How do Hungarian preschoolers interpret number words?

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Hungary
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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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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


Default meaning: "at least n"

Derived meaning: "exactly n"

Scalar implicature
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


Default meaning: "exactly n"

Derived meaning: "at least n"

Existential Closure
• ‘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]_{Foc} 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]_{Foc} 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.
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.’
Experiments – Results

Children

- at least n
- exactly n

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<thead>
<tr>
<th>Condition</th>
<th>1. condition</th>
<th>2. condition</th>
<th>3. condition</th>
<th>4. condition</th>
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<tbody>
<tr>
<td>100%</td>
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Experiments – Results

\[ X^2 = 99.5, \text{ df}=3, \text{ p}= .0001 \]
Experiment 2

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

(12) Elvehet egy lufit az, akinek van öt kártyája. PRT.get a ballon.ACC that who has five card.POSS ’If anybody has five cards, he or she can take a balloon.’
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

References