Acquiring the non-exact reading of numerical expressions: What semantics says you have to do and what pragmatics allows

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Numeral Semantics I

Sentences with numerals can give rise to multiple interpretations (Carston, 1980, 1988; Horn, 1972, 1989; Levinson, 2000, a.o.)

(1) 'exact'/two-sided reading
- Kim answered three questions correctly.
- (2) 'at least' / lower-bounded reading
- You have to answer three questions correctly to pass.
- (3) 'at most' / upper-bounded reading
- You are allowed to miss three questions on the test.

Under the Classic neo-Gricean Analysis, the upper bound is derived pragmatically via a Quantity Implicature. However, across a variety of empirical and experimental observations, numerals diverge from other scalar terms, suggesting that the upper bound is a matter of semantic content, rather than pragmatic reasoning. Specifically, the type of interpretation occurring with the numeral routinely makes a lower- or upper-bounded reading available, suggesting that their scopal interaction is responsible for the interpretation.

Child Language

Recent work investigating children's ability to access these readings has left open key questions.

Papafagos and Musolino (2003)

Children rejected "2 horses jumped over the log" but accepted same scenarios with same (reflecting their not having computing an upper bound with same).

Conclusion

Children have an 'exact' interpretation of number words (as opposed to other scalar terms).

Gap

Scenarios may have favored 'exact' reading; interaction of numerals with other operators not accepted same scenarios with same.

Musolino (2004)

Experiment 1:
- Troll putting hoops on pole. Gets 4, misses 1. (at most)
- Child did not allow the troll to win.
- The troll has to put 2 hoops on the pole to win. (at least)
- Child did not allow the troll to win.

Experiment 2:
- Troll puts only 2 cookies. Does Goofy have 2 cookies?
- Child said YES.

Conclusion

Children can access 'non-exact' interpretations of number words, but their ability to do so is highly context dependent.

Gap

All possible scenarios not tested, modal not systematically controlled.

allowed to (can) have to
- √
- √
- x

Experiment

Two types of test items

Continuous
- You are allowed to fill the pool with two feet of water.
- No, because it's not too much water.*

Discrete
- You are allowed to read two books before going to sleep.
- No, because he picked three books.*

Two modal conditions

at most
- You are allowed to fill the pool with two feet of water.
- No, because the water wasn't to the red line.

at least
- You have to read two books before going to sleep.
- No, because he wanted to go to sleep.*

Children

Results

Boys: Two Additional Three for Conditions

Allowed to
- Both age groups accept character's actions in '≥' scenarios.
- Both age groups are more likely to accept Character 2's actions for 'x >' than for 'x <' (response pattern more robust for adults)
- x ≤ values are deemed permissible pragmatically. Adult, unlike children, robustly compute this particularized conversational implicature.

Have to
- Both age groups accept character's actions in '≤' scenarios. Children display same rejection pattern for both types of scenarios.
- Adults are slightly more likely to accept character's actions for 'x >' than for 'x <' scenarios.

No difference between Continuous and Discrete items, demonstrating that the finding is not restricted to counting objects in a set.

Conclusions

While preschoolers (and adults) favor an exact interpretation of number words, 'non-exact' readings are made available by other linguistic expressions and real-world knowledge.

Allowed to (at most) readings
- Adults: pattern as expected, correctly assigning an upper bound.
  - Children: pattern in the direction expected, but are below chance.
  - Children: only correctly accept the exact interpretation.

Have to (at least) reading
- Adults: pattern in the direction expected, but are below chance.

Follow-Up research focuses on 'have to' condition:
- Adults: Two Additional Three for Conditions
  - 'x ≥' modal: upper / lower bound reading

Treat numerals as generalized quantifiers over degrees (<, ≥, t), which can interact usefully with modals, independent of their nominal (cf. Kennedy, 2012), and include maximization of the degree property that constitutes the numeral's scope.

Numeral Semantics II

Treat numerals as generalized quantifiers over degrees (<, ≥, t), which can interact usefully with modals, independent of their nominal (cf. Kennedy, 2012), and include maximization of the degree property that constitutes the numeral's scope.

- x ≥: two-sided reading
  - x: modal / lower bound reading
  - Therefore derive the upper bound semantically.

Selected References


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