An eye-tracking approach to meaning representation

Weike Huang[1], Shiru Zhang[1], Canaan Tsabary[1], Tamar Johnson[1], Jakub Szymanik[2], Ingmar Visser[1], Alexandra Sarafoglou[1]*

[1] University of Amsterdam; [2] University of Trento

weike.huang@student.uva.nl

shiru.zhang@student.uva.nl

Although the quantifiers ‘most’ and ‘more than half’ are generally considered truth-conditionally equivalent [1, 2], evidence indicates that they are interpreted differently, reflected in different processing speeds and proportion dependencies, and across cognitive parameters such as meaning threshold, vagueness, and response noise [4, 5]. These findings suggest that the quantifiers are processed using different verification strategies that vary in their cognitive demands; i.e., precise ‘counting-to-a-criterion’ for ‘more than half’, and heuristic ‘vote-counting’ for ‘most’ [2]; however, there is mixed support for this [e.g., 3]. While these strategies have been examined using behavioral paradigms, psychophysiological measures such as eye-tracking remain underexplored despite their potential to offer a more precise test for these strategies. We conducted a pilot study (n=9), in which participants were presented with Dutch quantifier statements (e.g., de meeste van de stippen in het vlak zijn blauw ('most of the dots are blue')) and verified these statements based on dot-array stimuli, under varied visual complexity. Pupil dilation and saccade amplitude were recorded as indices of cognitive effort and visual search strategy, and we used a Bayesian hierarchical cognitive model [5] to disentangle behavioral parameters. Results from our cognitive model suggest that vagueness is greater for 'most', supporting previous findings; however, 'more than half' exhibited a higher meaning threshold and response noise, which contradicts our predictions. Eye-tracking data indicated that verifying 'more than half' statements evokes increased pupil constriction and increased saccade amplitude, relative to 'most'. Together, these preliminary findings support potentially distinct processing strategies for these quantifiers. They also highlight the value of cognitive modeling and eye-tracking in studying the cognitive mechanisms that underlie differences in language interpretation, and consequently provide the foundation for an upcoming Registered Report that builds on this work.

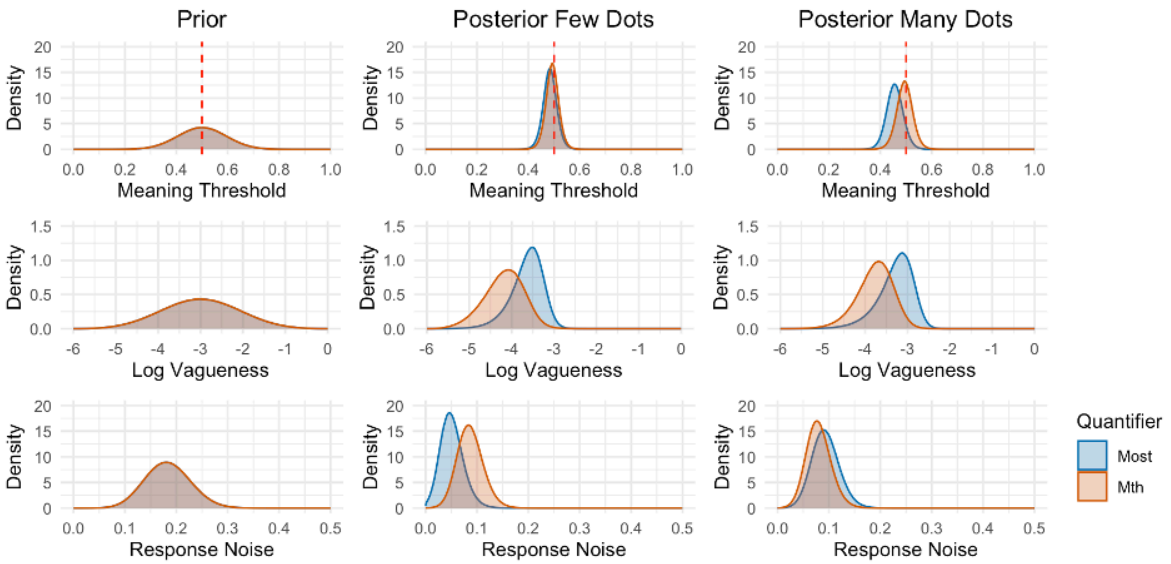

Figure 1. Group-level parameter estimates from the Bayesian hierarchical cognitive model for each quantifier in the pilot study. The left panels depict the prior distribution, while the middle and right panels show posterior distributions under two different visual complexity conditions (i.e., few dots = low complexity, many dots = high complexity).

References

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