Different Determiners, Different Algorithms: Two Majority Quantifiers in Cantonese Bias Distinct Verification Strategies

Tyler Knowlton¹, Athena Wong², Justin Halberda², Paul Pietroski³,¹, and Jeffrey Lidz¹

**Background: Meaning & Verification**

How are quantifier meanings represented in speakers’ minds?
- Which sets and operations do quantifier meanings highlight?
- Do those highlighted sets and operations bias participants to use certain verification strategies over (superior) alternatives?

**Case study: proportional vs. largest subset most**
- English *the most* vs. *most* [1, 6, 8]
- Polish *najwięcej* vs. *większe* [3]
- Cantonese *zeoi-do* vs. *daai-do-sou*

**Method**
- 14 native Cantonese-speaking participants judged truth of (1) and (2) with respect to briefly flashed dot-displays
- Number of distractor colors (non-blues) varied from 1 to 4 (yellow, red, cyan, magenta)
- Ratios varied from 2:1 to 8:7 (blues : largest non-blue subset for *zeoi-do*; blues : non-blues for *daai-do-sou*)

**Results**
- Both determiners bias strategies relying on approximate number → ratio-dependence [5]
- Largest subset most (*zeoi-do*) biases subset-selection → worse performance as # of distractor colors increases (A)
- Proportional most (*daai-do-sou*) biases subset-supersets → performance unaffected by # of distractor colors (A)
- Evidence of distinct strategies even on one-distractor displays (where either could be used) → different response pattern on TRUE and FALSE trials following *zeoi-do* but not *daai-do-sou* (B)

**Future directions**
- Comparative strategy is superior in spatially-separated 2-color contexts, but still isn’t used for English *most* (though it is used for English *more*) [6]
- Similar task in Cantonese (*daai-do-sou* predicted to lead to worse performance than *zeoi-do*)
- What factors lead to cross-linguistically shared meaning of propositional determiners? → Grammatical? Conceptual?

**Upshot:** quantifier meanings highlight certain sets/operations and carry weight in determining verification
- Both quantifiers bias approx. number-based strategies that are transparently related to their meanings
- Cross-linguistically, proportional quantifiers bias cardinality-based subset subtraction strategies
- Cross-linguistically, largest subset quantifiers bias cardinality-based subset comparison strategies
- Quantifiers even bias distinct strategies on identical displays, where either strategy is cognitively available


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**Contact:** tzknowlton@gmail.com

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**Figure:**

**Speeded Judgement Task**
- A. Percent correct and model fits
- B. One-distractor displays

**Current Case: Proportional vs. Largest Subset in Cantonese**
- (1) *zeoi-do* ge dim hai laam-sik superlative-many POSS dot is blue “the blue dots are the largest subset”
- (2) *daai-do-sou* ge dim hai laam-sik big-many-number POSS dot is blue “most of the dots are blue”

**Quantifier**
- *zeoi-do* (largest subset)
- *daai-do-sou* (proportional)

**Verification Strategy**
- **Proportional:** only if 2 colors
  - #(blue) > #(yellow) & #(#) & ... 
  - #(blue) > #(yellow) + #(#(pink) & ...) + ...
- **Comparative:**
  - #(#(blue) > #(#(pink) & ...)
  - #(#(blue) > #(#(green) & ...)

**Visual Processing**
- Approximate number [5]
  - 2 sets & total in parallel [4]
  - No selecting by negation [7]
- Possible Verification Strategies
  i. #(#(blue) > #(#(pink) + #(#(green) + ...
  ii. #(#(blue) > #(#(yellow) + #(#(pink) + #(#(green) + ...
  iii. OneToOne+(blue, (yellow, pink, green))

**Linking hypothesis: Interface Transparency**
- People are biased toward verification strategies that transparently reflect the meaning under evaluation [1] → e.g., one-to-one strategies [2] or direct comparison strategies [6] aren’t used to evaluate most-statements even when they are cognitively available and would be more fast or accurate (given the display)
- Methodological Strategy: Variation in verification that can’t be otherwise explained is due to the meaning