

Representing Polar Questions and Inferring States of Inquiry

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Our visual-world study investigates participants' mental representations as they listen to three types of polar question–answer pairs: positive (1a), low-negative (1b) and high-negative (1c).

(1a) -Has John ironed his brother's shirt? - Yes, he has. /No, he hasn't.

(1b) -Has John not ironed his brother's shirt? -Yes, he has. /No, he hasn't.

(1c) -Hasn't John ironed his brother's shirt? -Yes, he has. /No, he hasn't.

Semantic theories of polar questions fall into at least two categories. The partition view (e.g. [1]) treats questions as sets of possible or exhaustive answers, under which positive ($p?$), high-neg ($high \neg p?$) and low-neg ($low \neg p?$) polar questions all have the same semantic content $\{p, \neg p\}$. The proposition abstraction view (e.g. [2]) treats polar questions as abstractions over their relative propositions, thus positive and low-negative polar questions have different denotations: being abstractions on p and $\neg p$ respectively. The inquisitive semantics approach ([3]) proposes that assertions make salient one proposition. Polar questions introduce two propositions but only one of them is highlighted. Answer particles “yes” and “no” have been seen as anaphoric, referring to preceding positive or negative propositions in the context ([2]). In addition to question semantics, inferred speaker's expectations may affect processing. High-neg questions imply a positive epistemic implicature ([3]) while low-neg questions can be understood with or without such an implication. Negative questions are also more likely to be uttered when there is negative evidence present.

Study: participants listen to dialogues such as (1a-c), while looking at a scene containing a person, two distractors and two critical images: “positive” and “negative” - one corresponding to the positive proposition (ironed shirt), and the other to the negative (crumpled shirt). There is a 1.5-s pause between question and answer. When the participants hear the answer, they press a key that corresponds to the correct picture. Gaze and responses were recorded.

Predictions: Question phase: the partition view would predict equal proportions of looks to the positive and the negative images, while the proposition abstraction view would predict more looks to the positive image when listening to a positive question (1a) and vice versa for the low-neg question (1b) if low-negs are interpreted without the epistemic implicature. Answer phase: the proposition abstraction view should predict a faster representation for “yes” than “no” after a positive question. The partition view predicts no difference.

Results: Question phase: the positive condition established a significant bias towards the positive picture only during the noun (“shirt”) region ($p < .001$) and pause after the question ($p = .01$). We compare these results to those from a separate study using the assertion version of the same items (see Fig. 1). In the assertion study the positive bias was established much earlier for a positive sentence (immediately after the verb). Thus in positive *questions*, participants look to both states for much longer. Low-neg has comparable looks to both pictures in all regions. High-neg lies in between (trending positive bias during “shirt” $p = .06$). Answer phase: we found that in positive and low-neg conditions exhibit a stronger bias to the correct picture for “Yes” than for “No” answers ($p = .006$ & $p < .0001$). There is no such difference for high-neg (see Fig. 2). Responses

are made much later than biases to the correct picture is established (by 800 – 1000ms). In contrast to the eye gaze data, response times for “yes” and “no” answers are the same for positive and low-neg. For high-neg, RT for “yes” is faster than “no” ($p < .001$).

Conclusions: the eye-tracking results from the positive question and response suggest that participants consider both positive and negative alternatives during early incremental processing but they form a positive representation later. Combined with the high- and low-neg data, we argue that it is during a late phase of question processing that epistemic inferences are made. The lack of biases for high- and low-neg may be due to a conflict between the positive epistemic inference and likely presence of negative evidence. We conclude that while on-line semantic processing of questions seems to be consistent with the partition view, representation of the speaker’s state of ignorance may not simply be in terms of representing the question asked.

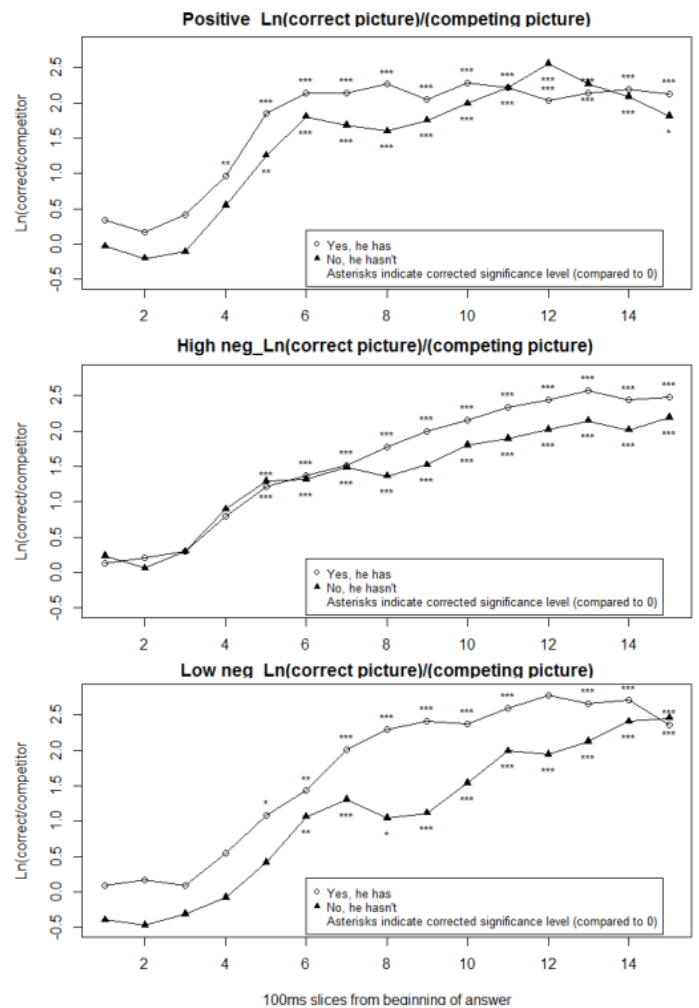
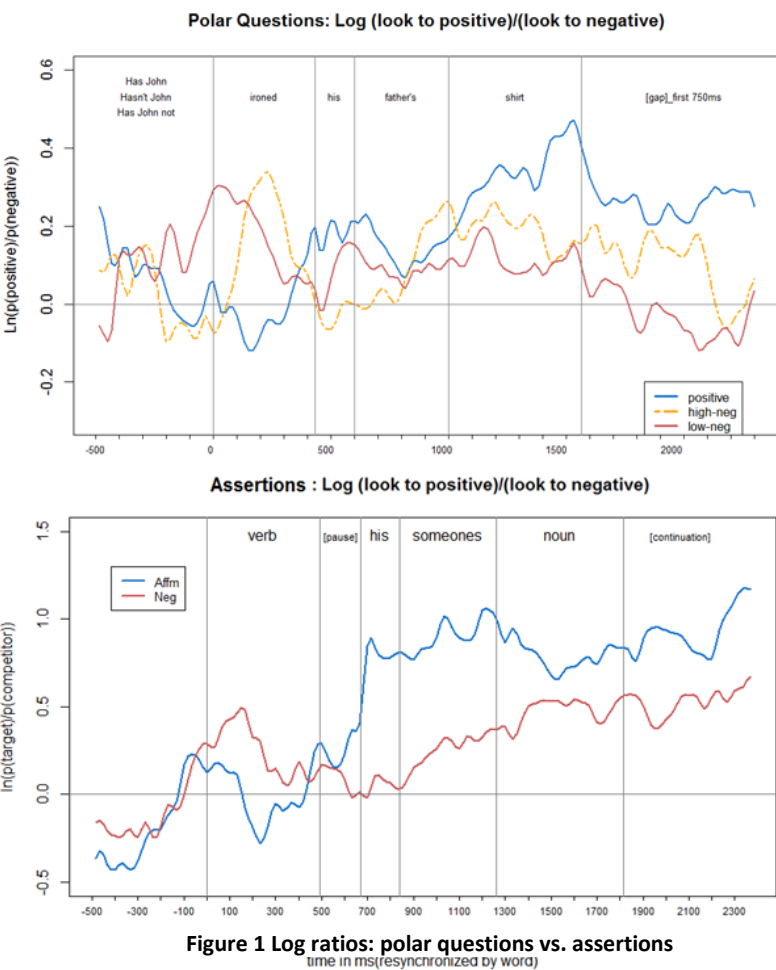


Figure 2 Log ratios of answer phase: 3 conditions

References: [1]. Hamblin, C.L. (1973) Questions in Montague English. In: Partee, B. (ed.) *Montague Grammar*. AP.
 [2]. Ginzburg, J., Sag, I.A. (2000) *Interrogative Investigations* CSLI Pubs. [3] Romero, M & Han C. (2004). On Negative Yes/No Questions. *Ling & Phil* 27(5). [3] Roelofsen, F., & Farkas, D. (2014). Polarity particle responses as a window onto the interpretation of questions and assertions *. *Language*, 1–57.