Priming Effects with Complex Determiners

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Summary

This study presents a priming experiment using a **Probe-Before-and-After** design in combination with **Self-Paced Counting (PBA-SPC)** to obtain information about abstract semantic concepts that are relevant during the verification of quantified statements.

§1 Priming Effects and the Semantics of Determiners

Semantic priming effects with content words are well known [5] and constitute one of the main means of elucidating their conceptual/semantic structure. Whether priming can be applied to quantificational determiners has not been systematically studied.

Under Generalized Quantifier Theory [1], the same determiner can have different semantic representations.

(1) ⟦ more than half ⟧(A)(B) = 1 iff |A∩B| > |A–B|
iff |A∩B| > ½|A|
iff |A∩B| > |A|–|A∩B|

Can we use priming to choose between the options in (1)?

§2 Self-Paced Counting + Priming

A two-step procedure

1) Verification of a quantified statement using the SPC method (cf. [2]).
2) Probe-After task (cf. [3]): How many questions asking for different numerosities (*related* and *unrelated* to the verification stage)

Expectation: priming effects for related numerosities; We propose that this can be used as a way to probe for the cognitive elements that are used in the verification of quantified statements, and hence into the semantics of quantificational determiners.

Proof of Concept. Two determiners:

a) **X>Y:** ⟦ There are more blue dots than yellow dots ⟧ = 1
iff |blue dots| > |yellow dots|

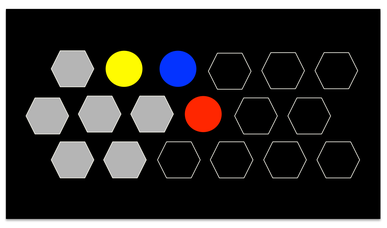
b) **X>each:** ⟦ There are more blue dots than each of the other colors ⟧ = 1
iff For all non-blue colors C, |blue dots| > |C dots|

Prediction:
Priming of |red dots| is expected for (b) but not for (a), because |red dots| is an integral part in the verification of (b) but not of (a).

Sequence of events in PBA-SPC

Q1
a) X>Y: *Are there more blue dots than yellow dots?*
b) X>each: *Are there more blue dots than each of the other colors?*

→ **Verification via SPC**



→ **Q1 Answer** (Yes or No) →

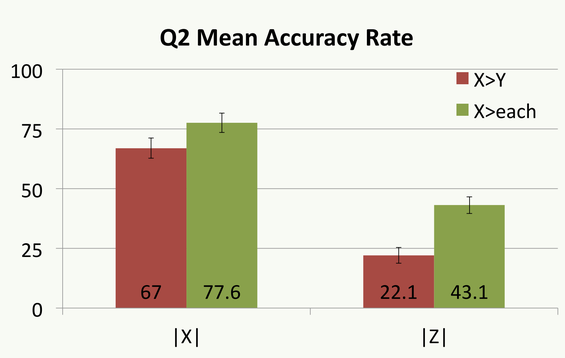
Q2
a) |X|: *How many blue dots did you see?*
b) |Z|: *How many red dots did you see?*

§3 Results

- 67 subjects (22 with Q1 accuracy rate < 75% are excluded)
- 32 target items + 48 filler items
- Only trials whose Q1 is answered correctly are included in the analysis

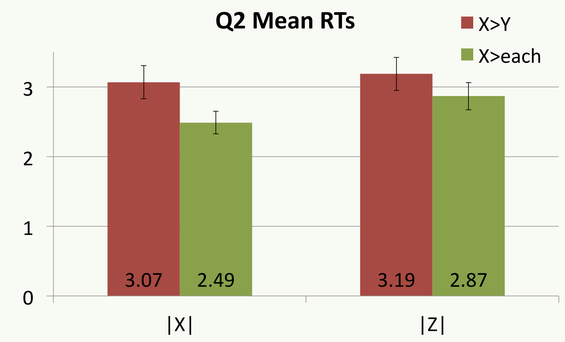
Q2 Accuracy Rates

- Significant main effects of both Q1 type and Q2 type (Contrastive coded mixed logit model; p<0.001)
- No significant interaction (Contrastive coded mixed logit model; p=0.281)



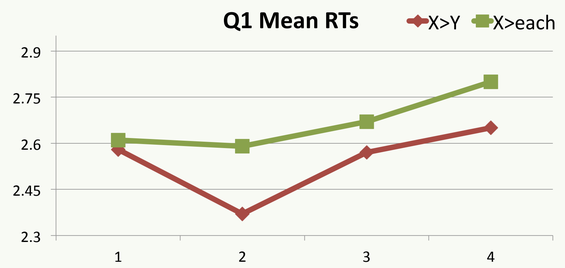
Q2 Reaction Times

We measured the time between the appearance of Q2 and the first key stroke.
- Significant main effects of Q1 Type and Q2 Type (p<0.05)
- No significant interaction (p=0.80)



Q1 Reaction Times

- Significant effect of Q1 Type in Frame 2 (p<0.05)
- Marginal effect of Q1 Type in Frame 4 (p=0.068)



§4 Applications and Extensions

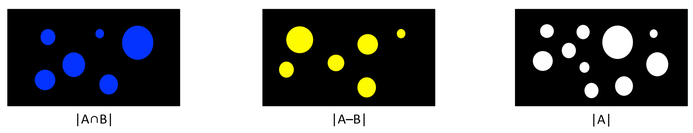
[2] and [4] propose competing views on how statements containing *most* are verified.

a) ⟦ most ⟧(A)(B) = 1 iff ∃X [A(X) ∧ B(X) ∧ ∀Y∈A [Y≠X→|X|>|Y|]]
b) ⟦ most ⟧(A)(B) = 1 iff |A∩B| > |A|–|A∩B|

Numerosities used in the verification of *most of the dots are blue*:
Prediction of (a): |A∩B| and subsets of |A–B|
Prediction of (b): |A∩B| and |A|

Complication: verifying *most* might not involve counting; *how many* questions may bias the verification procedure.

Solution: Q2 is a same/difference judgment about random dot clouds with numerosities implicated in the verification procedure, or unrelated, shown for very short durations.



References
[1] J. Barwise & R. Cooper (1981) Generalized quantifiers and natural language. *Linguistics & Philosophy*, 4.
[2] M. Hackl (2009) On the grammar and processing of proportional quantifiers. *NALS,* 17.
[3] J. Halberda, S. F. Sires & L. Feigenson (2006) Multiple spatially overlapping sets can be enumerated in parallel. *Psych. Sci.* 17.
[4] J. Lidz, P. Pietroski, T. Hunter & J. Halberda. (in press) Interface Transparency and the Psychosemantics of *most. NALS*
[5] D. E. Meyer & R. W. Schvaneveldt (1971) Facilitation in recognizing pairs of words. *J. of Exp. Psych,* 90.

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