Numeral Semantics | Friday

Lisa Bylinina & Rick Nouwen

ESSLLI 2019

bit.ly/esslli-numsem

Different contexts where cardinals appear

(Geurts 2006)

arithmetical	**Five** is the fourth Fibonacci number.
quantifying	**Five** ducks entered the lobby.
predicative	These are **five** buckets.
adjectival	the **five** girls
measure	**five** pounds of buckwheat
label	Chanel number **five**

Different contexts where cardinals appear

(Geurts 2006)

arithmetical	**Five** is the fourth Fibonacci number.
quantifying	**Five** ducks entered the lobby.
predicative	These are **five** buckets.
adjectival	the **five** girls
measure	**five** pounds of buckwheat
label	Chanel number **five**
recitation	one, two, three, four, **five**..

Cardinal meaning(s)

e entity	$\langle e, t\rangle$ property	$\langle\langle e, t\rangle, t\rangle$ quantifier	$\langle\langle e, t\rangle, \langle\langle e, t\rangle, t\rangle\rangle$ quantifier
d degree	$\langle d, t\rangle$ degree property	$\langle\langle d, t\rangle, t\rangle$ degree quantifier	

Today (joint work with Marcin Wagiel)

- English uses the same string (five) for all these cases
- It's not so for all languages
- The label 'cardinals' covers a family of numeral classes
- We'll look at: 1) recitation sequence; 2) 'math' contexts
- This will force us to look closer at:
  - what counting is
  - where mathematical language comes from

Part 1 starting point: Russian count list

Part 1 starting point: Russian count list

[Count up to 10!]

Part 1 starting point: Russian count list

[Count up to 10!]

raz, dva, tri, četyre, p'at', šest' ...

Part 1 starting point: Russian count list

[Count up to 10!]

raz, dva, tri, četyre, p'at', šest' ...

odin stol	dva stola	tri stola
one table	two tables	three tables

Part 1 starting point: Russian count list

[Count up to 10!]

raz, dva, tri, četyre, p'at', šest' ...

odin stol	dva stola	tri stola
one table	two tables	three tables

*raz stol

Part 1 starting point: Russian count list

[Count up to 10!]

raz, dva, tri, četyre, p'at', šest' ...

odin stol	dva stola	tri stola
one table	two tables	three tables

*raz stol

QUANT:	**raz**	dva	tri	četyre	...
RECIT:	**odin**	dva	tri	četyre	...

Questions

- What's a 'recitation list numeral'?
- What's the relation between recitation/counting and quantification?
- What's the role of language in counting as a cognitive ability?

Counting principles (Gelman and Gallistel 1978)

1. **The stable order principle**
   There must be a stably ordered list of counting symbols (**recitation sequence**)

Counting principles (Gelman and Gallistel 1978)

1. **The stable order principle**
   There must be a stably ordered list of counting symbols
   (**recitation sequence**)
2. **The 1-1 correspondence principle**
   The symbols must be applied in 1-1 correspondence to the individuals in the set being enumerated
   (**recitation sequence is used in counting**)

Counting principles (Gelman and Gallistel 1978)

1. **The stable order principle**
   There must be a stably ordered list of counting symbols
   (**recitation sequence**)
2. **The 1-1 correspondence principle**
   The symbols must be applied in 1-1 correspondence to the individuals in the set being enumerated
   (**recitation sequence is used in counting**)
3. **The cardinality principle**
   The cardinal value of the set is determined by the ordinal position of the last symbol reached in the count
   (**cardinality named after the recitation numeral used last**)

Acquisition of counting principles

- There is a stage (6-18 months) when **stable order** and **1-1 correspondence** are observed, but **the cardinality principle** isn't
- Wynn (1990) identified children who could count at least to six (observing **stable order** and **1-1 correspondence**), but who failed when asked to give 2 or 3 objects

Acquisition of counting principles

- There is a stage (6-18 months) when **stable order** and **1-1 correspondence** are observed, but **the cardinality principle** isn't
- Wynn (1990) identified children who could count at least to six (observing **stable order** and **1-1 correspondence**), but who failed when asked to give 2 or 3 objects

- Cognitively, counting precedes the ability to quantify
- Quantification depends on counting and recitation

‘Quinean bootstrapping’ capitalizes on this

Carey (2009) breaks number acquisition into 3 steps:

A. Learning the ordered list (one, two, three, four, five, six...);
B. Learning the meaning of the symbols in the list (five means 5);
C. Learning how the list represents number
(allows to infer the meaning of a newly mastered numeral symbol – e.g., eleven – from its position in the numeral list)

Bootstrapping: ‘the learner initially [learns] the relations of a system of symbols to one another directly, rather than by mapping each symbol onto preexisting concepts’

The role of language in number bootstrapping

- The child learns the count list as a list of meaningless words – their meaning boils down to their relative order in the list
- Using linguistic and non-linguistic clues, the learners acquire the numeric meaning of the most frequent cardinal numerals (one to three/four)
- 'They note the identity of the words one, two, three, and four ... and the first words in the otherwise meaningless counting list' (Carey 2009)

Count numerals are different from cardinals

QUANT:	**raz**	dva	tri	četyre	...	RUSSIAN
RECIT:	**odin**	dva	tri	četyre	...	

Count numerals are different from cardinals

QUANT:	**raz**	dva	tri	četyre	...	RUSSIAN
RECIT:	**odin**	dva	tri	četyre	...	

- Gã (Niger-Congo): ekome '1.COUNT' vs. eko '1.CARD'
- Palaung (Mon-Khmer): hlɛh '1.COUNT' vs. ū '1.CARD'

Count numerals are different from cardinals

QUANT:	bat	**bi**	hiru	lau	...	BASQUE
RECIT:	bat	**biga**	hiru	lau	...	

Count numerals are different from cardinals

QUANT:	bat	**bi**	hiru	lau	...	BASQUE
RECIT:	bat	**biga**	hiru	lau	...	

QUANT:	egy	**két**	három	négy	...	HUNGARIAN
RECIT:	egy	**kettő**	három	négy	...	

Count numerals are different from cardinals

QUANT:	bat	**bi**	hiru	lau	…	BASQUE
RECIT:	bat	**biga**	hiru	lau	…	
QUANT:	egy	**két**	három	négy	…	HUNGARIAN
RECIT:	egy	**kettő**	három	négy	…	
QUANT:	yī	**liăng**	sān	sì	…	MANDARIN
RECIT:	yī	**èr**	sān	sì	…	

Count numerals are different from cardinals

Quant:	bat	**bi**	hiru	lau	…	Basque
Recit:	bat	**biga**	hiru	lau	…	
Quant:	egy	**két**	három	négy	…	Hungarian
Recit:	egy	**kettő**	három	négy	…	
Quant:	yī	**liǎng**	sān	sì	…	Mandarin
Recit:	yī	**èr**	sān	sì	…	
Quant:	**ein**	**zwei**	drei	vier	…	German
Recit:	**eins**	**(zwo)**	drei	vier	…	

Count numerals are different from cardinals

Rarities:

- Irish: Separate forms for '2' and '4'
- Moroccan Arabic: Separate forms for '11'-'19'
- Chuvash: Separate forms for '1'-'10'

Count numerals are SYSTEMATICALLY different from cardinals

QUANT:	pĕr	ik(ĕ)	viș(ĕ)	tăvat(ă)	...	CHUVASH
RECIT:	pĕrre	ikkĕ	vișșĕ	tăvattă	...	

Count numerals are SYSTEMATICALLY different from cardinals

CHUVASH

QUANT:	pĕr	ik(ĕ)	viș(ĕ)	tăvat(ă)	...
RECIT:	pĕrre	ikkĕ	vișșĕ	tăvattă	...

GODOBERI (Tatevosov 1994)

1	ce:-da '1-CARD'	ce:-ɬi-la '1-ORD-COUNT'
2	k'e-da '2-CARD'	k'e-ɬi-la '2-ORD-COUNT'
3	ɬabu-da '3-CARD'	ɬabu-ɬi-la '3-ORD-COUNT'
...	...	...

Count numerals are SYSTEMATICALLY different from cardinals

QUANT:	pĕr	ik(ĕ)	viș(ĕ)	tăvat(ă)	...	CHUVASH
RECIT:	pĕrre	ikkĕ	vișșĕ	tăvattă	...	

GODOBERI (Tatevosov 1994)

1	ce:-da '1-CARD'	ce:-ɬi-la '1-ORD-COUNT'
2	k'e-da '2-CARD'	k'e-ɬi-la '2-ORD-COUNT'
3	ɬabu-da '3-CARD'	ɬabu-ɬi-la '3-ORD-COUNT'
...	...	...

More examples:

Gaelic (Hurford 1998), Abkhaz, Korean (?), Finnish (?), Lithuanian (?)

Recitation sequence and number acquisition

Wild guess based on (Greenberg 1978, Hurford 1998):
About half of languages have distinct count and cardinal forms

Recitation sequence and number acquisition

Wild guess based on (Greenberg 1978, Hurford 1998):
About half of languages have distinct count and cardinal forms

So what?

Recitation sequence and number acquisition

Wild guess based on (Greenberg 1978, Hurford 1998):
About half of languages have distinct count and cardinal forms

So what?

- It's not clear how problematic this is for Carey's 2009 theory (smth has to be said about the mapping task for the learner)
- The puzzle is how exactly and why count numerals are different from cardinals

Count vs. cardinal numerals: rough generalizations

GENERALIZATION 49 (Greenberg 1978)

[Count forms] may have overt markers added to the [cardinal forms], but not vice versa

Count vs. cardinal numerals: rough generalizations

Generalization 49 (Greenberg 1978)

[Count forms] may have overt markers added to the [cardinal forms], but not vice versa

The lists coincide:	English, Dutch
Both derived from some stem:	Godoberi
Count forms contain cardinal forms:	Hungarian, Basque, Chuvash
Cardinal forms contain count forms:	?

Potential counterexample (maybe irrelevant)

- Some classifier languages omit classifiers in numeral recitation (Caha and Wagiel 2019; Sudo 2016; Meng Zhang p.c.)

Japanese

*go-no hana 'five-GEN flower'

go-rin-no hana 'five-CL-GEN flower'

Potential counterexample (maybe irrelevant)

- Some classifier languages omit classifiers in numeral recitation (Caha and Wagiel 2019; Sudo 2016; Meng Zhang p.c.)

Japanese

*go-no hana 'five-GEN flower'

go-rin-no hana 'five-CL-GEN flower'

[Count up to 10!]

ichi, ni, san, shi, go, roku ...

Potential counterexample (maybe irrelevant)

- Some classifier languages omit classifiers in numeral recitation (Caha and Wagiel 2019; Sudo 2016; Meng Zhang p.c.)

Japanese

*go-no hana 'five-GEN flower'

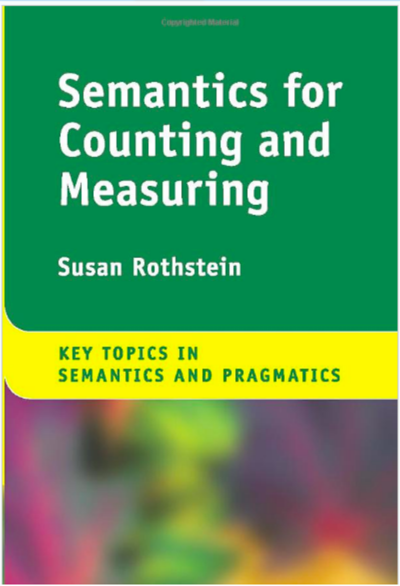
go-rin-no hana 'five-CL-GEN flower'

[Count up to 10!]

ichi, ni, san, shi, go, roku ...

- Ch'ol (Mayan) and Mi'gmaq (Eastern Algonquian) retain the classifier in recitation (Bale & Coon 2014; Bale, Coon & Arcos forth.; A. Bale, J. Coon p.c.)
- NB! Both languages are 'partly classifier languages'

More on classifiers



More on classifiers

8 Classifiers

'[F]or every collection of beasts of the forest and for every gathering of birds of the air, there is their own private name so that none may be confused with another.'

Arthur Conan Doyle, *Sir Nigel*, quoted in J. Lipton, *An Exaltation of Larks*

8.1 INTRODUCTION

This chapter explores the semantics of individuating classifiers in English, and in particular how they are used to create complex countable phrases. I will not give a semantic analysis of the whole range of individuating classifiers, since it would take us far beyond the scope of this book.[1] Instead, I want to focus on the role of classifiers in a mass/count language, and what the contrast is between classifiers in a 'classifier language' and in a 'non-classifier' language.

English, and languages like it, are often termed 'non-classifier languages' because count nouns can be modified directly by numer-

Interim summary

- (Apart from one type of classifier languages,)
- Count forms and cardinals are not just different, the former are never simpler than the latter

Interim summary

- (Apart from one type of classifier languages,)
- Count forms and cardinals are not just different, the former are never simpler than the latter

- **Hypothesis:** This extra material reflects what is more basic – cardinals are more basic than recitation
- Contra (Carey 2009)!

Interim summary

- (Apart from one type of classifier languages,)
- Count forms and cardinals are not just different, the former are never simpler than the latter

- **Hypothesis:** This extra material reflects what is more basic – cardinals are more basic than recitation
- Contra (Carey 2009)!

We talked a lot about cardinals, but we don't understand what recitation forms are

Part 2: Math contexts

- In a vast majority of the languages, the recitation form is the same form as used in mathematical contexts
- Chuvash, Hungarian, Mandarin Chinese, Basque, German (?)..

vișșĕ / *viș(ĕ) măšărsăr xisep — CHUVASH
three.COUNT / three.CARD odd number
'Three is an odd number'

- Same holds for classifier languages like JAPANESE:

juu waru go-wa ni-da	*juu-**ko** waru go-**ko**-wa ni-**ko**-da
ten divide five-TOP two-COP	ten-CL divide five-CL-TOP two-CL-COP
'Ten divided by five is two'	

Math contexts: reminder

(1) Five is prime.
Five is the fourth Fibonacci number.
Five times two equals ten.
John can count up to five.

(2) #Five things are prime.
#Five things are the fourth Fibonacci number.
#Five things times two things equals ten things.
#John can count up to five things.

- Numerals in math contexts denote numbers (type d)

Recitation is not number-naming

- If recitation is not cardinal listing, maybe it's number-naming?
- Not all languages have 'math numerals' (conventional mathematical discourse) at all – it's pretty recent culturally; it's not likely recitation is based on them

  'None of the speakers I consulted were comfortable expressing equations in Mi'gmaq [...] since you cannot express the number without indicating what is being counted.' (Alan Bale, p.c.)

- Russian raz can not be used in math contexts!

Another route to explain recitation: Ellipsis

- NP ellipsis: Mary read three books and John read two __
- Fragment answers: – How many books did you read? – Two.

Another route to explain recitation: Ellipsis

- NP ellipsis: Mary read three books and John read two __
- Fragment answers: – How many books did you read? – Two.

- Math forms are, generally, recycled elliptical forms.

Another route to explain recitation: Ellipsis

- NP ellipsis: Mary read three books and John read two __
- Fragment answers: – How many books did you read? – Two.

- Math forms are, generally, recycled elliptical forms.
- If a language has a special form of the numeral in cardinal construction with NP ellipsis, it will be used in equations.
- German, Hungarian, Chuvash, Basque..

Suggestion for math numerals

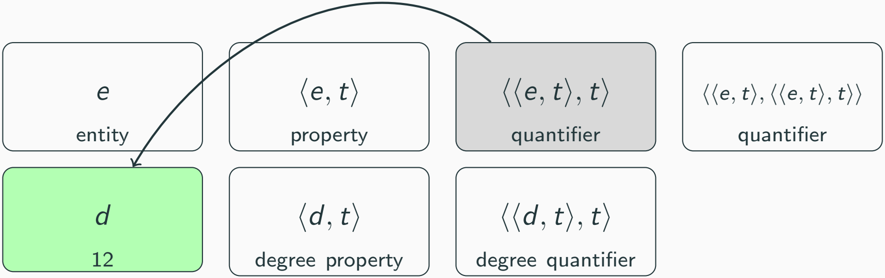
- Diachronically, math forms have internal structure that includes a cardinal DP –

Suggestion for math numerals

- Diachronically, math forms have internal structure that includes a cardinal DP –
- abstracting away from what is being counted along with development of abstract mathematical language

Suggestion for math numerals

- Diachronically, math forms have internal structure that includes a cardinal DP –
- abstracting away from what is being counted along with development of abstract mathematical language



Back to recitation

- Are recitation numerals also DPs with an ellided head noun?

Back to recitation

- Are recitation numerals also DPs with an ellided head noun?

- No – Russian raz is not an elliptical cardinal numeral:

  [How many tables do you have in your apartment?]

  *Raz.

Back to recitation

- Are recitation numerals also DPs with an ellided head noun?

- No – Russian raz is not an elliptical cardinal numeral:

  [How many tables do you have in your apartment?]

  *Raz.

- Raz means ‘times’ – as in I called three times

Back to recitation

- Are recitation numerals also DPs with an ellided head noun?
- No – Russian raz is not an elliptical cardinal numeral:

  [How many tables do you have in your apartment?]

  *Raz.
- Raz means 'times' – as in I called three times
- (Speculation about recitation numerals quantifying over events rather than individuals – but still nothing close to Carey 2009)

To do

- Get more data!

To do

- Get more data!
- Develop an analysis based on the event quantification hypothesis behind numeral recitation / counting constructions

To do

- Get more data!
- Develop an analysis based on the event quantification hypothesis behind numeral recitation / counting constructions
- Study cases a noun appears in counting:
  raz čaška, dva čaška, tri čaška RUSSIAN
  (note unusual morphosyntax)

To do

- Get more data!
- Develop an analysis based on the event quantification hypothesis behind numeral recitation / counting constructions
- Study cases a noun appears in counting:
  raz čaška, dva čaška, tri čaška RUSSIAN
  (note unusual morphosyntax)
- Which of the forms of the 'cardinal family' are other types of numerals derived from?

To do

- Get more data!
- Develop an analysis based on the event quantification hypothesis behind numeral recitation / counting constructions
- Study cases a noun appears in counting:
  raz čaška, dva čaška, tri čaška — Russian
  (note unusual morphosyntax)
- Which of the forms of the 'cardinal family' are other types of numerals derived from?
  ikě / *ikkě kěneke 'two books' — Chuvash
  2.card / 2.count book

To do

- Get more data!
- Develop an analysis based on the event quantification hypothesis behind numeral recitation / counting constructions
- Study cases a noun appears in counting:

  raz čaška, dva čaška, tri čaška RUSSIAN

  (note unusual morphosyntax)
- Which of the forms of the 'cardinal family' are other types of numerals derived from?

  ikĕ / *ikkĕ kĕneke 'two books' CHUVASH

  2.CARD / 2.COUNT book

  *ikĕ-mĕš / ikkĕ-mĕš kĕneke 'second book'

  2.CARD-ORD / 2.COUNT-ORD book

Thank you!