

# How do Hungarian preschoolers interpret number words?



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- Research questions

- Background

- Experiments

  - Predictions

  - Participants

  - Material

  - Results

- Discussion



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# Research questions

- Can Hungarian preschoolers differentiate between the lower-bounded ('at least') and upper-bounded ('**exactly**') readings of numerals?
- Do they rely on structural information or other pragmatic factors when interpreting numerals?
- How do the results obtained in the experiments contribute to the semantic discussion concerning the default meaning of numerals?



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# Background

## Different interpretations of NumNPs:

(1) - *How many mistakes did you make?*

- *I made five mistakes.*

(2) *You need to make five mistakes to be allowed to take the test again.*

(3) *You can make five mistakes and still pass this test.*

What is the **default** meaning?

# The neo-Gricean view

Horn 1972, Levinson 2000.

Default meaning:

„*at least n*”



Scalar  
implicature

Derived meaning:

„*exactly n*”



## Maxim of Quantity

(4) John: *Are the cakes ready?*

Mary: *Some of them are.*

→ implicature: *some but not all*

(5) John: *Are the cakes ready?*

Mary: *Three of them are.*

→ implicature: *no more than three*

# The Alternative Approach

Geurts 2006, Breheny 2008.

Default meaning:

„*exactly n*”



Existential  
Closure

Derived meaning:

„*at least n*”

- ‘**at least**’ reading  
→ an instance of Existential Closure
- EXISTS [a set of cardinality  $n$ ]
- compatible with both the lower-bounded and upper-bounded readings
- Breheny (2008): „pragmatically derived existential closure”

## Hungarian data

- In Hungarian the distinction between the ‘at least’ and ‘**exactly**’ meaning of numerals is grammaticalized.
- Numerals being focussed obligatorily receive an ‘**exactly**’ reading,
- non-focussed numerals are interpreted as ‘at least *n*’.

(É. Kiss 1998, 2006)

## Hungarian data

- Focus is marked syntactically.
- The focussed constituent moves to the pre-verbal position:

(6a) - How many pancakes did John eat?

- *János [15 PALACSINTÁT]<sub>Foc</sub> evett meg.*  
John 15 pancake.ACC ate PRT  
'John ate *exactly* fifteen pancakes.'

(6b) *János megevett 15 palacsintát.*

John PRT.ate 15 pancake.ACC  
'John ate fifteen pancakes (*or more*).'

## The standard analysis

(i) the default meaning of numerals is ‘at least n’  
(Horn 1972)

(7) Who brought up two children is entitled to  
a 15% pension raise.  
→ ‘two or more’

## The standard analysis

(ii) Hungarian pre-verbal focus expresses exhaustive identification which is responsible for imposing the upper-bound (É. Kiss 2006)

(8) - Who did John call?

- *János [A KIRÁLYNŐT]<sub>Foc</sub> hívta fel.*  
John the Queen.ACC called up  
'It is the Queen that John called.'

- exclusion of alternatives by identification
- exhaustivity of pre-verbal focus is a semantic feature
- its interpretation is unaffected by contextual factors

## The standard analysis

- alternatives to  $n$ : all the numbers higher than  $n$
- as a result of identification numbers higher than  $[n]_{\text{FOC}}$  are excluded
- in the case of numerals exhaustivity manifests itself as the upper bounded ('**exactly**') reading



# Experimental background

## Scalar implicatures

Children, unlike adults, often fail to derive scalar implicatures.

*might vs. must* – Noveck, 2001.

*some vs. all* – Huang and Snedeker, 2009.

Musolino, 2004.

Noveck, 2001.

Papafragou and Musolino, 2003.

Papafragou and Musolino, 2003.

(9) *Some of the horses jumped over the fence.*

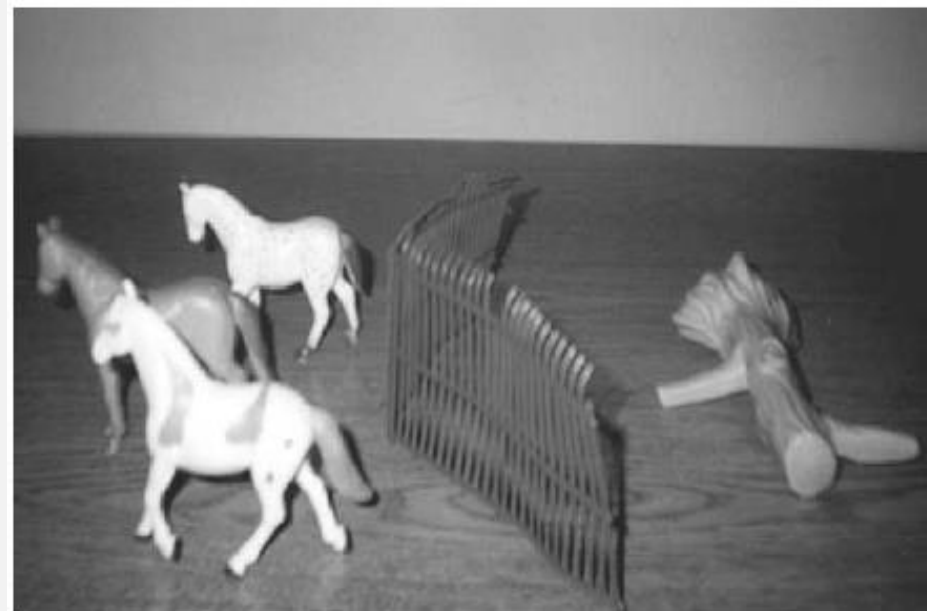
adults: false (92%)

children: **false (12%)**

(10) *Two of the horses jumped over the fence.*

adults: false (100%)

children: **false (65%)**



Musolino presumes that children do not rely on implicatures to derive the upper bound meanings of numerals, but they rely on their default meaning which must be '**exactly n**'.

(See also Huang, Snedeker and Spelke, 2013.)

# Experimental background

## Focus sensitivity

(11) A MACI ült fel a székre.

The bear sat.Sg3.PRT the chair

*'It is the bear who is sitting on the chair.'*



5-year-old children:  
**true (100%)**

(Pintér, 2011)

(See also Lukács and Kas,  
2013.)

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# Experiments – Predictions

- If it is true that in Hungarian the interpretation of numerals is determined by the information structure of the sentence,
- and children are not sensitive to the exhaustivity feature of identificational focus,
- then it is reasonable to assume that the '**at least**' reading of numerals will be more accessible for children.

# Experiments – Participants

- a group of **20 preschoolers**  
(9 girls and 11 boys; mean age 5;6)
- a group of **17 adult native speakers of Hungarian.**

None of the children received any mathematical training before and none of the adults were educated in linguistics.





# Experiments – Material

- 16 test sentences
  - The position of the numeral and the type of the verb were varied:
    - The numeral appeared either in or out of focus,
    - and the verb expressed either a simple action (e.g. *pick*) or possession (*have*).
- **four conditions**

Kapjanak cukorkát azok a macik, ...

Get.IMP candy.ACC those the bear.PL

*'Those bears shall get a candy ...'*

(1.) ... akik szedtek három málnát.

who.PL picked three raspberry.PL.ACC  
(non-focussed numeral with action verb)

(2.) ... akik HÁROM MÁLNÁT szedtek.

who.PL three raspberry.PL.ACC picked  
(focussed numeral with action verb)

*'Those bears shall get a candy who picked three raspberries.'*

Kapjanak cukorkát azok a macik, ...

Get.IMP candy.ACC those the bear.PL

*'Those bears shall get a candy ...'*

(3.) ... akiknek van három málnájuk.

who.PL have three raspberry.POSS

(non-focussed numeral with possession verb)

(4.) ... akiknek HÁROM MÁLNÁJUK van.

who.PL three raspberry.POSS have

(focussed numeral with possession verb)

*'Those bears shall get a candy who have three raspberries.'*

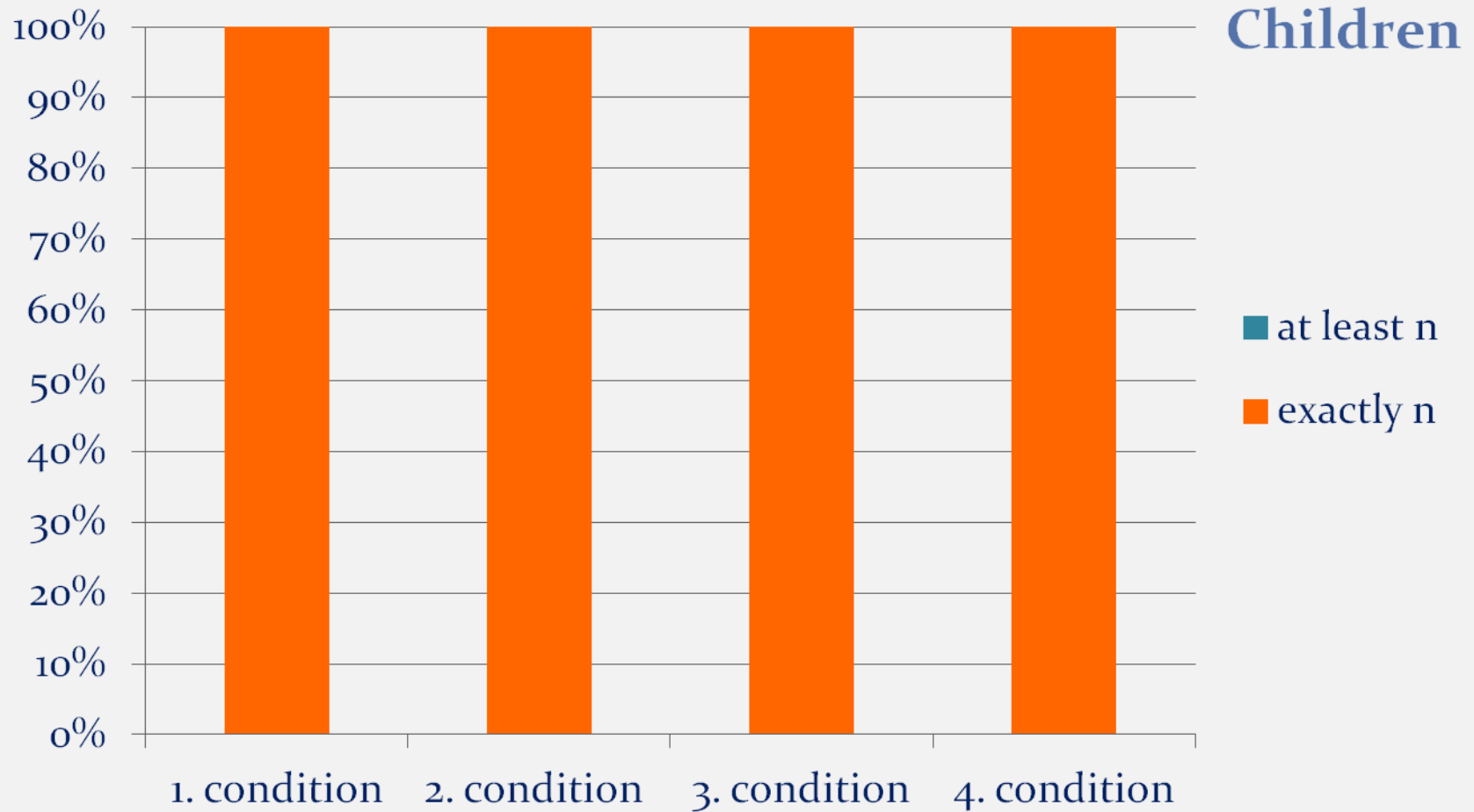
„*exactly n*”



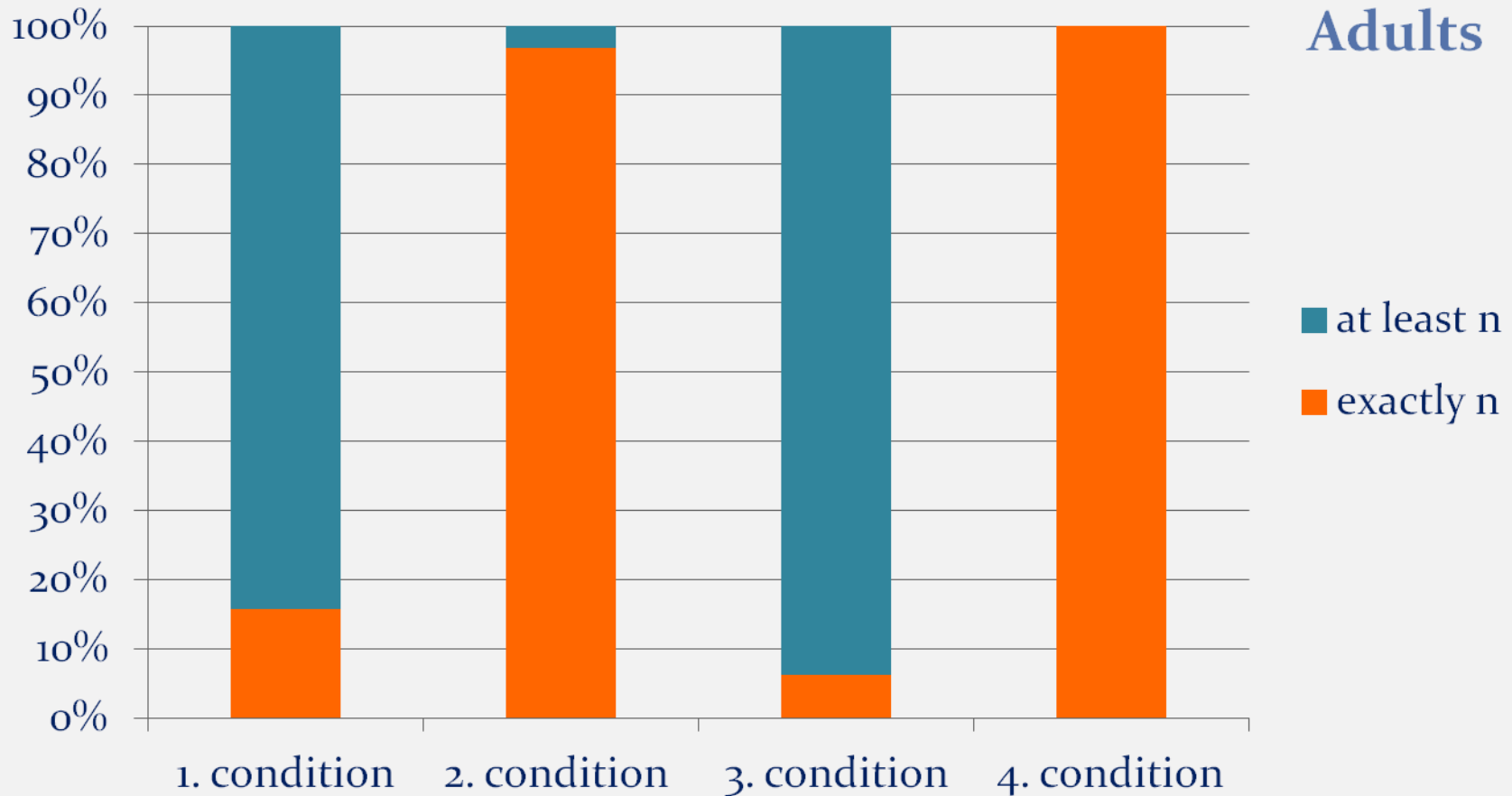
„*at least n*”



# Experiments – Results



# Experiments – Results



$\chi^2 = 99.5, df=3, p= .0001$

## Experiment 2

Is the ‘*at least n*’ meaning available at all?

(12) Elvehet egy lufit az, akinek van öt kártyája.

PRT.get a balloon.ACC that who has five card.POSS

*‘If anybody has five cards, he or she can take a balloon.’*

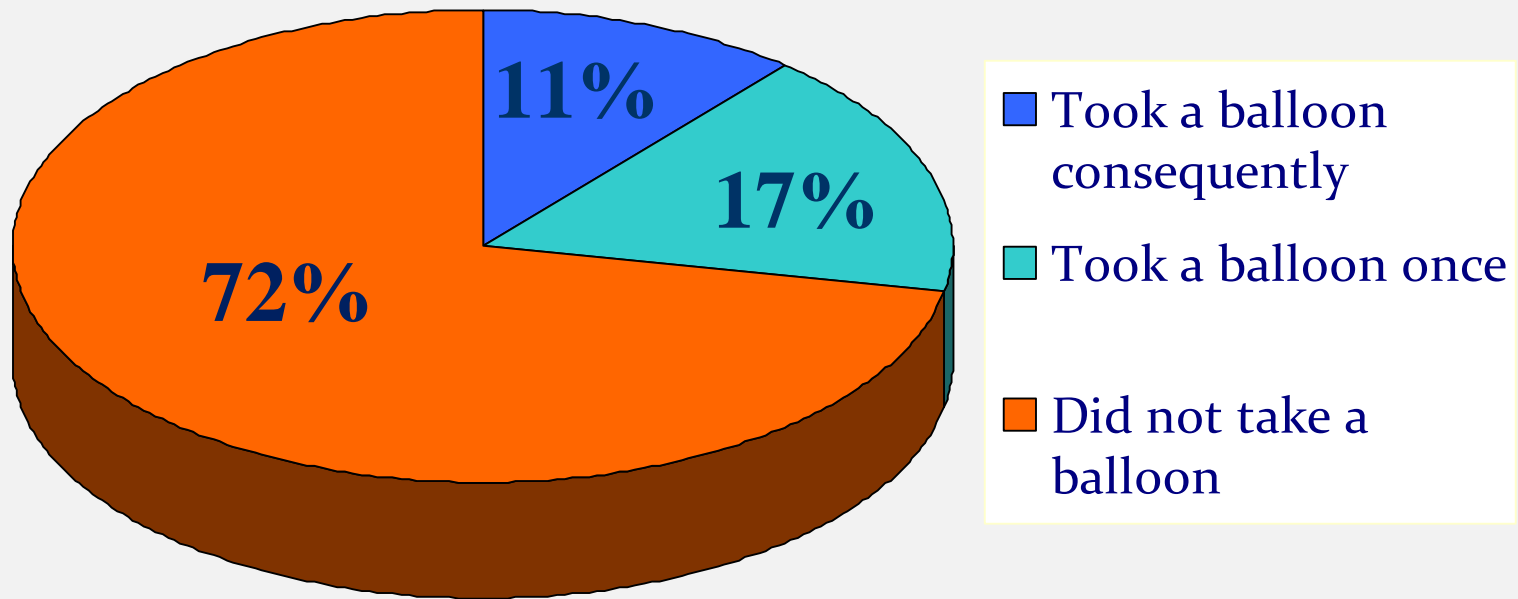
Hedgehog:



Child:







## Explanations:

*„I don't have five.”*

*„I have only six.”*

*„If this one was not here, I could have one.”*



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# Discussion

## Findings:

- Children's interpretation of numerals is unaffected by the information structure of the sentence.
- Strong preference for the 'exactly' reading.
- The influence of the context is limited.

# Discussion

## Conclusions:

- The results do not support the standard analysis of NumNPs.
- The ‘**exactly**’ interpretation is not a consequence of exhaustivity.
- They are in line with the Alternative Approach:
  - the default meaning of numerals is in fact ‘**exactly n**’
  - the ‘**at least**’ reading is an implicature arising as a result of inferential processes
- The ‘at least’ implicature is blocked when the numeral is focussed. → Why?

# Discussion

- Children seemed to have no or limited access to the ‘at least’ reading.
- Possible reasons:
  - they thought they were tested on counting
  - they have not yet mastered the required skills to be able to perform the existential closure operation
  - they are unable to decompose sets into smaller subsets (see Pica & Lecomte, 2008)



**Thank you for your attention!**

# References

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