Most set-building is heterogeneous: A relook at verification strategies

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Linguistic Society of America's 88th Annual Meeting, January 2-5, 2014 • Minneapolis, MN

Background

- Lidz *et al*. (2011) argue that the verification strategies speakers use to judge sentences are biased toward the canonical formal specifications of the sentences' truth conditions. In judging (1), the non-blue dot set can be calculated in two possible ways, as in (2).

  (1) Most of the dots are blue.

  (2) a. |DOT ∩ BLUE| > |DOT – BLUE|

  b. |DOT ∩ BLUE| > (|DOT| – |DOT ∩ BLUE|)

- They state that the computation of the |DOT – BLUE| set requires attention to and summation of the sets of dots comprising it – see (3).

  (3) |DOT ∩ BLUE| > (|DOT ∩ RED| + |DOT ∩ YELLOW|)

- According to Halberda *et al*. (2006), speakers can only reliably attend to three sets of dots at once. Since Lidz *et al*. (2011) found that accuracy in determining the truth conditions of (1) is not affected by the number of colors, they conclude that the subtraction strategy in (2b) must be used.

Experimental Design

- Dot arrays of 2 to 6 colors, displayed for 250 milliseconds – see Figure 1.
- The number of dots varied randomly, as did the ratio of the target to non-target set (1:2, 3:4, 5:6, 7:8).
- Data from 50 native English speakers, each encountering a total of 150 images.

  (4) Are *most* of the dots…

  a. red? b. not red?

  c. green and blue? d. neither green nor blue?

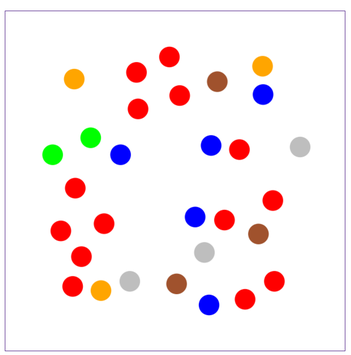

Figure 1

- If (2b) is the strategy being used, judging (4c) requires attention to at least four sets, which should lead to low accuracy rates, according to Halberda *et al*. (2006).

(5) (|DOT ∩ GREEN| + |DOT ∩ BLUE|) > (|DOT| – {|DOT ∩ GREEN| + |DOT ∩ BLUE|})

- (4a) and (4c) showing similar accuracy rates would suggest that speakers form and attend to heterogeneous sets *directly*.

Results

- Fairly high (and significantly above chance) accuracy rates for (4b-d), albeit lower than for (4a) – see Table 1.
- This suggests that the participants were able to judge the truth conditions of these sentences despite the heterogeneity of the target sets.

Condition	Overall accuracy (%)
4a	74.9
4b	69.8
4c	68.3
4d	64.2

Table 1

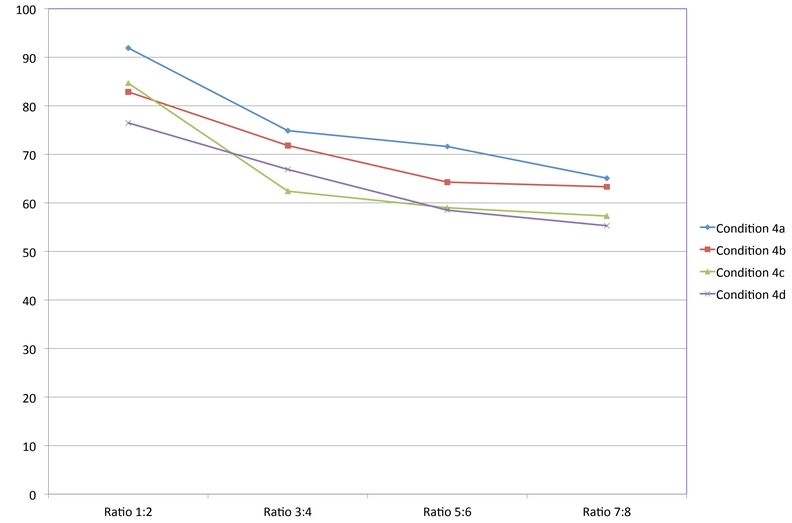

Figure 2

- When broken down by ratio group (Table 2), the results show that the accuracy rates declined at a similar rate for all four conditions (Figure 2), suggesting that the same strategy was being used across conditions.
- While the heterogeneity of the target set in (4c) and (4d) did decrease accuracy rates in comparison to (4a), the facts from Figure 2 suggest that subjects used the same strategy they used for (4a), be it (2a) or (2b).

- If, as per Lidz *et al*. (2011), the subtraction strategy is the strategy used for judging these truth conditions, then (5) should be how the truth conditions of (4c) are computed.
- Yet, this requires computing the cardinalities of four sets, which should not be possible, as per Halberda *et al*. (2006).

Condition	Overall accuracy by ratio group (%)			
	1:2	3:4	5:6	7:8
4a	91.9	74.9	71.6	65.1
4b	82.9	71.8	64.3	63.3
4c	84.7	62.4	59.0	57.3
4d	76.5	66.9	58.5	55.3

Table 2

Conclusions

- These results suggest that speakers *are* capable of heterogeneous set-building. If this were not so, participants would not do well at judging the truth/falsity of questions requiring attention to four sets or more.
- As such, accuracy rates across all ratio groups for at least questions (4c-d) ought to be consistently at or around chance (i.e., 50%), which is not what our empirical results show.
- These findings bring into question Lidz *et al*.'s (2011) claim that the strategy in (2b) is the default. Rather, since both strategies are consistent with the present finding, further research is required to more adequately tease (2a) and (2b) apart.

References: [1] Lidz, J., Halberda, J., Pietroski, P., & Hunter, T. (2011). Interface transparency thesis and the psychosemantics of *most*. *Natural Language Semantics, 19*, 227-256. [2] Halberda, J., Sires, S., & Feigenson, L. (2006). Multiple spatially-overlapping sets can be enumerated in parallel. *Psychological Science, 17*(7), 572-576.

Acknowledgments: We would like to thank Anna Szabolcsi, Allyson Ettinger, Lucas Champollion, Chris Barker, and the members of Semantics II at NYU in Spring 2013 for their invaluable guidance, feedback, comments, and support.