

The role of Information Structure in children's interpretation of numerically modified expressions

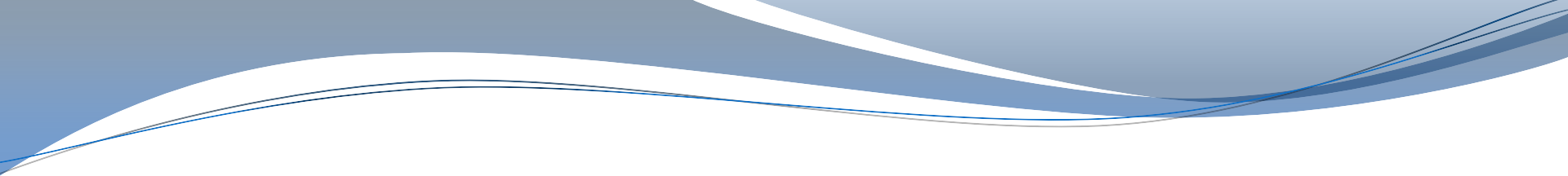
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Research questions

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

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- Background
 - Experiments
 - Experiment 1a
 - Experiment 1b
 - Experiment 2
 - Discussion



- **Background**

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Background

The interpretation of NumNPs:

- (1) - How many mistakes did you make?
- I made five mistakes. (*exactly*)
- (2) You need to make five mistakes to be allowed to take the test again. (*at least five*)
- (3) You can make five mistakes and still pass this test.
(*at most five*)

What is the default meaning?

Neo-Gricean view (Horn 1972, Levinson 2000):

- Default meaning: 'at least n '
- The **exactly n** interpretation is a scalar implicature
- NumNPs are similar to other scalar expressions:
 - (4) - Are the cakes ready?
 - Some of them are. (\rightarrow *not all of them*)
 - (5) - Have the guests arrived?
 - Three of them did. (\rightarrow *no more than three*)

Alternative approaches (Geurts 2006, Breheny 2008):

- Default meaning: **exactly n**
- The 'at least n ' interpretation is derived (semantically or pragmatically)

Hungarian data

- In Hungarian the information structure of the sentence greatly affects how NumNPs are interpreted:
 - if focused, the NumNP obligatorily receives an 'exactly' reading
 - if not focused, the NumNP is interpreted as 'at least n '

Hungarian data

- Focus marks the new, non-presupposed information
- In Hungarian Focus is marked by word order
 - The focused constituent moves to the position immediately preceding the tensed verb:

(6) a. – Kit hívott fel János?

Who.ACC called up John?

Who did John call?

b. - János [MARIT_{FOC}] hívta fel.

focused

John Mary.ACC called up

John called MARY.

(7) János felhívta Marit.

neutral

John up.called Mary.ACC

John called Mary.

Hungarian data

The effect of focussing on the interpretation of NumNPs:

(8) János [15 PALACSINTÁT_{FOC}] evett meg.

John 15 pancake.ACC ate PRT

'John ate exactly fifteen pancakes.'

(9) János megevett 15 palacsintát.

John PRT.ate 15 pancake.ACC

'John ate fifteen pancakes (or more).'

Standard Account (É. Kiss 2006, 2010):

- The interpretational differences can be derived from the semantic features of Hungarian focus

Standard Account

- (i) the default meaning of NumNPs is ‘at least n ’
- (ii) Hungarian focus expresses exhaustive identification
 - Exhaustivity:
 - (10) John called [Mary_{FOC}]. → (and noone else)
 - Exhaustivity is part of the logico-semantic meaning of Hungarian focus (see Szabolcsi 1981, Kenesei 1989, Horváth 2005)
 - Focus is an identificational predicate (É. Kiss 2006)
 - Identifies the maximal set of individuals for which the predicate holds → excludes all the relevant alternatives
- Alternatives to a number n : all the numbers not equal to n
- The ‘**exactly**’ reading arises as a result of the identificational process associated with pre-verbal focus.



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Experiment 1a – Goals

- To test whether children's interpretation of NumNPs is sensitive to the information structure of the sentence.
- Predictions based on the Standard Account:
 - If the interpretation of NumNPs is sensitive to the information structure, then focusing should trigger the 'exactly' reading
 - If, however, the interpretation is not sensitive to the information structure, then the 'at least' reading should arise regardless of the syntactic position of the NumNP.

Experiment 1a – 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.



Experiment 1a – Material

- 16 test sentences
- The position of the NumNP and the type of the verb were varied:
 - The NumNPs 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-focused numeral with action verb)

(2.) ... akik HÁROM MÁLNÁT szedtek.

who.PL three raspberry.PL.ACC picked
(focused 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-focused numeral with possession verb)

(4.) ... akiknek HÁROM MÁLNÁJUK van.

who.PL three raspberry.POSS have

(focused numeral with possession verb)

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

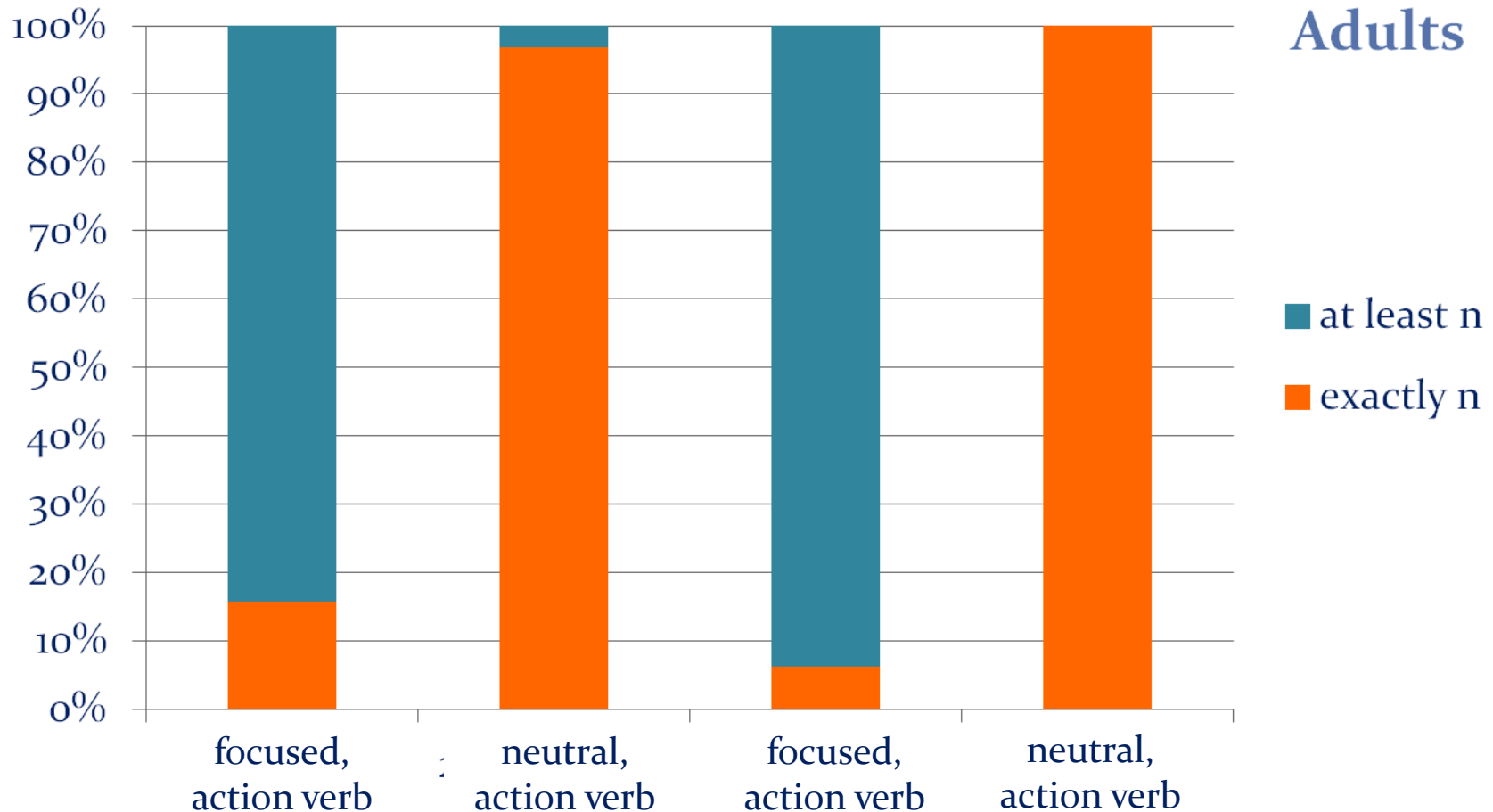
„*exactly n*”



„*at least n*”

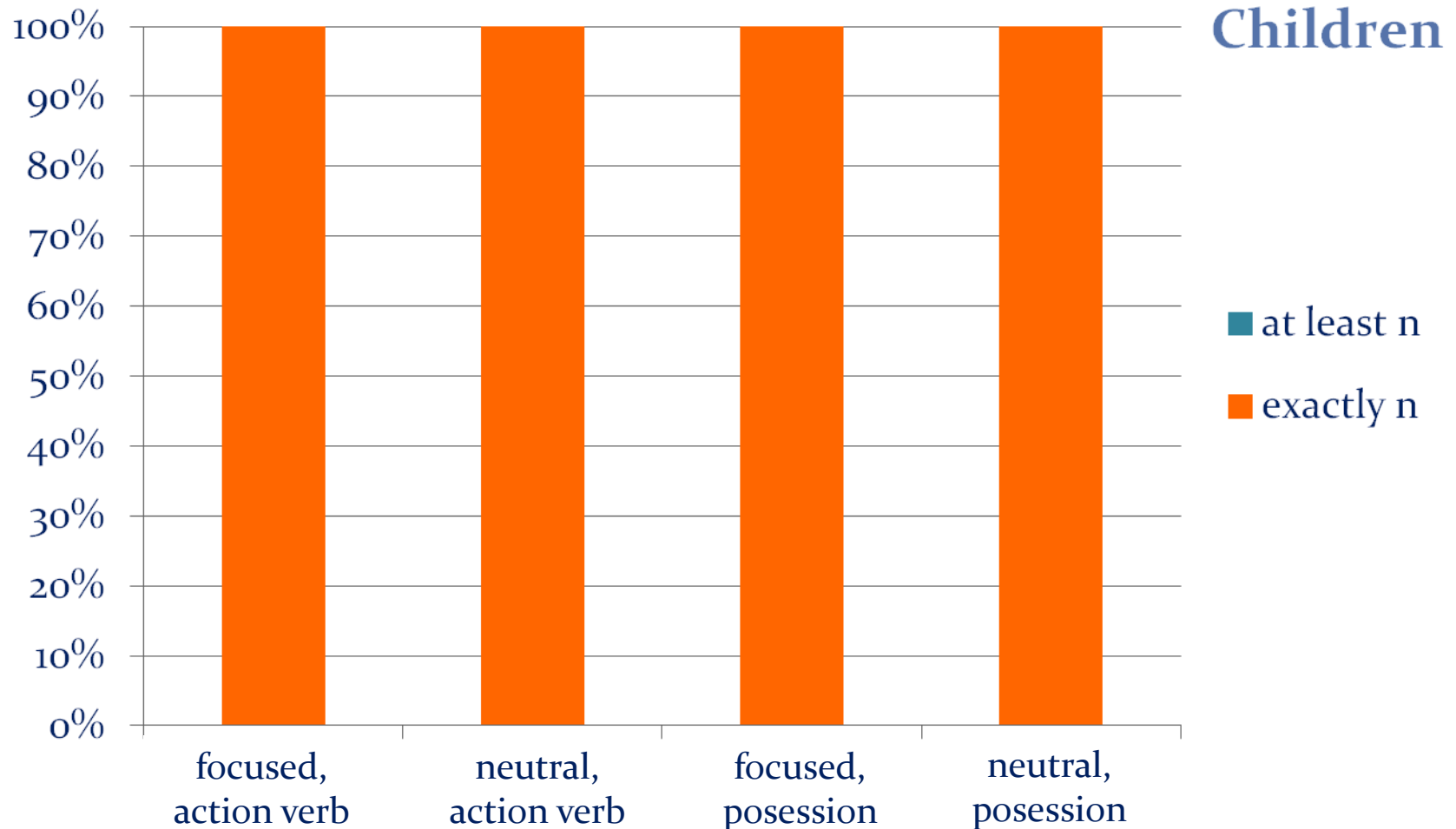


Experiment 1a – Results



$X^2 = 99.5$, $df=3$, $p < .0001$

Experiment 1a – Results



Experiment 1b

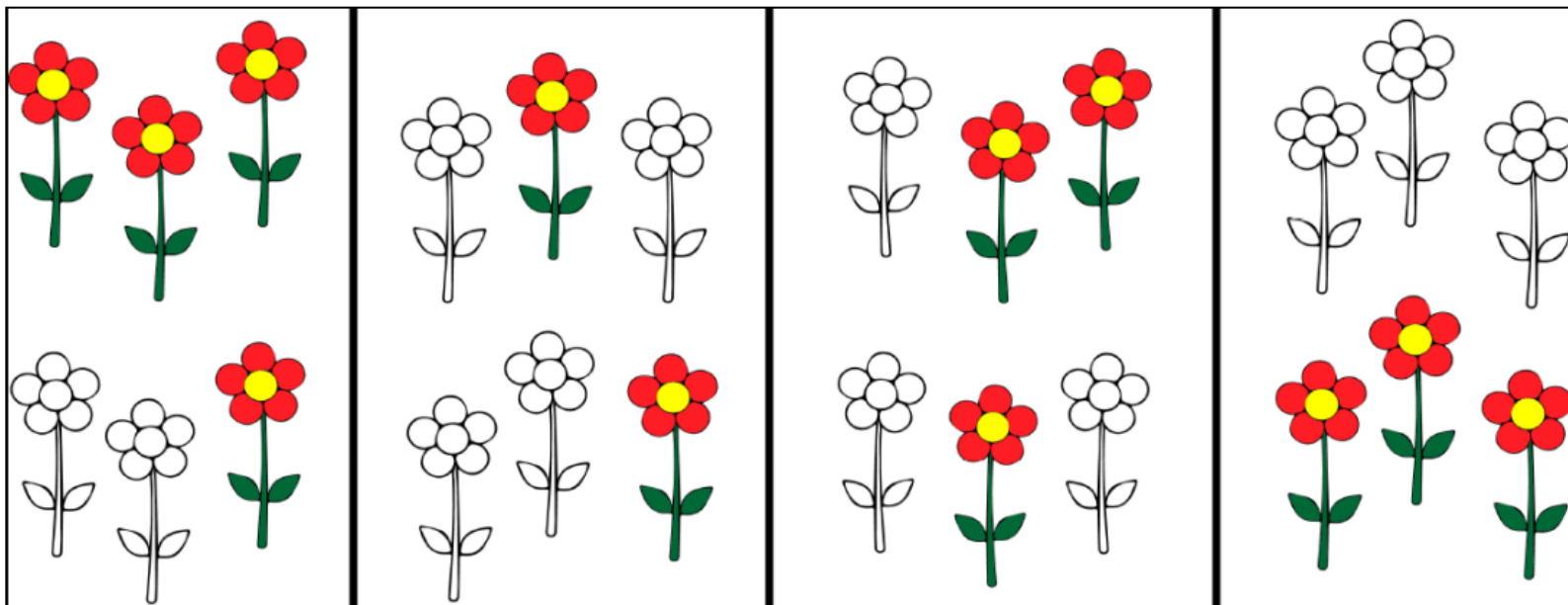
- Participants: a group of **16 preschoolers** (11 girls and 5 boys; mean age 6 years 1 month)
- 8 test sentences, 12 fillers
- Changes of the experimental setup:
 - test sentences contained verbal particles
 - there were always 6 items on each card
 - 4 bears instead of 8

(1) Kapjanak cukorkát azok a macik, akik ki- színezték
Get.IMP candy.ACC those the bear.PL who.PL PRT-paint.PAST

3 virágot.

3 flower.ACC

'Those bears shall get a candy, who painted (at least) 3 flowers.'

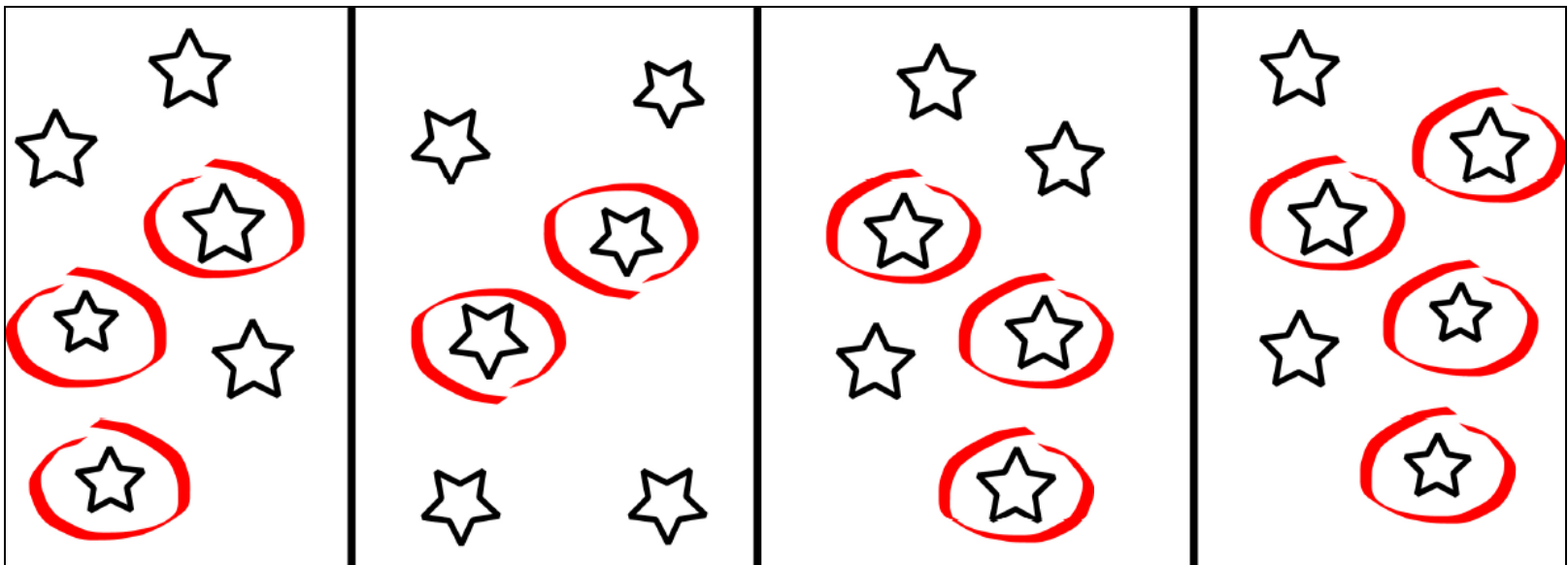


(2) Kapjanak cukorkát azok a macik, akik 3 CSILLAGOT
Get.IMP candy.ACC those the bear.PL who.PL 3 star.ACC

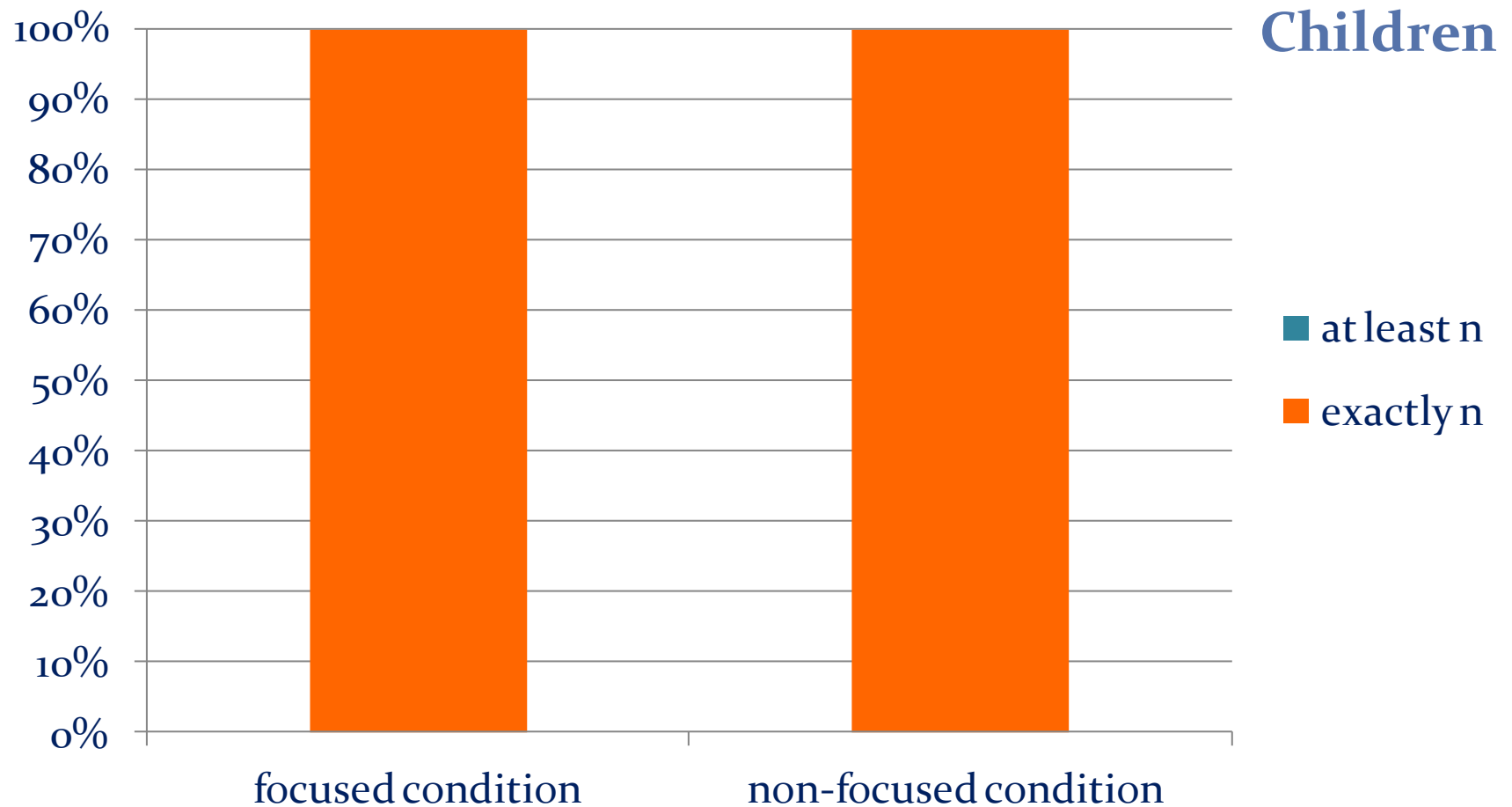
karikáztak be.

circle.PAST PRT

'Those bears shall get a candy, who encircled (exactly) 3 stars.'



Experiment 1b – Results



Experiment 1 – Discussion

Why do preschoolers prefer the ‘**exactly**’ interpretation so firmly?

- Is children’s preference generated by the task itself?
- Are children unable to decompose a set of entities into smaller subsets? (see Pica and Lecomte, 2008)
- Is the default meaning of NumNPs in fact ‘**exactly n** ’?
 - The ‘**at least**’ interpretation arises through inferential reasoning? (Breheny 2008)
 - Children’s pragmatic knowledge considered to be less stable than that of adults (see Noveck 2001, Papafragou & Musolino 2003, Huang & Snedeker 2009).

Experiment 2 – Goals

- To test if the ‘at least’ reading can be elicited by the manipulation of the context.
- To test if children’s strong preference for the ‘**exactly**’ reading is due to their inability to decompose sets into smaller subsets.
- Comparison with *enough*

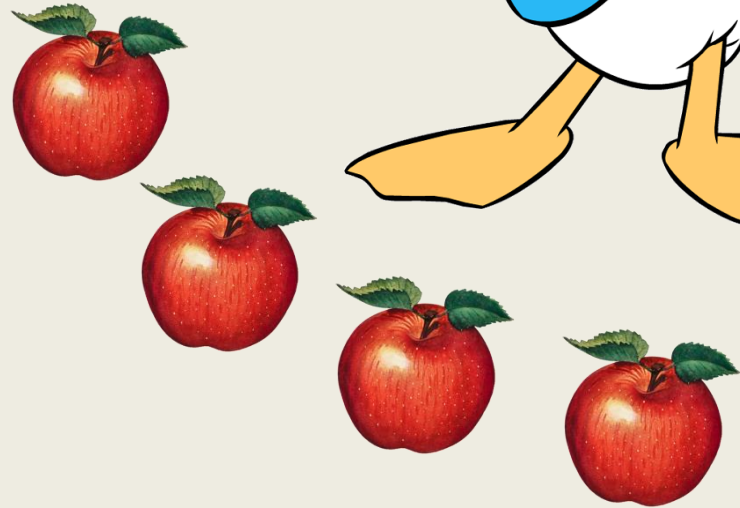
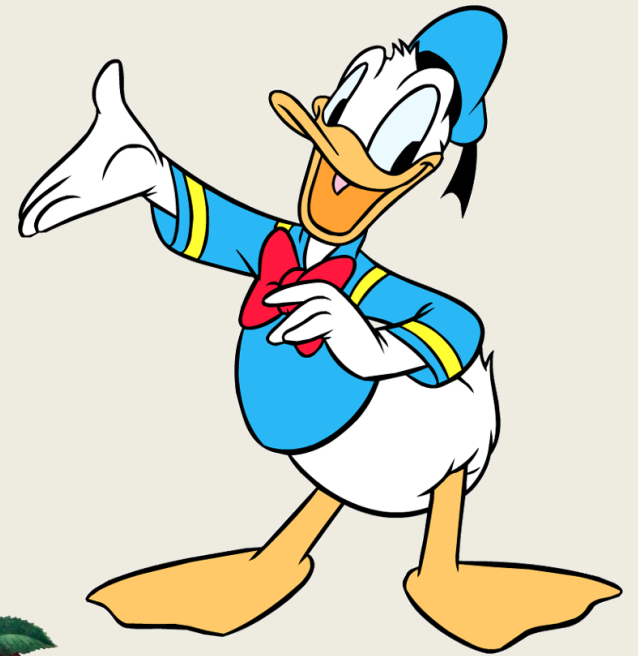
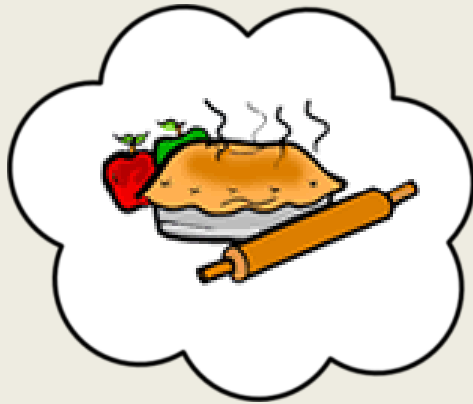
Experiment 2 – Background

Kadmon (2001) → Musolino (2004)



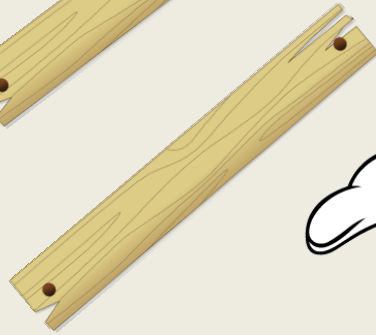
Does Goofy have two cookies?

Children: 80% – ‘yes’



Experiment 2 – Participants

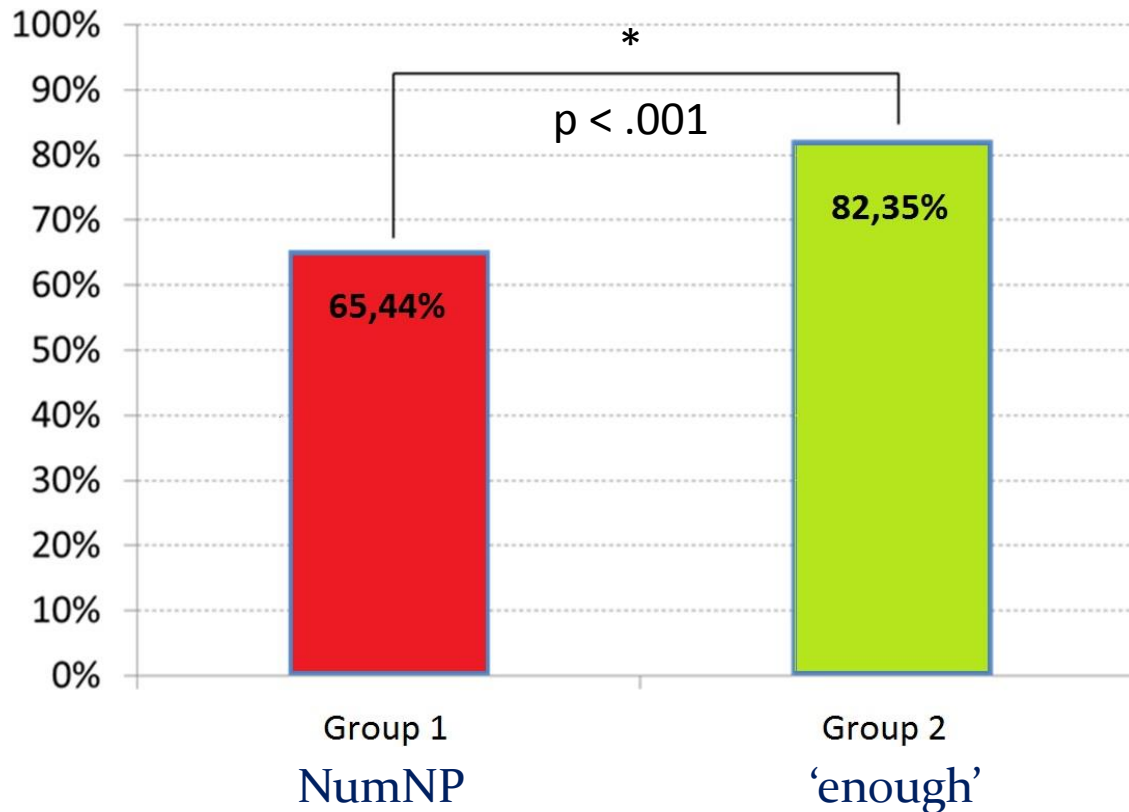
- **36 preschoolers**
(19 girls and 17 boys; mean age 5;4)
- **24 adult native speakers of Hungarian**
- **Group 1:** test sentences contained NumNPs
(11) *Van Donaldnak három almája?*
'Does Donald have three apples?'
- **Group 2:** test sentences contained 'enough'
(12) *Van Donaldnak elég almája?*
'Does Donald have enough apples?'



Experiment 2 – Predictions

- If preschoolers are unable to decompose a set of individuals into smaller subsets, then we should get equally low percentages of 'yes' responses in both Group 1 and 2.
- If the problem is specifically related to the 'at least' interpretation of NumNPs, then we should find a significant difference between the responses of the two groups.

Experiment 2 – Results



Children

- The number of 'Yes' responses was significantly lower in Group 1 than in Group 2.

Experiment 2 – Discussion

- It was not the inability of decomposing sets that affected our previous results.
- It is also unlikely that the misinterpretation of the task biased the results in Experiment 1a and 1b.
- Preschoolers actually do have access to the ‘at least’ reading of NumNPs.
 - Whether it arises or not mostly depends on the context.



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Discussion

Findings:

- Children are able to differentiate between the ‘at least’ and ‘**exactly**’ readings of NumNPs (see Experiment 2)
- The ‘**exactly**’ reading is strongly preferred.
- Contrary to adults, children's interpretation of NumNPs is unaffected by the information structure of the sentence:
They interpret NumNPs as ‘**exactly n**’ even if they are not focused.

Discussion

- The results do not support the Standard Account.
- The ‘**exactly**’ interpretation of focused NumNPs is not a consequence of the exhaustive identification process associated with Hungarian pre-verbal focus.
- The data suggest, that the default meaning of NumNPs is in fact ‘**exactly n**’.

Discussion

An alternative account:

- NumNPs in focus cannot receive an ‘at least’ interpretation due to pragmatic reasons.
- The focused constituent conveys the answer to an explicit or implicit question.
(Question Under Discussion, Roberts 1998)
- A (congruent) answer to a question is expected to be maximally informative.
- If the cardinality of a set is in question, then the answer is expected to provide an exact amount.

Discussion

An alternative account:

- If the NumNP is not focused the ‘at least’ reading arises
→ blocking effect
- The presence of a competing structure in the grammar (i.e. the focused one) blocks the ‘**exactly**’ interpretation.

Discussion

- The results of Experiment 2 showed that children can access to the lower-bounded reading if the context adequately supports it.
- Still, the preference for the ‘**exactly**’ interpretation remained relatively strong (in comparison to adults).
- Possible reasons - assuming that the ‘at least’ interpretation is derived pragmatically:
 - Children’s pragmatic capabilities might not be mature enough to be able to derive the ‘at least’ reading from the ‘exactly’ reading.



Thank you for your attention!

References

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