundle	all bundles that share a feature	*ABA
Smith et al. 2019	{±atomic, ±minimal} 	privative, on separate heads	contiguous linear spans	*AAB

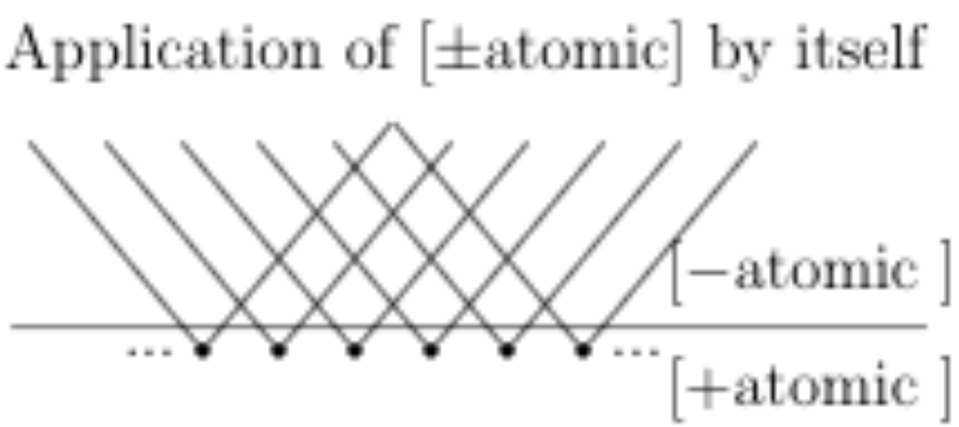
Harbour 2014, 2016

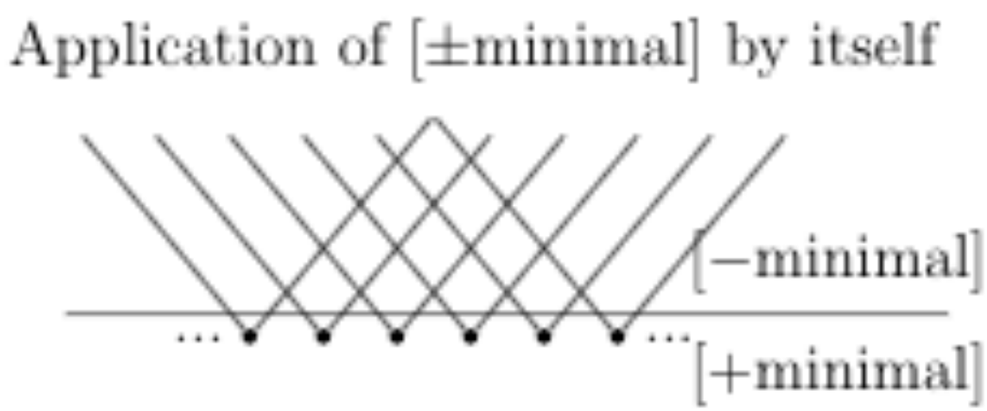
[+atomic] = λx.atom(x)

[−atomic] = ¬λx.atom(x)

[+minimal] = λPλx.¬∃y(P(y) ∧ y⊏x)
presupposition: P(x)

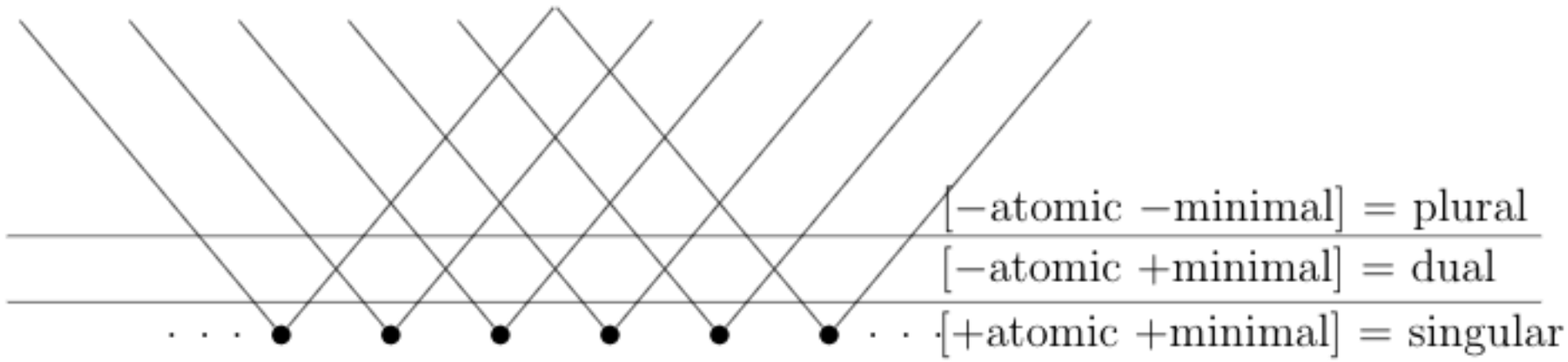
[−minimal] = λPλx.∃y(P(y) ∧ y⊏x)
presupposition: P(x)





Following Noyer, Harbour picks out du-pl (ABB) and sg-du (AAB) natural classes

Application of [±atomic] and [±minimal] to derive sg-du-pl
(simplified Hasse diagram, adapted from Harbour 2007: 70)



Following Noyer, Harbour picks out du-pl (ABB) and sg-du (AAB) natural classes

Application of [±atomic] and [±minimal] to derive sg-du-pl
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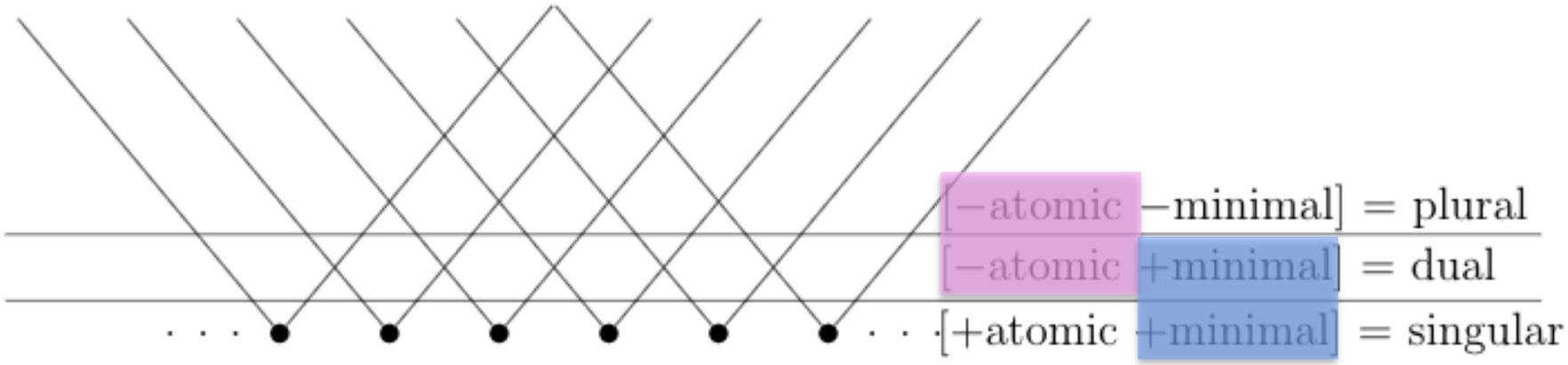
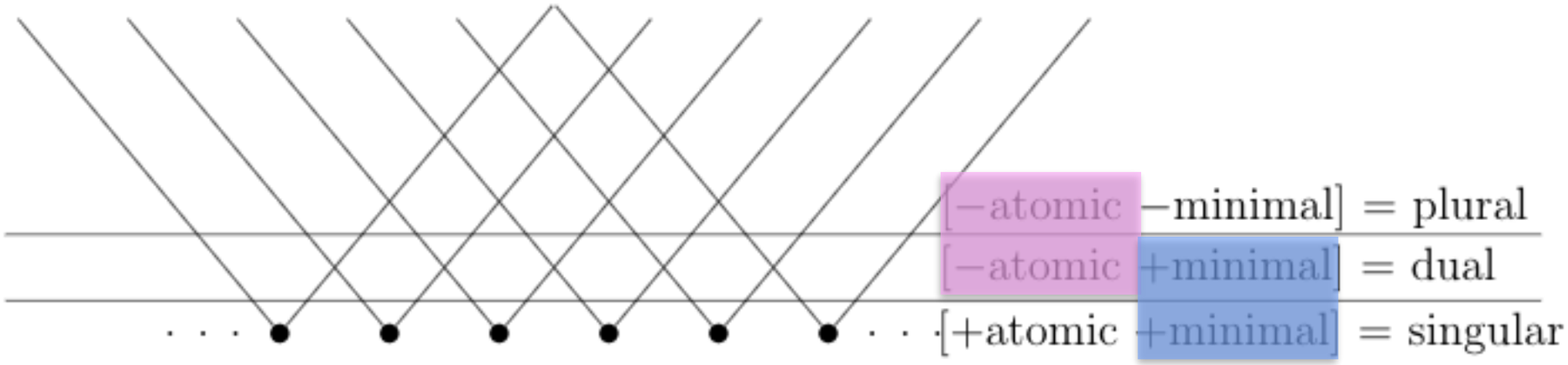


Harbour	sg	du	pl
✅	A	B	B
✅	A	A	B
	A	B	A

Following Noyer, Harbour picks out du-pl (ABB) and sg-du (AAB) natural classes

Application of [±atomic] and [±minimal] to derive sg-du-pl
(simplified Hasse diagram, adapted from Harbour 2007: 70)



Hopi's dual, composed from [−atomic] and [+minimal]

a. pam
that.SG=[+ATOMIC]
wari
run.SG/DU=[+MINIMAL]
he/she ran.

b. puma
that.DU/PL=[−ATOMIC]
wari
run.SG/DU=[+MINIMAL]
they (two) ran.

c. puma
that.DU/PL=[−ATOMIC]
yu'tu
run.PL=[−MINIMAL]
they (more than two) ran.

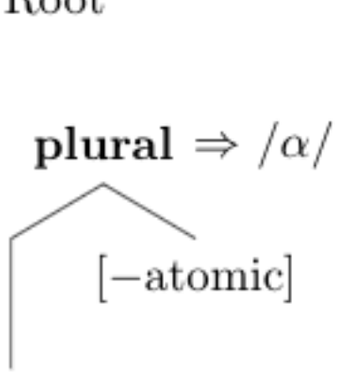
Harbour	sg	du	pl
✅	A	B	B
✅	A	A	B
	A	B	A

Smith et al. can derive a single suppletive root for sg-pl to the exclusion of du

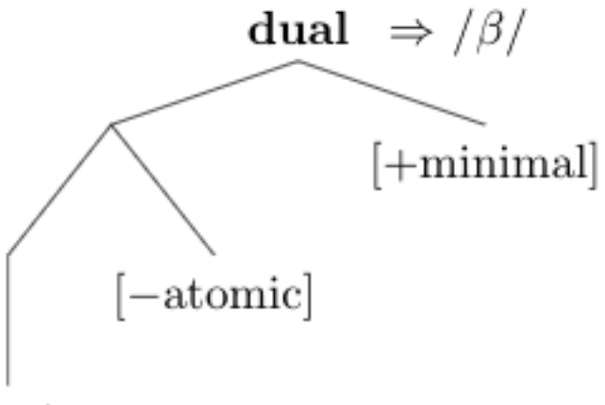
ABA:
Matched morphosyntactic trees

a. **singular** ⇒ /α/

b. **plural** ⇒ /α/

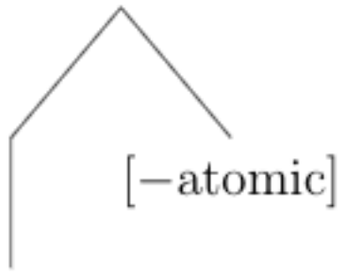


c. **dual** ⇒ /β/

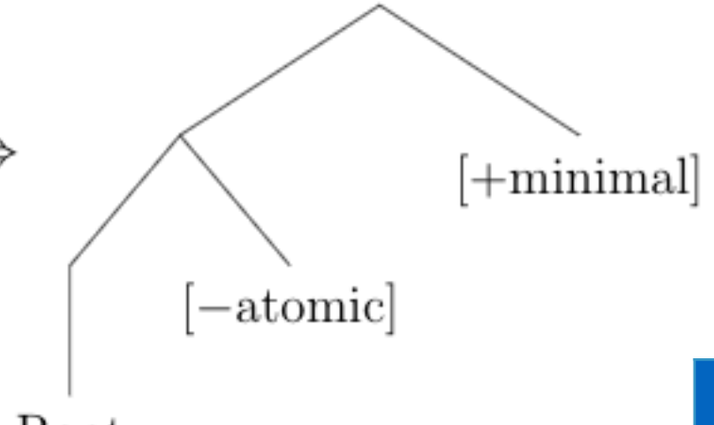


ABA:
Lexical entries

⟨ /α/ ⟺



⟨ /β/ ⟺



- no recourse to defaults
- Root node is included in spellout here: Smith et al. are modeling pronoun stem suppletion

Smith	sg	du	pl
✅	A	B	B
	A	A	B
✅	A	B	A

A typological survey of 30 sg-du-pl languages' number neutralization patterns

	ABB	**AAB**	**ABA**
syncretism	22	6	1
suppletion	14	5	1
total languages	26 (87%)	10 (33%)	2? (7%)

Dual syncretism with the plural

(1)	ha-yom-∅	ʕavar	maher	singular
	DEF-day-SG	pass.PST.3.M.SG	quickly	
(2)	ha-yom-ayim	ʕavru	maher	dual
	DEF-day-DUAL	pass.PST.3.PL	quickly	
(3)	ha-yam-im	ʕavru	maher	plural
	DEF-day-PL	pass.PST.3.PL	quickly	

	sg	du	pl
✅	A	B	B
	A	A	B
	A	B	A

ABB patterns are abundantly common: Koryak

papa

	sg	du	pl
abs	appa	appa-nte	appa-w
loc	appa-na-k	appa-jək	
erg/instr	appa-na-k	appa-jək	
abl	appa-na-ŋqo	appa-jək-ŋqo	
trans	appa-na-jpəŋ	appa-jək-jpəŋ	
dat	appa-na-ŋ	appa-jək-əŋ	
adit	appa-na-jtəŋ	appa-jəka-jtəŋ	

syncretism in number suffixes on Declension II nouns (before case suffixes)

1st person

sg	du	pl
gəmmo	muji	muju
gəmə-k	mujə-k	
gəm-nan	močgə-nan	
gəmka-ŋqo	mojka-ŋqo	
gəmka-jpəŋ	mojka-jpəŋ	
gəmka-ŋ	mojka-ŋ	
gəmka-jtəŋ	mojka-jtəŋ	

suppletion for number of 1st, 2nd, and 3rd person pronoun stems

AAB only appears if ABB also does: Koasati suppletive verbs

	sg	du	pl	
ABC	haccá:lin	hikkí:lin	lokkó:lin	to stand
	cokkó:lin	cikkí:kan	í:san	to sit
	á:tan	áswan	í:san	to dwell
AAB	íllin		hápkan	to die
	á:yan		yomáhlin	to go about
	alí:yan		amá:kan	to go
	óntin		ilmá:kan	to come
ABB	nakallan	wasátkan		to be lost
	walí:kan	tólkan		to run
	onno-halí:kan	onno-káhkan		to clamber up
	ac-halí:kan	as-káhkan		to exit
	cok-halí:kan	cok-káhkan		to enter
	acapílkan	askáhlin		to release (obj)
	í:sin	píhlin		to pick up (obj)
	batáplin	bóklin		to hit (pluractional)
	naksá:kan	sakáplin		to make noise (plur)

AAB only appears if ABB also does: Samogitian noun declensions

syncretism in case-number suffixes

potato

	sg	du	pl
nom	bolbė		bolbės
gen	bolbės	bolbiu	
dat	bolbē	bolbiem	bolbiems
acc	bolbė		bolbės
ins	bolbi	bolbiem	bolbiems
loc	bolbie	bolbies	
voc	bolbė		bolbės

…on -*e* declension nouns

word

sg	du	pl
žuodis	žuodio	žuodē
žuodė	žuodiu	
žuodiou	žuodems	
žuodi	žuodio	žuodius
žuodio	žuodēs	
žuodie	žuodiūs	
žuodi	žuodio	žuodē

…on -*is* declension nouns

Proposed examples of ABA pronoun suppletion are not robust: ~~Wambaya~~

	sg	du	pl
1st incl	—	mrindiyani	ngurruwani
1st excl	ngawu(rniji)	ngurluwani	ngirriyani

suppletion for number of 1st inclusive pronoun stems?

Proposed examples of ABA pronoun suppletion are not robust: ~~Dehu~~

	sg	du	pl
3rd, equal/familiar	angeice		angate
	nyide	nyido	
3rd, contemptuous	nyene	nyude	nyuden

suppletion for number of
3rd person pronoun stems?

Proposed examples of ABA pronoun suppletion are not robust: Yagua?

	sg	du	pl
1st incl	—	vúúy	
1st excl	ráy	nááy	núúy
2nd	jiy	saadá	jiryéy
3rd	níí	naadá	ríy

jíy: co-reference clitic, for some other participant in the clause - **not used for 1st and 2nd singular**, with no inherent person/number index

suppletion for number of
2nd person pronoun stems?

Proposed examples of ABA pronoun suppletion are not robust: Yagua?

	sg	du	pl
1st incl	—	vúúy	
1st excl	ráy	nááy	núúy
2nd	jiy	saadá	jiryéy
3rd	níí	naadá	ríy

	sg	du	pl
1st incl	—	vúúy	
1st excl	ráy	nááy	núúy
2nd	jíy	saaná	jíryey
3rd	sa	naada	riy

One additional potential ABA pattern: Yup'ik relative and oblique nominal declensions

	possessor	sg	du	pl
abs	unposs.	+q	+ɣ	+t
	1sg	-ka	+ɣka	+nka
	1du	+puɣ	+ɣpuɣ	-puɣ
	1pl	+put	+ɣput	-put
rel	unposs.	+m	+ɣ	+t
	1sg	-ma	+ɣma	-ma
	1du	-miɣnuɣ	+ɣmiɣnuɣ	-miɣnuɣ
	1pl	-mta	+ɣ+mta	-mta

syncretism in case-possessor-number suffixes for non-absolutive noun declensions?

One additional potential ABA pattern: Yup’ik relative and oblique nominal declensions

	possessor	sg	du	pl
abs	unposs.	+q	+ɣ	+t
	1sg	-ka	+ɣka	+nka
	1du	+puɣ	+ɣpuɣ	-puɣ
	1pl	+put	+ɣput	-put
rel	unposs.	+m	+ɣ	+t
	1sg	-ma	+ɣma	-ma
	1du	-miɣnuɣ	+ɣmiɣnuɣ	-miɣnuɣ
	1pl	-mta	+ɣ+mta	-mta

syncretism in case-possessor-number suffixes for non-absolutive noun declensions?

ABB: demonstrative suffix

AAB: number suffix for ‘dog harness’, ‘summer trousers’, ‘fur boots’

Language	Family	ABB	AAB	ABA	Syncretism? Suppletion?	Description	Source
Arapesh (Bukiyip)	Torricelli	✓			Syncretism	verbal prefix, for number of 2nd person subjects	Conrad & Wogiga 1991
		✓			Suppletion	3rd person pronoun stems	
Awtuw	Sepik-Ramu	✓			Suppletion	1st person pronoun stem	Feldman 1986
Chinook	Penutian						Boas 1911
Comanche	Uto-Aztecan	✓			Suppletion	2nd person subj, obj, poss, postpositional pronouns	Charney 1989
		✓			Suppletion	'thing' noun root	
		✓			Suppletion	'hold', 'say/tell', 'talk', 'sleep', 'lie down' verb roots	
Dehu	Austronesian (Oceanic)			?	Suppletion	3rd person familiar/equal pronoun stem	Ray 1917
Dieri (Diyari)	Pama-Nyungan	✓			Syncretism	ablative suffix on lexical nouns	Austin 2013
Hebrew (Mod.)	Afro-Asiatic	✓			Syncretism	verb and adjective agreement	Corbett 2000
Hmong Njua	Hmong-Mien	✓			Suppletion	2nd person pronoun stem	Mottin 1978
Ho	Austro-Asiatic						Burrows 1915
Hopi	Uto-Aztecan	✓			Syncretism	2nd and 3rd person pronominal number affix	Hale et al. 1991
		✓			Suppletion	1st person pronoun stem	
			✓		Syncretism	verbal suffix / reduplicative prefix	
			✓		Suppletion	'die', 'run', 'cry', 'kill', 'put', 'throw' verb stems	
Jingulu (Djingili)	West Barkly	✓			Suppletion	2nd person pronouns, in all cases	Pensalfini 2003
		✓			Variable agr.	plural demonstratives, nouns, or bound pronouns can agree with dual ones	
Kham	Sino-Tibetan (Magaric)	✓			Suppletion	1st, 2nd personal, possessive pronouns, verbal prefixes	Watters 2002
		✓			Syncretism	1st person object suffixes, imperatives	
Khoekhoe	Khoe-Kwadi						Hagman 1974, Lee 2019
Kinnauri	Sino-Tibetan (Bodic)	✓			Suppletion	1st incl, 1st excl pronoun stems	Śarmā 1988
		✓			Syncretism	1st excl, honorific 2nd, honorific 3rd person indicative verbal suffixes	
Koasati	Muskogean	✓			Syncretism	verbs (of motion) suffix, for number of 3rd person subjects	Kimball 1985
		✓			Suppletion	'run', 'be lost', 'clamber', 'exit', 'enter' verb stems	
		✓			Suppletion	'release', 'pick up' verb stems, for number of objects	
			✓		Suppletion	'go about', 'die', 'go', 'come' verb stems	
Koryak	Chukutko-Kamchatkan	✓			Syncretism	decl. II nouns in all non-absolutive cases	SMG
		✓			Suppletion	1st, 2nd, 3rd, pronoun stems in all non-absolutive cases	
Manam	Austronesian (Oceanic)	✓			Suppletion	1st, 3rd, pronoun stems	Lichtenberk 1983, Turner 1986
		✓			Syncretism	verbs and most adjectives' number endings	
Mazahua	Oto-Manguean	✓			Syncretism	3rd person pronominal number suffix	Suárez 2009

Language	Family	ABB	AAB	ABA	Syncretism? Suppletion?	Description	Source
Navajo	Na-Dene	✓			Suppletion	1st, 2nd person pronoun stems	Goossen 1995, Young & Morgan 1980
		✓			Syncretism	verbal subject / object prefixes	
		✓			Suppletion	'die' verb stem	
			✓		Syncretism	verbal affixes, for 3rd person subjects	
			✓		Syncretism	3rd person personal, possessive, postpositional pronouns	
Ngandi	Gunwinyguan	✓			Suppletion	1incl, 1excl, 3rd (full and verbal prefix) pronominal stems	Heath 1978
		✓			Syncretism	possessive suffixes for all persons (except 3.f)	
		✓			Syncretism	3rd feminine and mixed m/f personal pronouns	
Sámi (N)	Uralic	✓			Syncretism	verbal agreement for indefinite subjects	Vinka 2001, Nevins 2011
Samogitian (Lithuanian)	Indo-European	✓			Syncretism	genitive noun number affix	
		✓			Syncretism	locative noun number affix	
			✓		Syncretism	-*e*-declension nominative noun number affix	
			✓		Syncretism	-*e*-declension accusative noun number affix	
			✓		Syncretism	-*e*-declension vocative noun number affix	
Slovene	Indo-European	✓			Syncretism	genitive and locative noun endings in all declensions	SMG
			✓		Suppletion	'person' noun stem	
Tonkawa	Coahuiltecan	✓			Syncretism	pronominal object verbal affixes	Hoijer 1933
		✓			Syncretism	pronominal number affixes, all persons (composed dual)	
			✓		Syncretism	pronominal personal suffixes, all persons (composed dual)	
Tunica	Gulf	✓			Syncretism	feminine lexical noun affixes	Haas 1940, Swanton 1921
			✓		Suppletion	3rd person masculine pronoun stems	
Wappo	Yuki	✓			Suppletion	3rd possessive pronoun stems	Radin 1929
Yagua	Austronesian (Oceanic)	✓			Syncretism	1st inclusive Set I prefixal clitics (for animates)	Payne 1985
			✓		Suppletion	3rd animate free pronoun stem (also Set II suffixal clitic)	
			✓		Suppletion	numeral classifier base affix for animate nouns	
				✓?	Suppletion	2nd animate free pronoun stem (also Set I & Set II clitics)	
Yaudanchi (Yokuts)	Penutian	✓			Suppletion	'kill' verb stem, for number of objects	Kroeber 1907
		✓			Syncretism	animate noun endings	
Yup'ik	Eskimo-Aleut	✓			Syncretism	nominal demonstrative expander morpheme +ku	Miyaoka, Bossong, & Comrie 2012, Corbett 2000
			✓		Syncretism	1 or 2 instances of 'dog.harness' and 'summer.trousers' take the dual for nominal number endings and verbal agreement	
				✓?	Syncretism	possessed (non-3rd possessor) relative & oblique nominal affixes	
Zuni	Isolate	✓			Syncretism	1st, 2nd person, nom, acc. pronominal number affixes	Bunzel 1934, Newman 1965
		✓	✓		Variable agr.	same lexical noun in sg or pl can agree with dual pronoun	
			✓		Syncretism	all verb agreement (subject, object, indirect object number affixes)	