Representing Polar Questions and Inferring States of Inquiry

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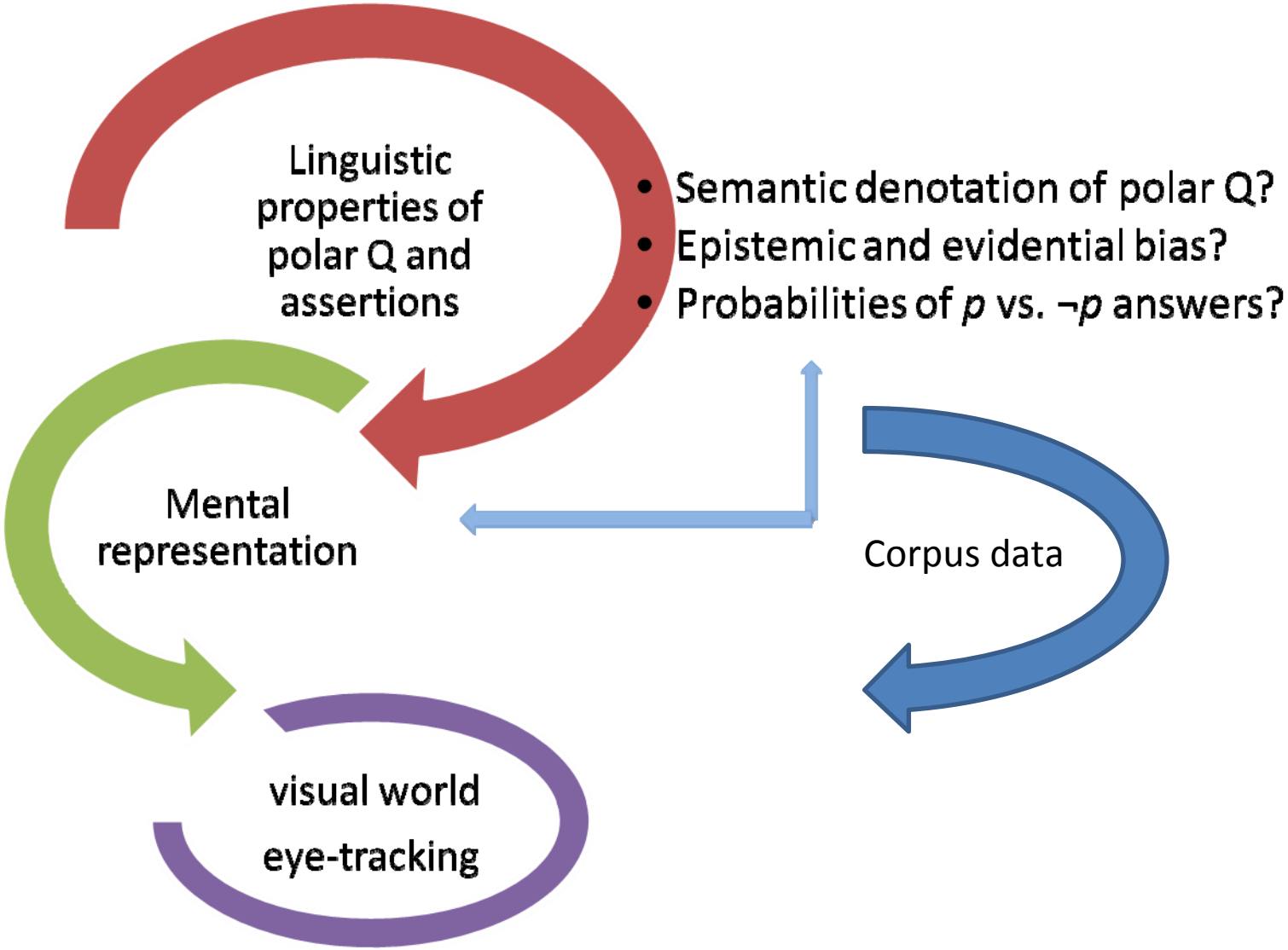
Questions Answers and Negation, Berlin Jan 2016

Polar questions

- In conversations, we frequently respond to polar Questions and assertions such as (1a), (1b) or (1c) by confirmation or rejection.

- (1a) Positive: - Is John home?/ John is home. - Yes, (he is). /No, (he isn’t).
- (1b) Low-neg: -Is John not home?/John isn’t home. - Yes, (he IS). /No, (he isn’t).
- (1c) High-neg: -Isn't John home? - Yes, (he is). /No, (he isn’t).

- Based on the *forms*, we refer to the questions as positive, low-negative and high-negative polar questions.


Linguistic properties of polar Q and assertions
• Semantic denotation of polar Q?
• Epistemic and evidential bias?
• Probabilities of p vs. ¬p answers?
Mental representation
Corpus data
visual world eye-tracking

Roadmap

- Review of semantic theories of polar Q and assertions (we know all this by heart now right?)
- What do corpus data tell us about epistemic and evidential bias?
- And about probabilities of *p* vs. ¬*p* answers?
- Mental representation: from eye-tracking
- Can we link them?

Semantic theories of polar Q and assertions

		Hamblin 1973; Groenendijk & Stokhof, 1984	**Hausser1983 ; Ginzburg & Sag, 2000)**	**Farkas & Bruce, 2010; Roelofsen & Farkas, 2014**	**Krifka (2013): In terms of discourse referents**
Polar Questions	positive	{p, ¬p}	{p}	{**p**, ¬p}	{p}
	Outside neg	{p, ¬p}	{¬p}	{**p**, ¬p}	{p}
	Inside neg			{p, **¬p**}	{p, ¬p}
Assertions	Positive	{p}	{p}	{**p**}	{p}
	negative	{¬p}	{¬p}	{**¬p**}	{p, ¬p}

- A pragmatic theory: Enfield et al. (2009) proposed that what marks a proposition *p* to be an assertion or a polar question is primarily the different levels of commitment to *p* by the speaker and the addressee.
- In context where the asymmetry of knowledge is obvious, the speaker can ask a polar question simply by making a statement.

Semantic theories of answer particles

- Roelofsen & Farkas (2014) : absolute features ([+]/ [-]) mark a response clause as positive or negative. Relative features ([AGREE]/[REVERSE]) mark a response as agreeing or disagreeing with the antecedent.

- Krifka (2013): polarity particles are anaphors that pick up a salient propositional discourse referent (propDR) introduced by the antecedent. “Yes” asserts the salient propDR and “No” asserts its negation.

- Different theories on polar questions may have different prediction on the differences (or lack of) accessibility of p vs. $\neg p$.

CORPUS STUDY

Percentage of different polar Qs

Polar Questions		
Positive	3733	96.21%
High neg (outside reading)	132	3.40%
High neg (inside reading)	6	0.15%
Low neg	9	0.23%
Sub-total	*3880*	*100%*
Declarative polar questions		
Positive	1016	83.87%
negative	210	17.13%
Sub-total	1226	100%
All		
Positive	4749	94%
all negatives	357	7%
Total	5006	

Switchboard Dialog Act Corpus

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Sub-total	1226	100%
All		
Positive	4749	94%
all negatives	357	7%
Total	5006	1:20 (polar Q : assertion)
Total assertions:	101,573	

Switchboard Dialog Act Corpus:
Polar Q

75145 statement non-opinion + 26428 statement opinion

Why do we ask polar questions?

<table>
<tr><th>belief/ opinion
evidence</th><th>NA</th><th>positive</th><th>negative</th></tr>
<tr><td>NA</td><td>Information seeking</td><td colspan="2">-Does my belief match your evidence/ knowledge?
-Do you share my opinion?</td></tr>
<tr><td>positive</td><td rowspan="2">Please confirm what I inferred from the evidence.</td><td></td><td>Surprise / challenge</td></tr>
<tr><td>negative</td><td>Surprise / challenge</td><td></td></tr>
</table>

What questions do we use?

evidence \ belief/ opinion	NA	positive	negative
NA	**positive**		
positive	**positive**		
negative	**Low neg**		

What questions do we use?

Please confirm what I inferred from the evidence:

Do you like Berlin?

(saw you after Christmas): Have you put on weight?

(we both know you want to lose weight. I saw you at the end of Januray): Have you not lost any weight?

What questions do we use?

evidence \ belief/ opinion	NA	positive	negative
NA	**positive**	**High neg**	**Positive** (optional NPI) **High neg** with embedded low neg
positive	**positive**		
negative	**Low neg**		

What questions do we use?

Positive bias:

•Does my **belief** match your evidence/ knowledge?

A: isn't that where they have a summer music festival there, too?

B: Right, right, in the summer time they have musicals there. *(sw05utt/sw_0550_3124.utt)*

•Do you share my **opinion**? *Don't you think/ Wouldn't it be nice/ isn't it good …*

A: <Lipsmack> Wow, [they've got the, + don't they have the] best record now?

B: I think they do, as a matter of fact. *(sw01utt/sw_0133_3796.utt)*

Negative bias:

•*Positive:* sometimes containing NPI, see Guerzoni, 2003)

Do you have the faintest idea how to solve this problem?

•*High-neg (rare)*

Isn't it not technically correct to say there are four fundamental forces anymore? (reddit)

What questions do we use?

evidence \ belief/ opinion	NA	positive	negative
NA	**positive**	**High neg**	**Positive** (optional NPI) **High neg** with embedded low neg
positive	**positive**		**positive**
negative	**Low neg**	**Low neg**	

In line with (Gunlogson & Büring, 2000), Sudo (2013)

What questions do we use?

*Negative belief, **positive** evidence:*

Do you like chilli? I thought you didn't.

*Positive belief, **negative** evidence:*

Do you not like chilli? I thought you did.

A: I've never seen that.

B: Haven't you? → High-neg with inside reading

C. uh-uh

(sw05utt/sw_0507_3606.utt)

But

- We all know high-neg are ambiguous (data in the corpus, outside reading majority)
- Are low-negs possibly also ambiguous??
  - "some" as PPI

Is there not some hypocrisy when the Opposition talk of problems of unemployment and housing, yet suggest that we add to them? (BNC HHW W_hansard). Speaker has **opinion** of p

Is there not some call on judges to be just a little more respectful perhaps when they're dealing with cases like this? (BNC HUV S_brdcast_discussion). Speaker has **belief** of p.

Probabilities of *P* vs. ¬*P* answers

	P	¬P	Unsure	P : ¬P
Positive	54%	26%	20% *	2 : 1
High-neg Out	58%	8%	33%	6.6 : 1
High-neg In	33%	50%	17%	1 : 1.5
Low neg	11%	44%	44%	1 : 4

* Sample estimate

However, in terms of confirmation / rejection, positive questions are less often confirmed.

EYE-TRACKING STUDY

Our experiment – visual world eyetracking

- Visual world eye-tracking

	Question	Answer
Positive	Has John ironed his father's shirt?	Yes, he has. No, he hasn't
High-neg	Hasn't John ironed his father's shirt?	
Low-Neg	Has John not ironed his father's shirt	

"Has John ironed his father's shirt?"

"Yes, he has."

"No, she hasn't."

"Hasn’t John ironed his father's shirt?"

"Yes, he has."

"No, she hasn't."

"Has John not ironed his father's shirt?"

"Yes. He has."

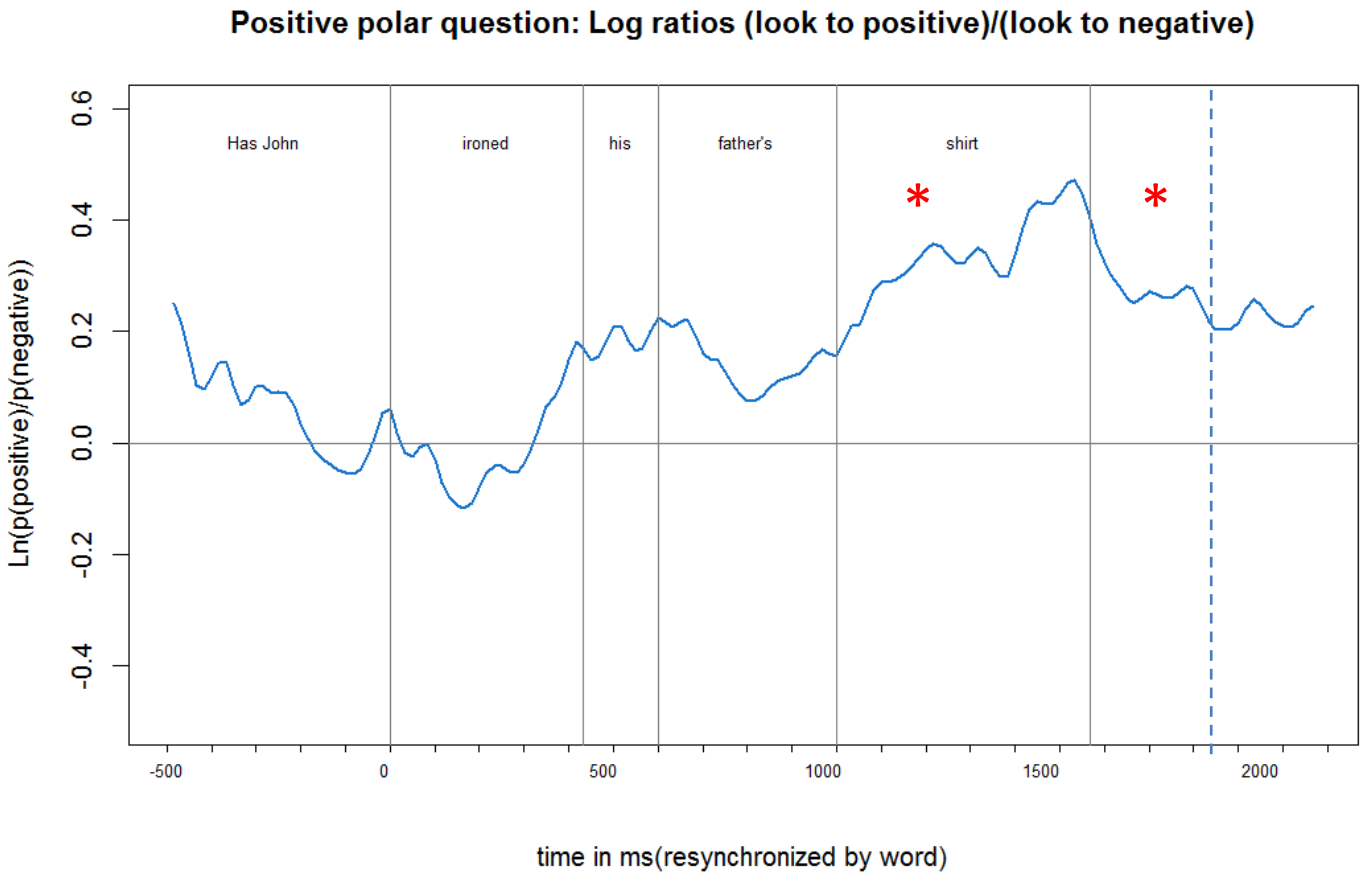
"No, she hasn't."

Our experiment – visual world eyetracking

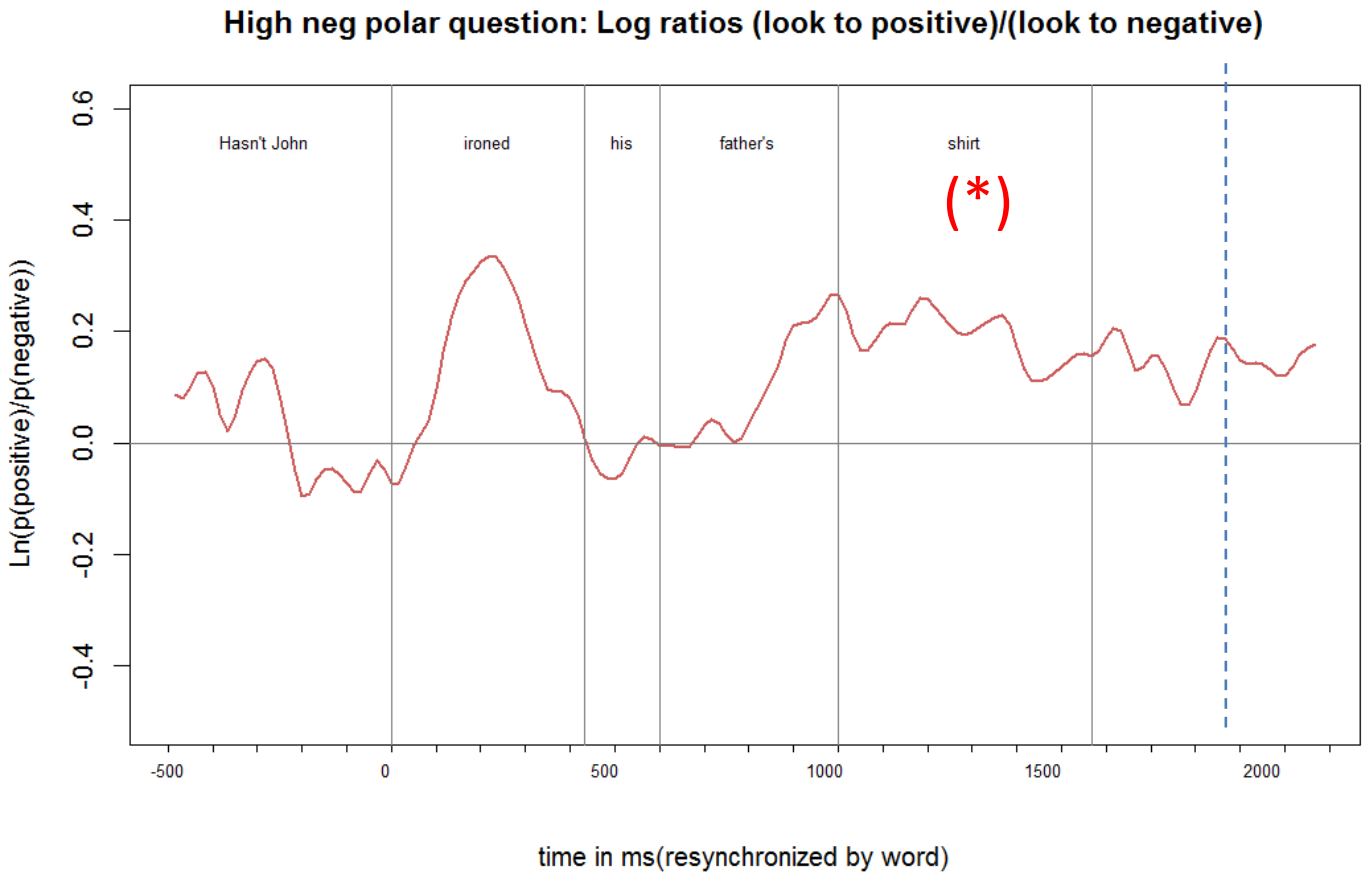
- 42 experimental sentences (3 conditions, 14 each), plus 14 positive fillers.
- 1.5 second preview time. Then the audio starts. Between the question and the answer, there is a 1.5 second gap.
- Participants press a key that corresponds to the correct picture after they've heard the answers. The trial is terminated as soon as they press the response.
- The eye movements and responses are recorded.

Results for each condition

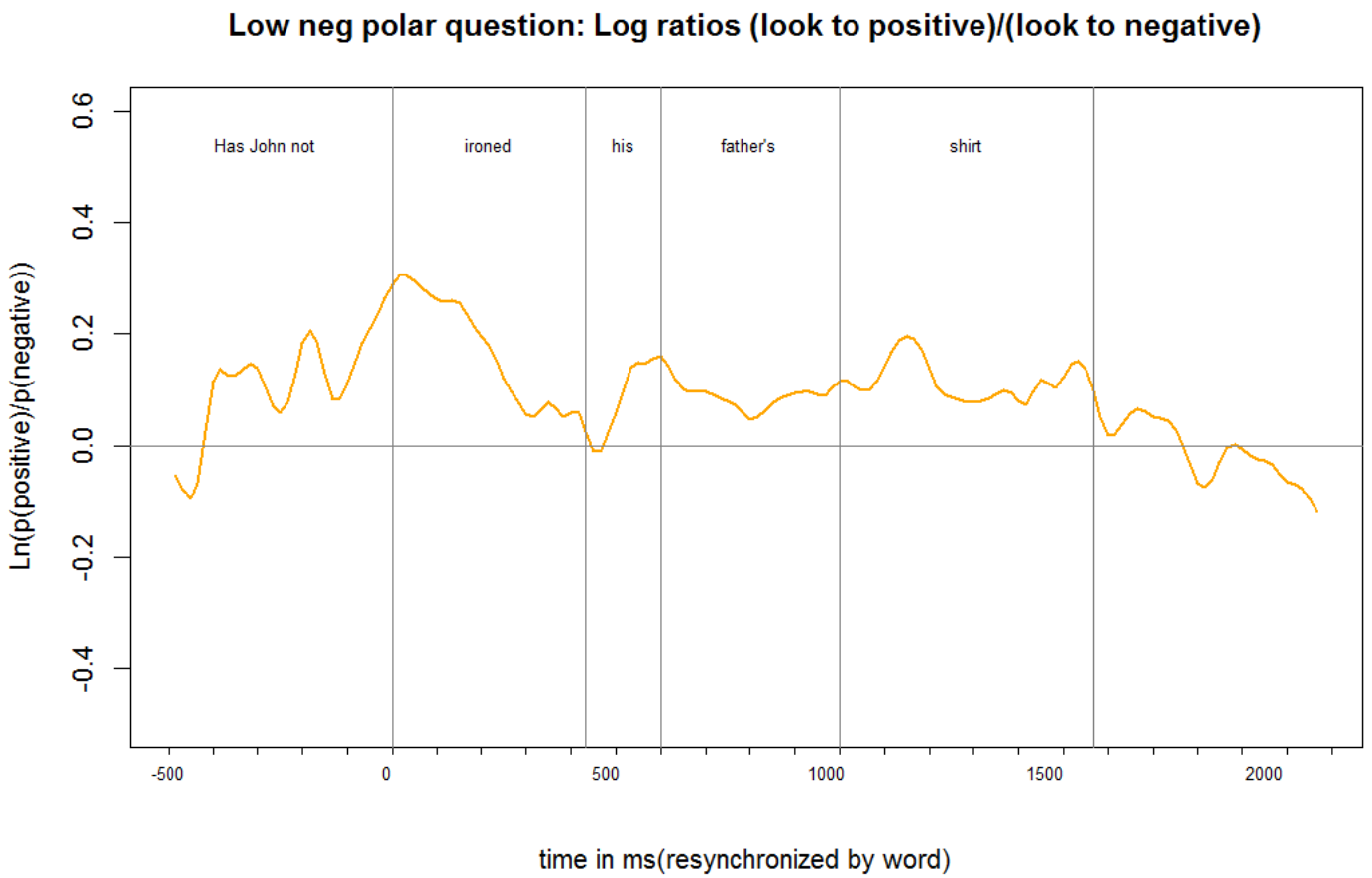
Question Phase: Positive



Question Phase: High neg

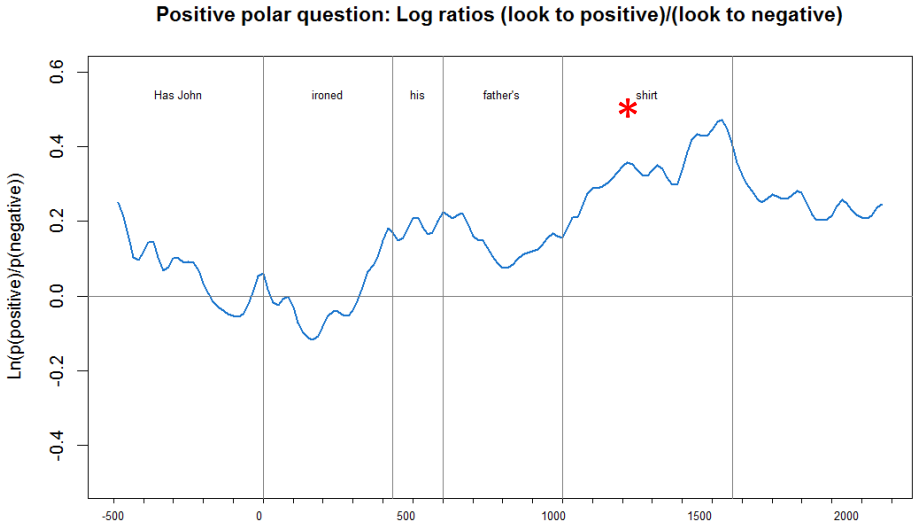


Question Phase: Low neg



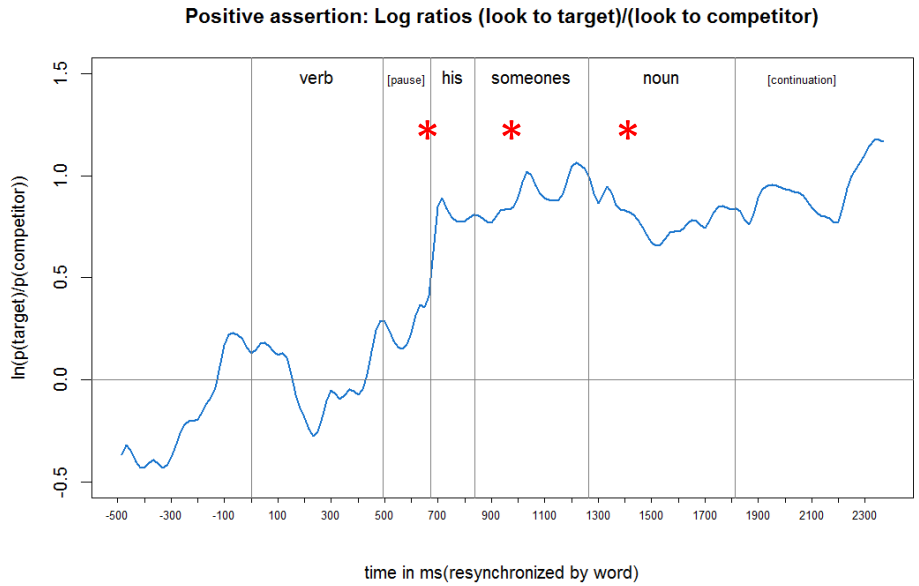
Comparison with positive assertion

Positive Question



Note: Different task for Assertion data!
But same items

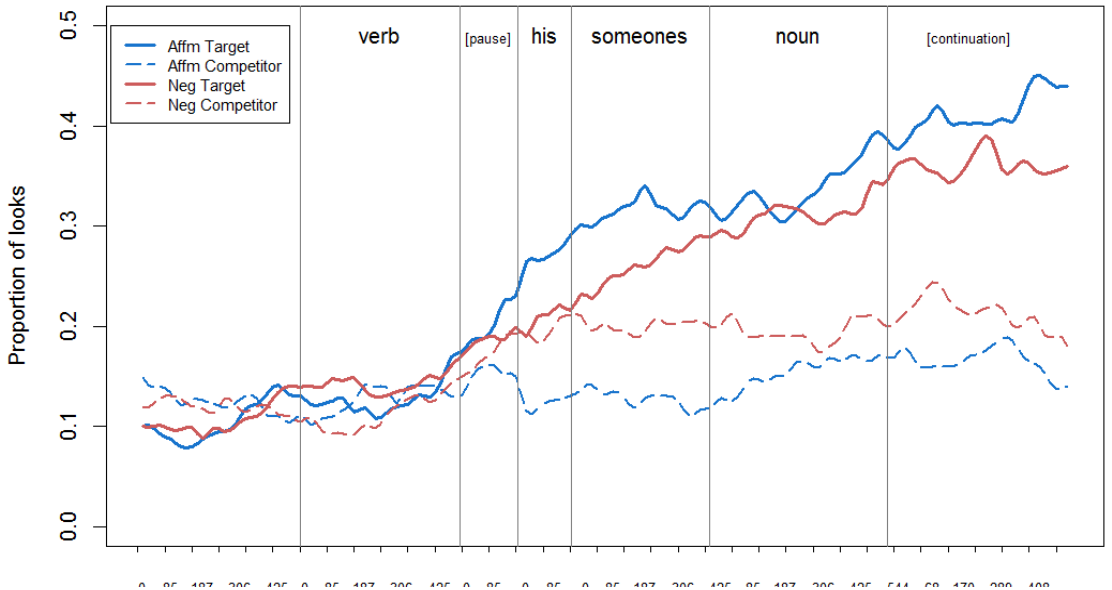
Positive Assertion



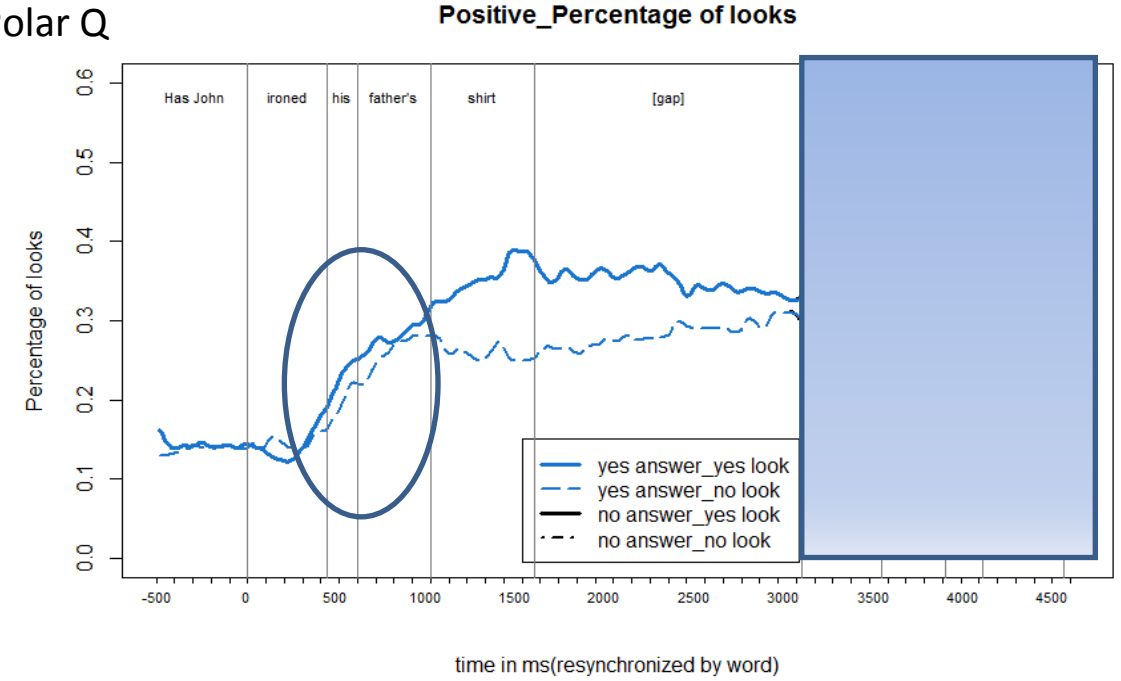
Tian, Ferguson and Breheny, (2016), Language Cognition and Neuroscience

- Delay in bias formation implies prolonged inspection of negative state of affairs for positive questions.

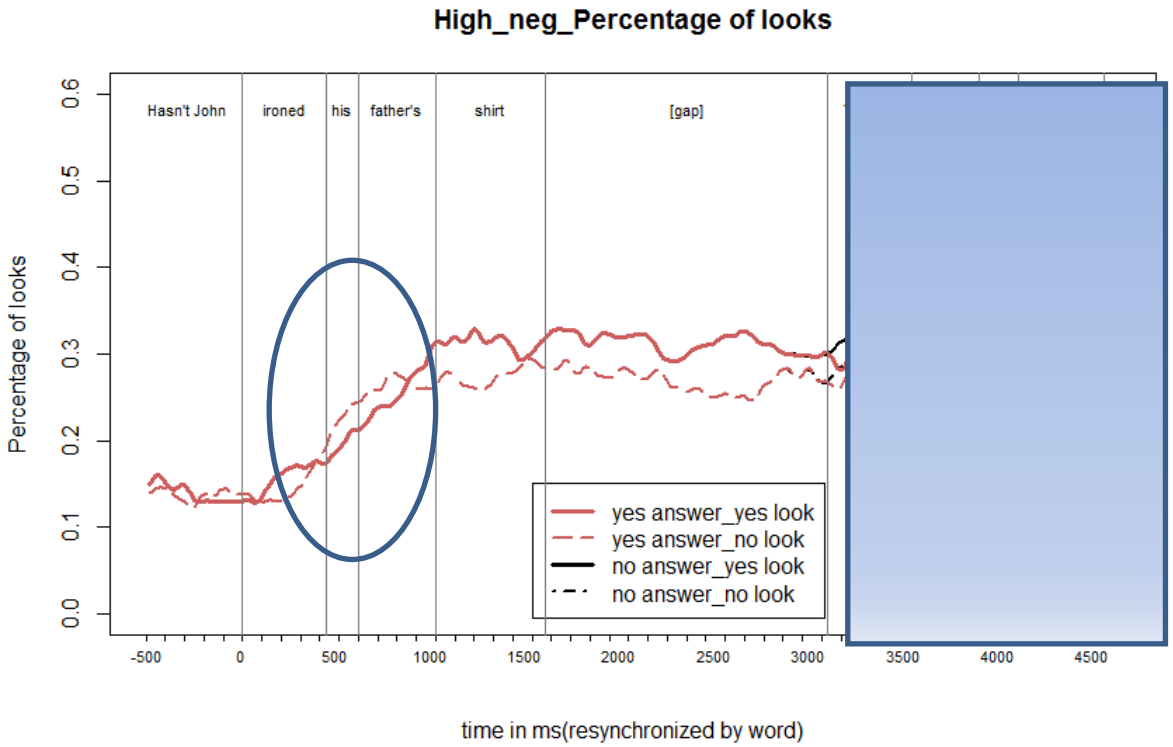
assertions



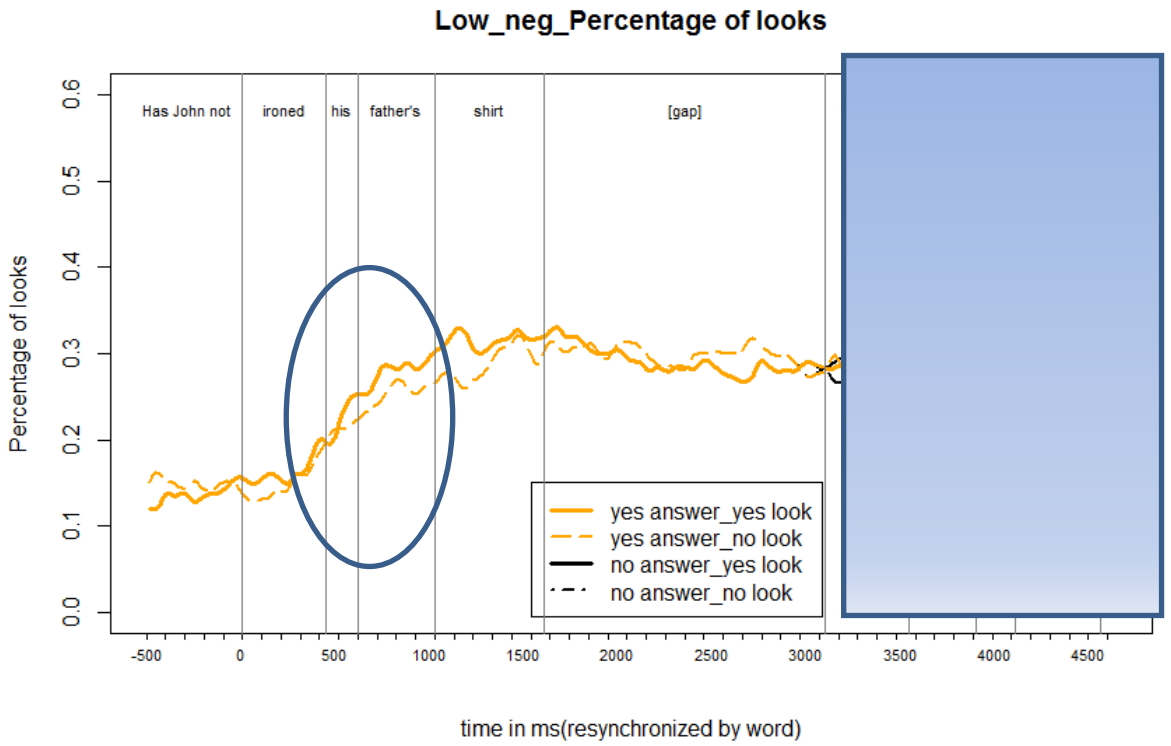
Polar Q



- Delay in bias formation implies prolonged inspection of positive and negative state of affairs for high-neg questions.



- Delay in bias formation implies prolonged inspection of positive and negative state of affairs for low-neg questions.



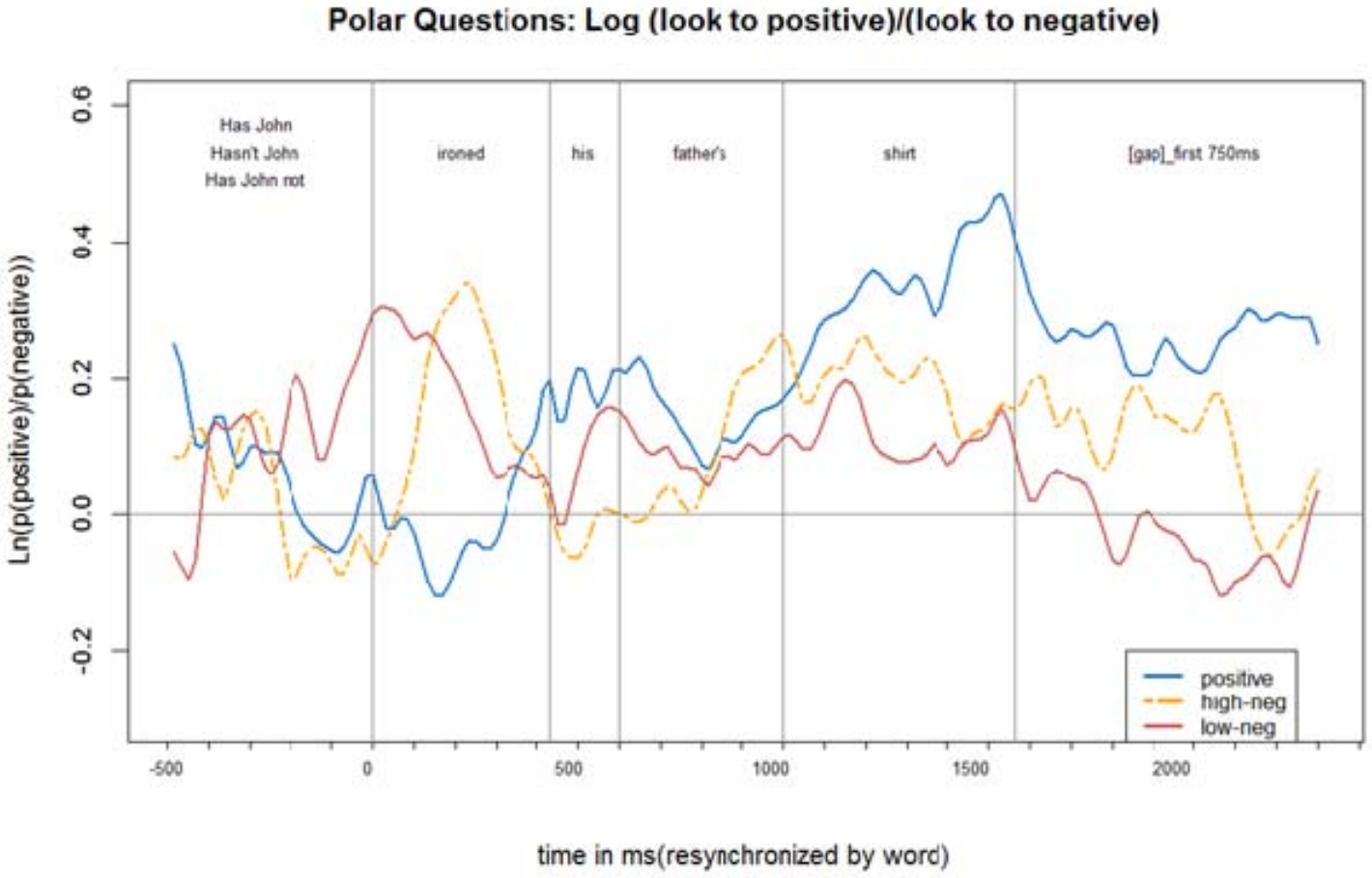
Results for each condition

Mixed effect models on natural log ratios of looks to the positive and negative pictures. The looks are averaged per trial for a region. The random effects are subjects and item, the fixed effect is condition.

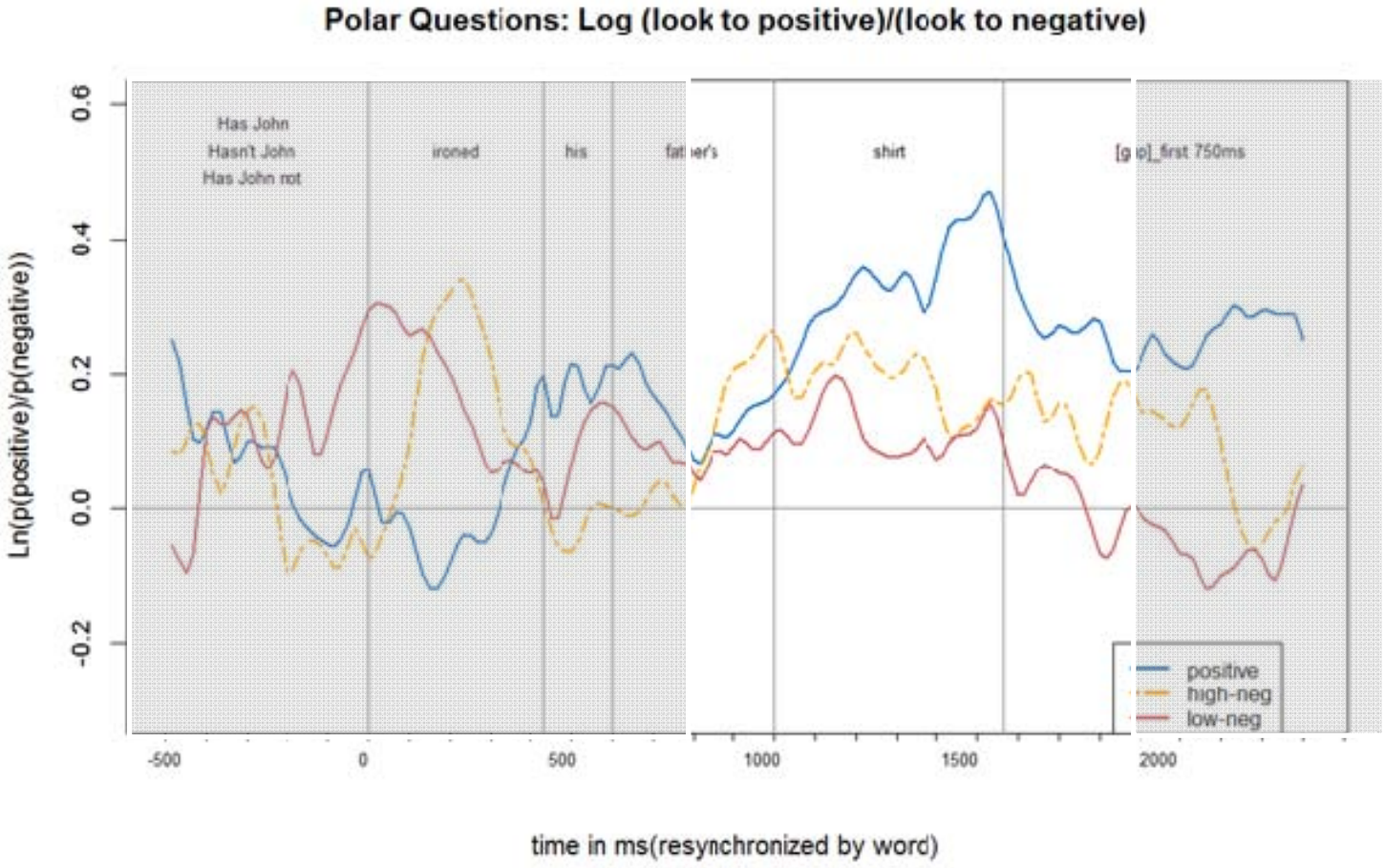
Ln(positive/negative)				p values		
Period	**Positive**	**High-neg**	**Low-neg**	**Pos**	**High Neg**	**Low Neg**
Noun	0.5	0.22	0.13	p<0.001*	(p=0.06*)	n.s.
gap 0-750ms	0.5	0.21	0.02	p=0.01	n.s.	n.s.
gap 750-1500ms	0.24	0.2	-0.08	n.s.	n.s.	n.s.

Results comparing three conditions

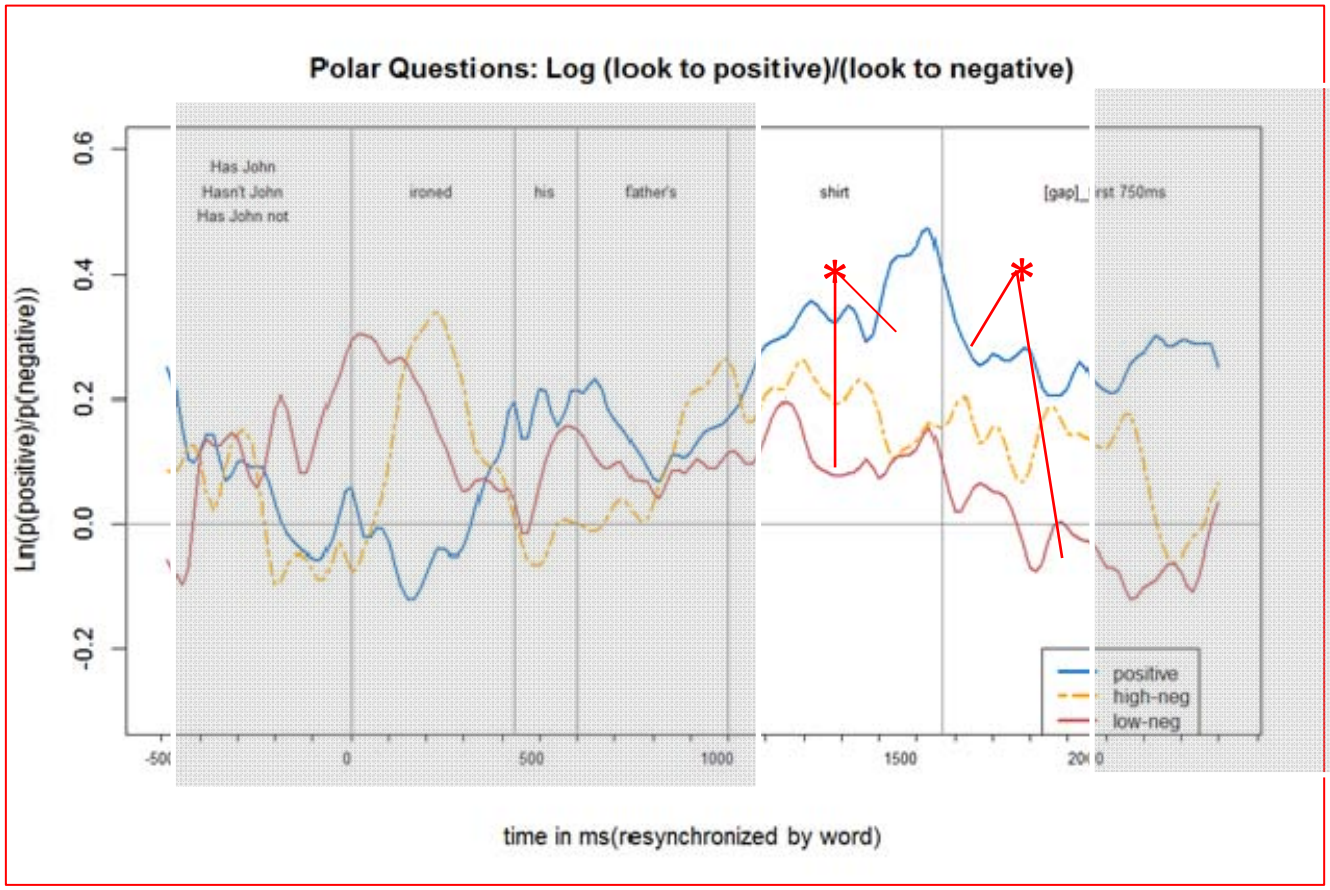
Results – Question Phase



Results – Question Phase



Results – Question Phase



Results – comparing pos, high and low neg

Mixed effect models on natural log ratios of looks to the positive and negative pictures. The looks are averaged per trial for a region. The random effects are subjects and item, the fixed effect is condition.

Ln(positive/negative)						
Period	**Positive**	**High-neg**	**Low-neg**	**pos vs. high**	**pos vs. low**	**high vs. low**
Noun	0.5	0.22	0.13	p=0.10	p=0.049*	p=0.73
gap 0-750ms	0.5	0.21	0.02	p=0.09	p=0.01*	p=0.42
gap 750-1500ms	0.24	0.2	-0.08	p=0.71	p=0.09	p=0.18

Recap Q- Phase

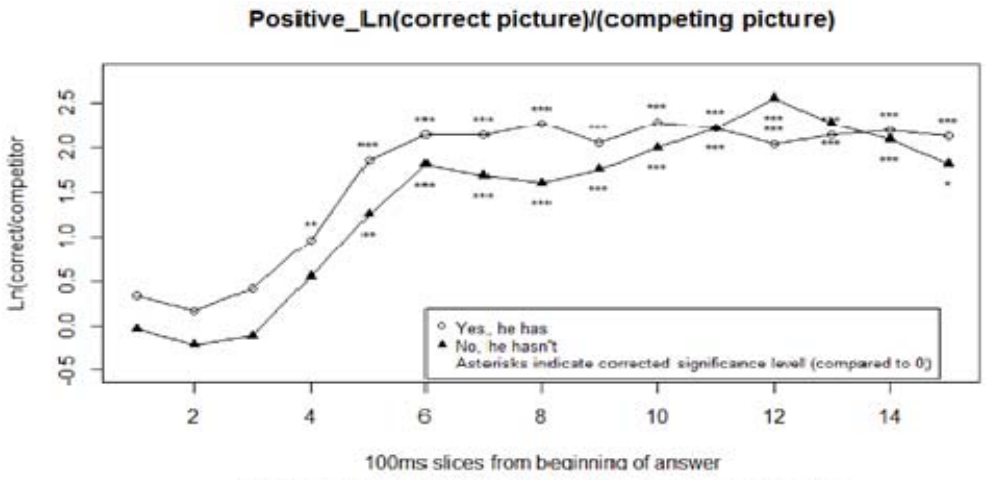
- Experimental procedure allows for rapid discrimination of positive and negative states.
  - No cost of inferring negative SAO.

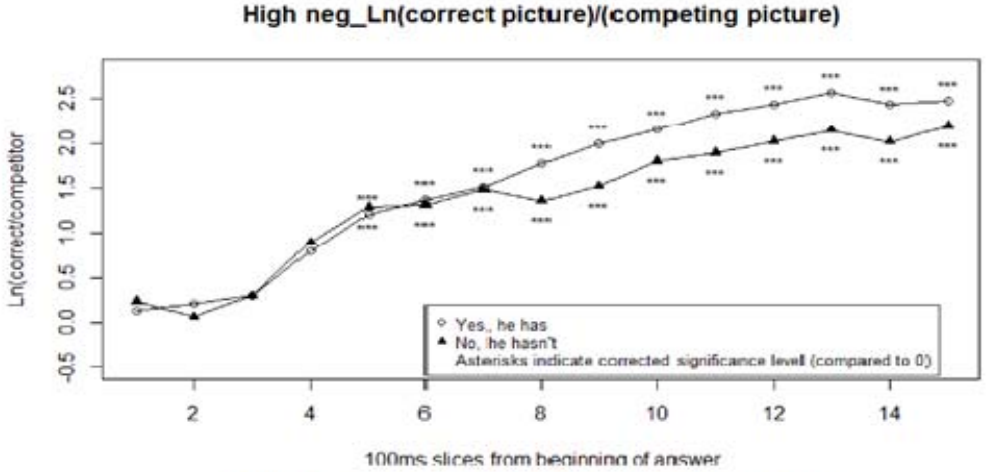
- We show rapid attention to **both** positive and negative images in all question forms.

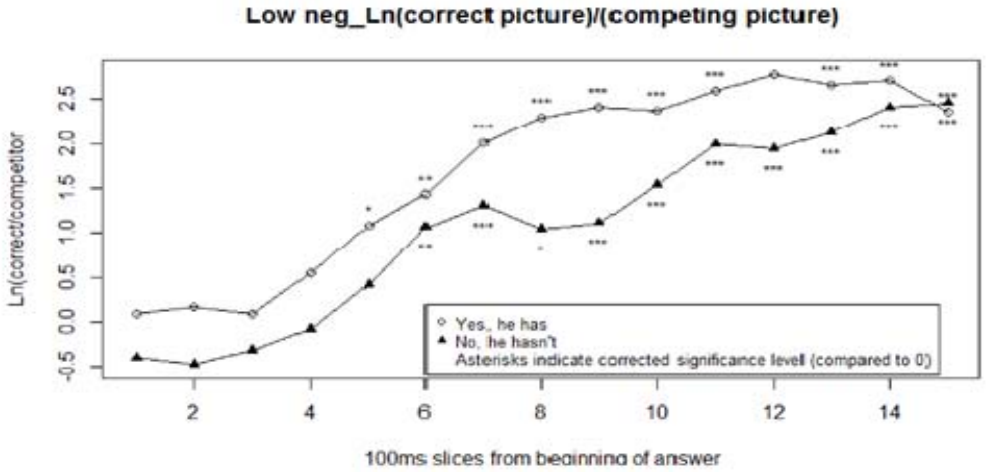
- **Late bias** to positive image for **Positive** and **High Neg**

Results – Answer Phase

- Compared the log ratio (P(correct picture)/P(competing picture)) for “yes” and “no” answers in each condition.







Looks to correct picture above competing picture for both “yes” and “no”.

In the positive and (surprisingly) low-neg conditions, bias to the correct picture is stronger for Yes answer than for No answer ($p = .006$, and $p < .0001$) respectively.

Not significant for High-neg.

Answer Phase Response data

- Responses much delayed relative to bias formation.

- Response 700-1000ms later

Summary of data

- Question phase: Initial processing of Positive, High-Neg and Low-Neg questions involves **no overall bias**.

- Later phase shows a **bias to positive** image in Positive and High Neg

Summary of data

- Answer Phase: rapid bias formation for both polarities.
  - Much faster than key responses.

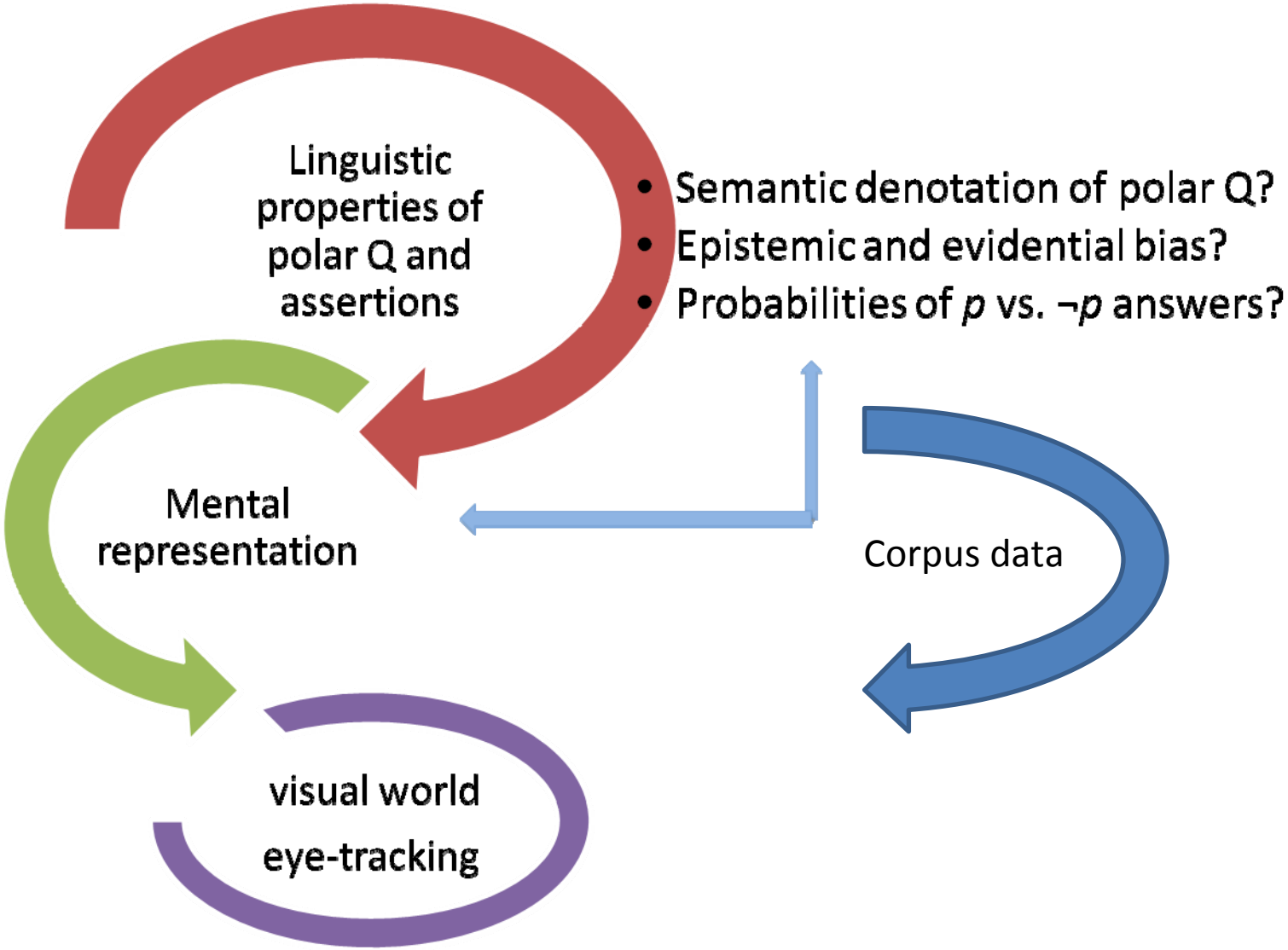
- Overall stronger gaze bias for ‘yes’ vs. ‘no’ response, even for low neg.
  - Not significant for High-Neg condition

Discussion

- Polar questions evoke both positive and negative states of affairs during processing.
  - Different from positive assertions.

- Late positive bias in Positive Question and High Neg.

Can we link everything?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• Semantic denotation of polar Q?
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• Probabilities of p vs. ¬p answers?
Mental representation
Corpus data
visual world eye-tracking

Not much to say…

		Hamblin 1973; Groenendijk & Stokhof, 1984	Hausser1983 ; Ginzburg & Sag, 2000)	Farkas & Bruce, 2010; Roelofsen & Farkas, 2014	Krifka (2013): In terms of discourse referents
Polar Questions	positive	{p, ¬p}	{p}	{p, ¬p}	{p}
	Outside neg	{p, ¬p}	{¬p}	{p, ¬p} ?	{p} ?
	Inside neg			{p, ¬p}	{p, ¬p}
Assertions	Positive	{p}	{p}	{p}	{p}
	negative	{¬p}	{¬p}	{¬p}	{p, ¬p}

Except that the semantic denotation of polar Q is NOT the only thing that drives mental representation.

What questions do we use?

evidence \ belief/ opinion	NA	positive	negative
NA	**positive**	**High neg**	**Positive** (optional NPI) **High neg** with embedded low neg
positive	**positive**		**positive**
negative	**Low neg**	**Low neg**	

Bias profile could explain the data (high-neg ambiguous between checking p vs. not p)

Proportions of *P* vs. ¬*P* answers

	P	¬P	Unsure	P : ¬P
Positive	54%	26%	20% *	2 : 1
High-neg Out	58%	8%	33%	6.6 : 1
High-neg In	33%	50%	17%	1 : 1.5
Low neg	11%	44%	44%	1 : 4

The mental representations does not reflect the probability of *P* vs. ¬*P.*

State of Inquiry

- *Wondering about P* is different from *Wondering about not P*
  - Due to ‘confirmation bias’, we prioritise search for confirming evidence for the target of inquiry.
  - Search for disconfirming evidence has lower priority.

Conclusions

- Corpus data can inform us the bias profile and the probabilities of positive and negative answers of polar questions.
- In terms of mental representation:
  - Polar questions evoke both positive and negative states of affairs during processing.
  - Late positive bias in positive and high-neg questions.
  - Different from assertion.
- Mental representation reflects the speaker's state of inquiry: wondering about p/ verifying p because of evidence/ wants to confirm belief of p.

I do have a story about polar particles

They can be ambiguous because they pick up different **types** of antecedent.

•Explicit: picks up salient discourse referent. Can be used bare.

I do have a story about polar particles

(Tian & Ginzburg, in prep)

They can be ambiguous because they pick up different **types** of antecedent.

- Explicit: picks up salient discourse referent. Can be used bare.
- **Implicit:** used when there is a *grounding misalignment.* Picks up implicit antecedent: biases, assumptions, interpretations that cannot be grounded. Cannot be used bare.
  - Involves more metalizing
  - E.g. “yeah, no, I agree”. “no, she is my wife now.”. “No, I AM.”
- Extraphoric: exclamative no

Importantly, I propose that the “disagreement” uses of particles are licenced not by the linguistic antecedent, but an implicit speaker’s bias.

I do have a story about polar particles

(Tian & Ginzburg, in prep)

They can be ambiguous because they pick up different **types** of antecedent.

•Explicit: yes, yeah, yep, uh-huh (rising tone). / no, nope, uh-uh (falling tone).

•**Implicit: No, + a clause**

•Extraphoric: No

Evidence:

•Experimental data: strength of speaker's bias influences the ratio of "disagreement" no uses.

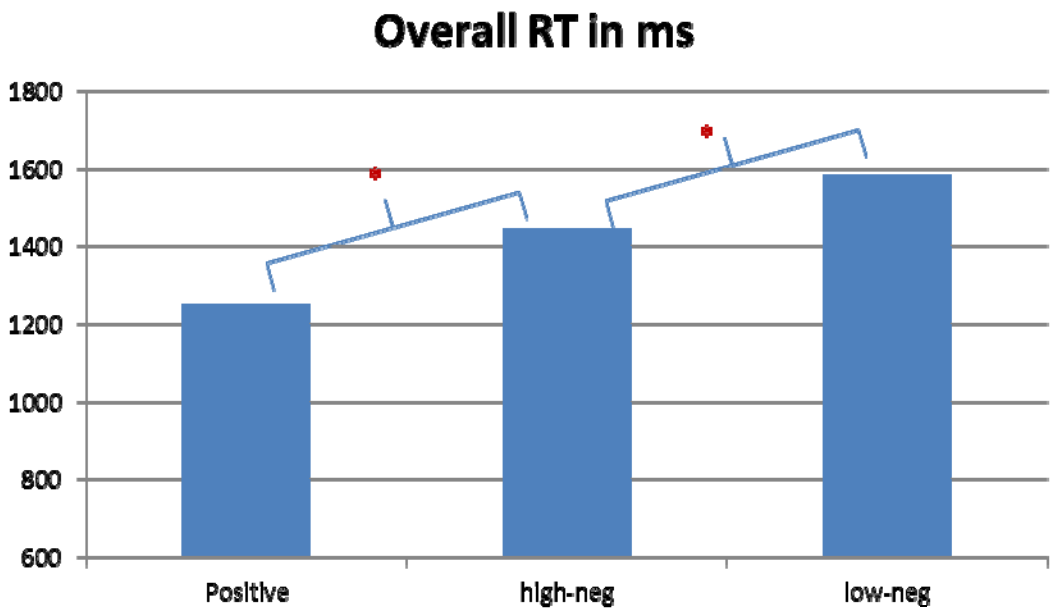
•"No" and the French "si" can be licensed by positive antecedents.

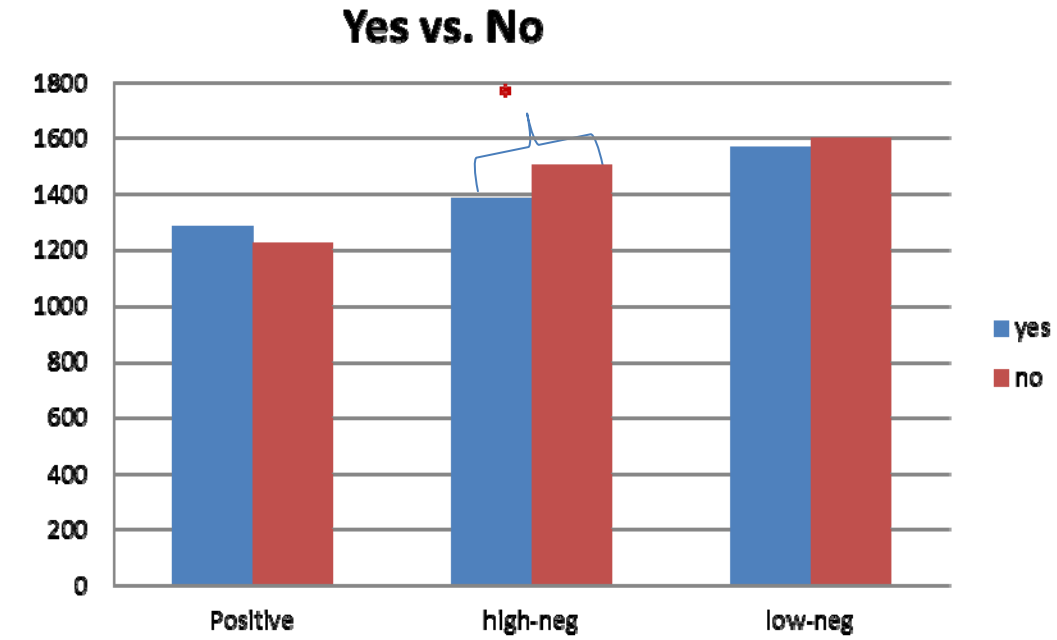
•I propose the French "si" is licensed by the negative bias (Tian, Turco & Noveck, in prep).

Danke

Answer Phase - RT

RT	Yes	No	Overall	Significance
Positive	1282	1223	1253	Overall, positive is significantly faster than Highneg, which is significantly faster than lowneg.
Highneg	1384 *	1507	1445 *	For each condition, highneg yes is significantly faster than highneg no, no difference between positive yes and no, or between lowneg yew and no
Lowneg	1567	1597	1583	No significant interaction in condition*yes/no


Overall RT in ms
1800
1600
1400
1200
1000
800
600
Positive
high-neg
low-neg


Yes vs. No
1800
1600
1400
1200
1000
800
600
400
200
0
Positive
high-neg
low-neg
yes
no

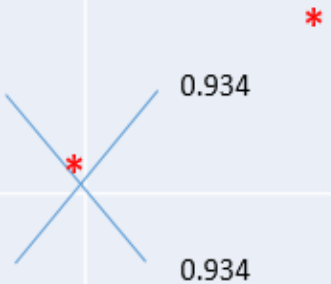
Answer Phase RT data

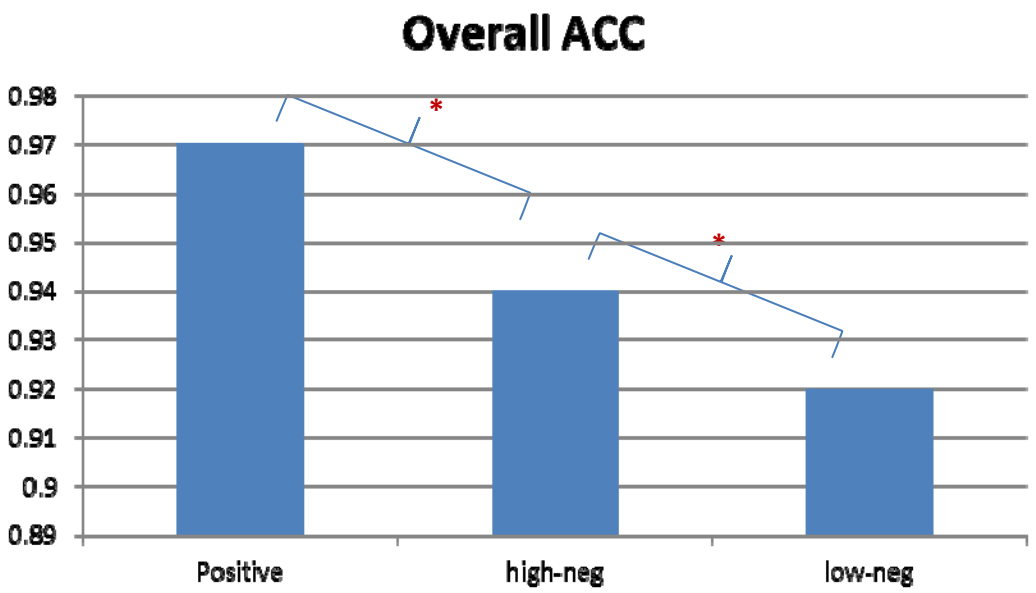
- Responses much delayed relative to eye movements bias formation.

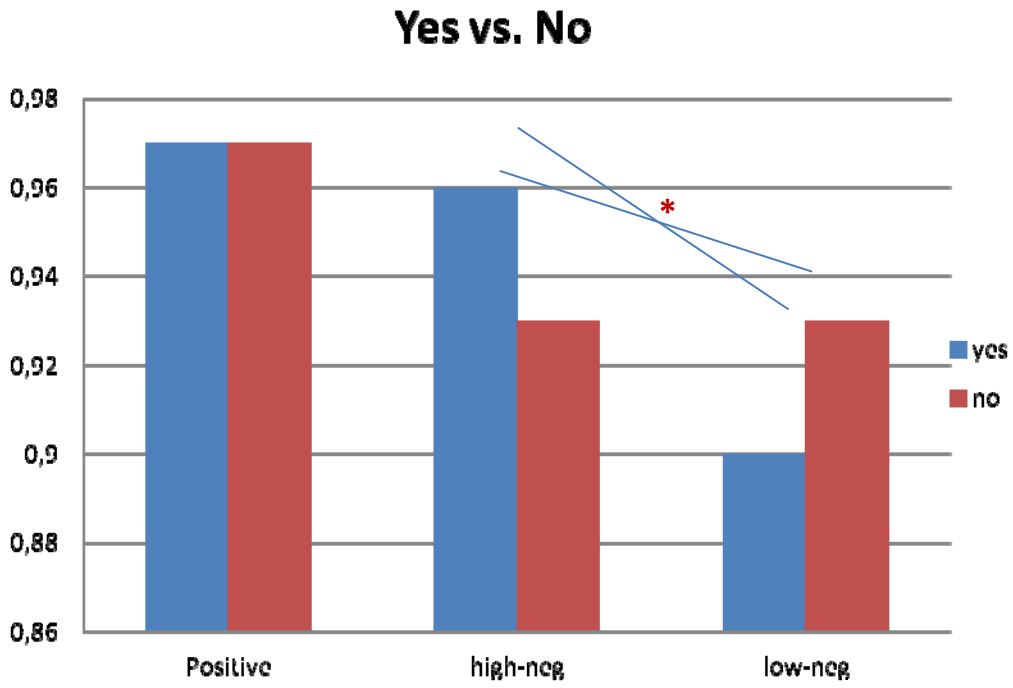
- Response 700-1000ms later

Answer Phase – Accuracy

ACC	Yes	No	Overall	Significance
Positive	0.969	0.969	0.969	Overall, positive is significantlly higher than Lowneg. Trending difference between positive/high (p=0.08), and between high/low (p=0.07)
Highneg	0.958	0.934	0.944	For each condition, there is no significiant difference between Yes and No.
Lowneg	0.903	0.934	0.919	significant high/low * yes/no interaction




Overall ACC
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.9
0.89
*
*
Positive
high-neg
low-neg


Yes vs. No
0,98
0,96
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0,9
0,88
0,86
*
yes
no
Positive
high-neg
low-neg