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# Decomposition and Processing of Negative Adjectival Comparatives

## Theoretical and Empirical Questions

✧ What are the smallest units of compositional interpretation?
✧ Recent semantic analyses of comparatives have highlighted units below the word level: negative adjectives like 'shorter' contain a silent morpheme 'little' and thus are more complex than the positive 'taller' (Rullmann 1995, Heim 2006, Büring 2007).
✧ We obtain evidence for this decomposition in language processing in English and Polish.

## Task and Predictions

- **Sentence-to-Picture Verification**: images of two lines of different lengths paired with statements containing 'taller' and 'shorter', and with equivalent mathematical statements, A > B, B < A.
- Predictions for **Language**: polarity and congruence are expected to be additive to RTs and error rates.
- Predictions for **Math**: If 'negative' features are specifically linguistic (Just & Carpenter 1971, Clark & Chase 1972), **polarity effects** might not be observed with math.
  - `Simple' hypothesis: math statements are representationally transparent (i.e. non-decompositional), and so are likely to be processed differently than linguistic statements.
  - Deschamps et al. (2015): effect of polarity only with quantifiers (*many/few*, *more/less*), not with math.

## Linking language and vision

- **How semantic representations make contact with extralinguistic cognition?** → Just and Carpenter 1971, Clark and Chase 1972, Trabasso et al. 1971, Clark et al. 1973, a.o.: **How can a sentence meaning and a representation of a picture be compared?**
  - Both are encoded in a common representational format.
- What affects response latencies?
  - Positive statements easier to process than negative (**polarity effects**)
  - Statements that are true wrt. to the display are easier to verify than false ones (**congruence effects**)
- **Interface Transparency Thesis** (Lidz et al. 2011): Cognition, by default, carries out procedures that align with the operations specified in the semantic representation of a sentence.

## "Sentence-First Model" Clark and Chase 1972

*Stage 1*: form a mental representation of the sentence → general format
*Stage 2*: form a mental representation of the picture → general format
*Stage 3*: compare the two representations ('representational identity') → transformations possible
*Stage 4*: produce a response

- Parameters affecting response latency (additively related):
  *+a* - cost of 'linguistic/implicit negation'
  *+b* - cost of comparison operations

## English

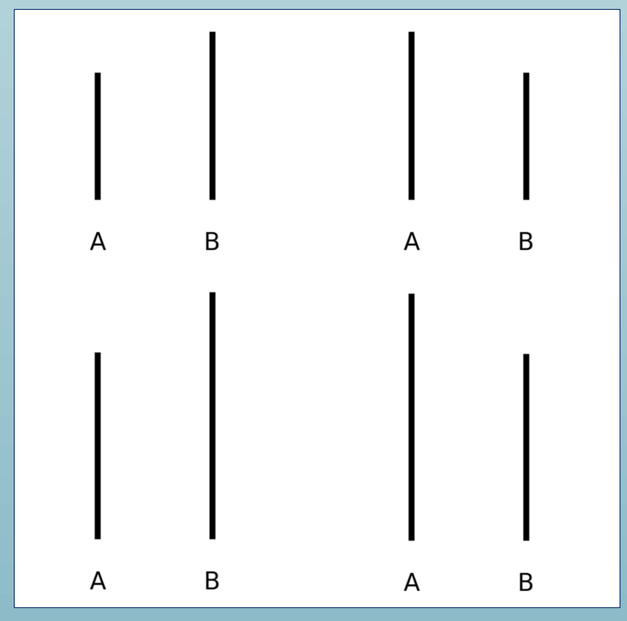
| | English | Math |
|---|---|---|
| Positive | *A is taller than B, B is taller than A* | *A > B, B > A* |
| Negative | *A is shorter than B, B is shorter than A* | *A < B, B < A* |

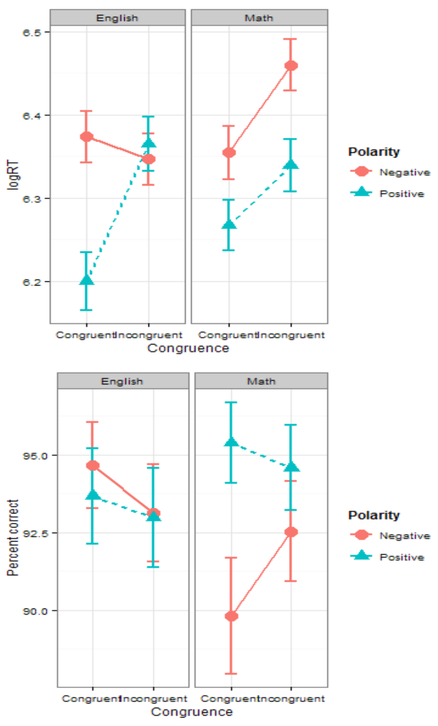
20 pictures, 5 ratios ($\frac{1}{2}, \frac{3}{4}, \frac{5}{6}, \frac{7}{8}, \frac{9}{10}$)
200 ms picture display, 160 trials, n = 15

## Polish

| | Polish | Math |
|---|---|---|
| Positive | *A jest wyższe niż B, B jest wyższe niż A* | *A > B, B > A* |
| Negative | *A jest niższe niż B, B jest niższe niż B A* | *A < B, B < A* |

20 pictures, 5 ratios ($\frac{1}{2}, \frac{3}{4}, \frac{5}{6}, \frac{7}{8}, \frac{9}{10}$)
< 4s picture display, 80 trials, n = 31



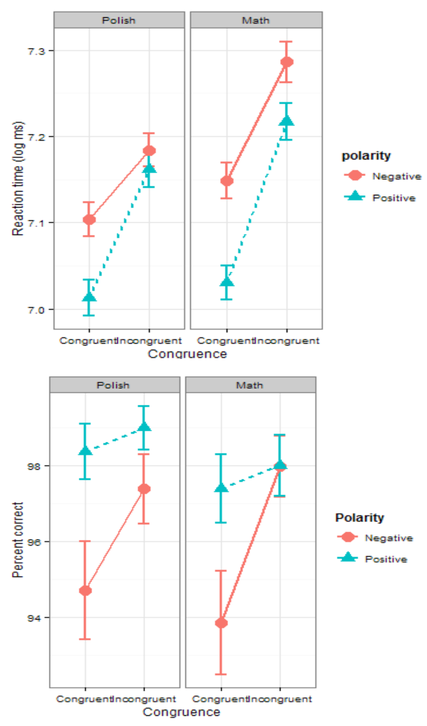




RTs English:
- Effect of polarity (p < .01)
- No effect of congruence
- No interaction

RTs Math:
- Effect of polarity (p < .01)
- Effect of congruence (p = .05)
- No interaction

Accuracy English:
- No effect of polarity
- No effect of congruence
- No interaction

Accuracy Math:
- No effect of polarity
- No effect of congruence
- No interaction




RTs Polish:
- Effect of polarity (p < .01)
- Effect of congruence (p < .01)
- No interaction

RTs Math:
- Effect of polarity (p < .01)
- Effect of congruence (p < .01)
- No interaction

Accuracy Polish:
- Effect of polarity (p = .02)
- No effect of congruence
- No interaction

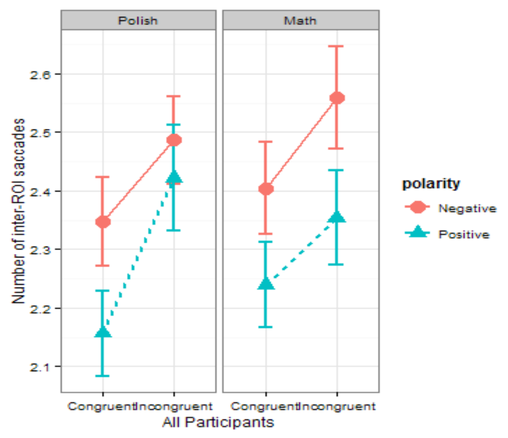
Accuracy Math:
- No effect of polarity
- No effect of congruence
- No interaction

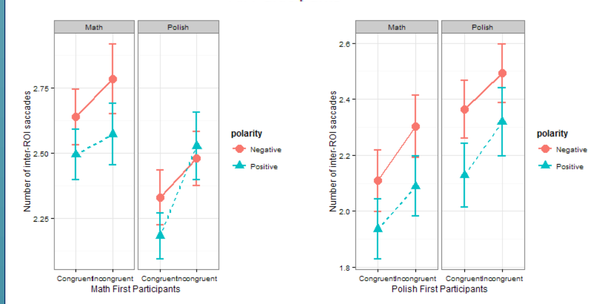
**Eye-Movements in Polish Experiment:**

Number of switches between A & B: effects of polarity and congruence for both PL and M.

But the signature differs for participants who saw M in the 1st half and those who saw PL:

No effects of polarity or congruence for Math First Participants ⇔ Sig. effects for Polish First.




## Results and Discussion

✧ Our results are predicted by **decompositional analyses** of 'shorter' versus 'taller', given the linking hypotheses we have assumed.
✧ Despite the different task demands, we find that both **language** and **math** statements lead to increases in processing load along with the number of negative symbols (RTs, accuracy).
✧ This finding is consistent with the decomposition hypothesis for comparatives, but not with the 'simple' hypothesis for math.
- Participants understand the math statements in terms of natural language translations like *A is greater/less than B?*
- Why does English differ from Math? (Time pressure results in a bias to positively encode a scene? Picture-First Model)
- In the Polish experiment (ample viewing time, emphasis on accuracy over speed), the predictions of the Sentence-First Model are met. Perhaps surprisingly, they are met both in Polish and Math.

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