

Contextual predictability facilitates  
processing of negation...  
or, does it facilitate a strategy for  
making anti-predictions?

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Chris Kent  
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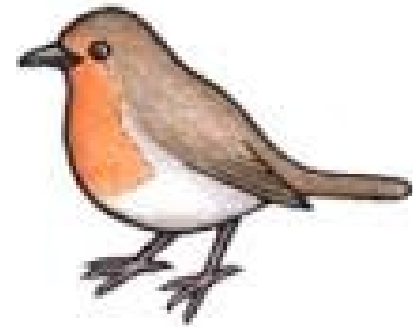
Are negating elements processed incrementally?

# Are negating elements processed incrementally?

- NO – the embedded proposition must be computed first

A robin is a **bird** / **tree**

A robin is not a **bird** / **tree**



Fischler et al (1983)

# Are negating elements processed incrementally?

- YES – if the context is pragmatically supportive

With proper equipment, scuba-diving is very **safe** / **dangerous**

With proper equipment, scuba-diving is not very **safe** / **dangerous**



Nieuwland & Kuperberg (2008)

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  - Eleanor offered to fix her visitor some coffee. Then she realized she didn't have a clean ...”

Federmeier & Kutas (1999)

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- BUT hard to control and reliant on world knowledge
- Solution: episodic contexts providing ad-hoc relations between entities not already associated in LTM



# Methodology: Mouse-tracking

- Mouse trajectories can tap into multi-stage decision processes
- Compared to SAT techniques
- Advantages: no extra cognitive load, natural for participants, fewer trials required
- Now used in many domains
- Software: MouseTracker (Jon Freeman)



Review: Freeman, Dale & Farmer (2011)

# Methodology: Mouse-tracking

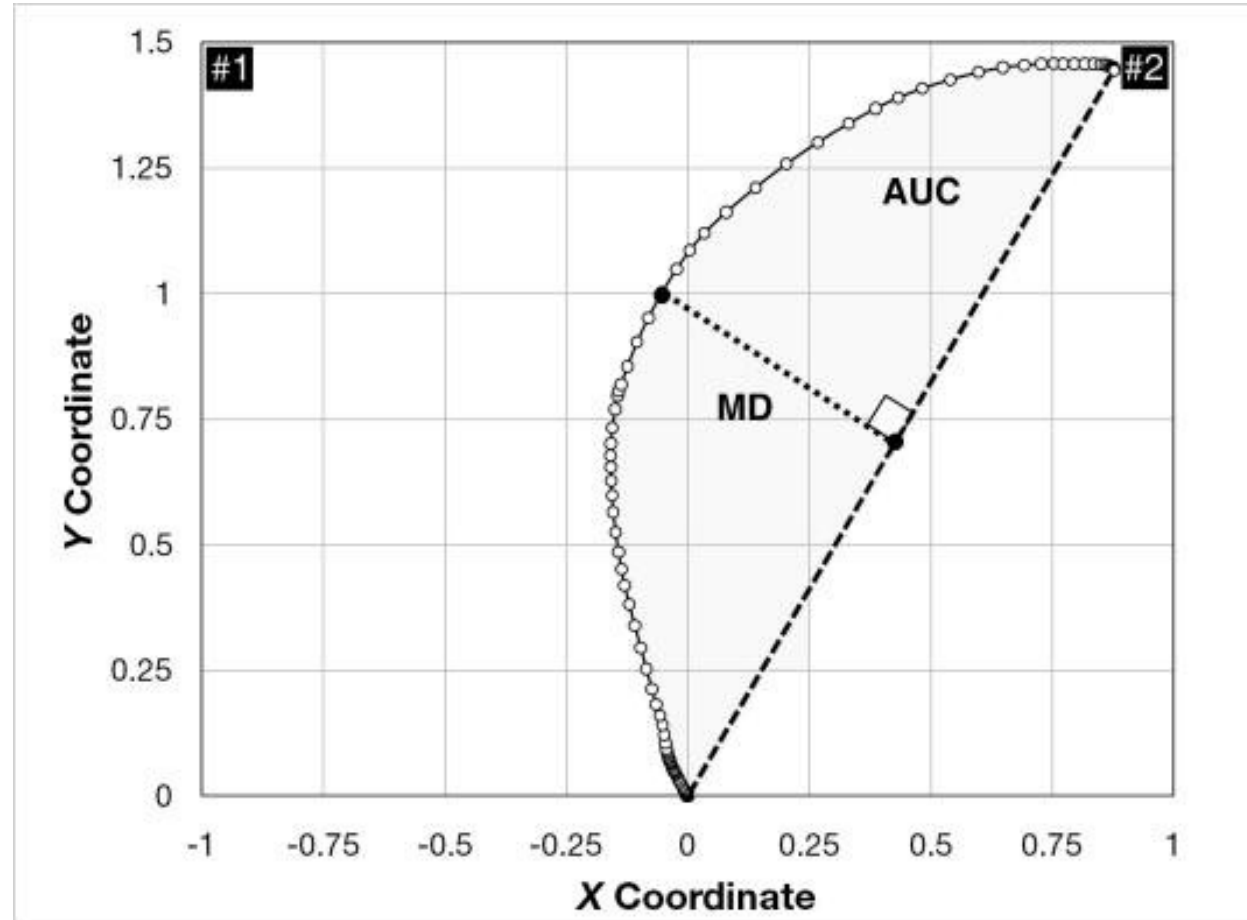


Image from [mousetracker.jbfreeman.net](http://mousetracker.jbfreeman.net)

# Methodology: Mouse-tracking

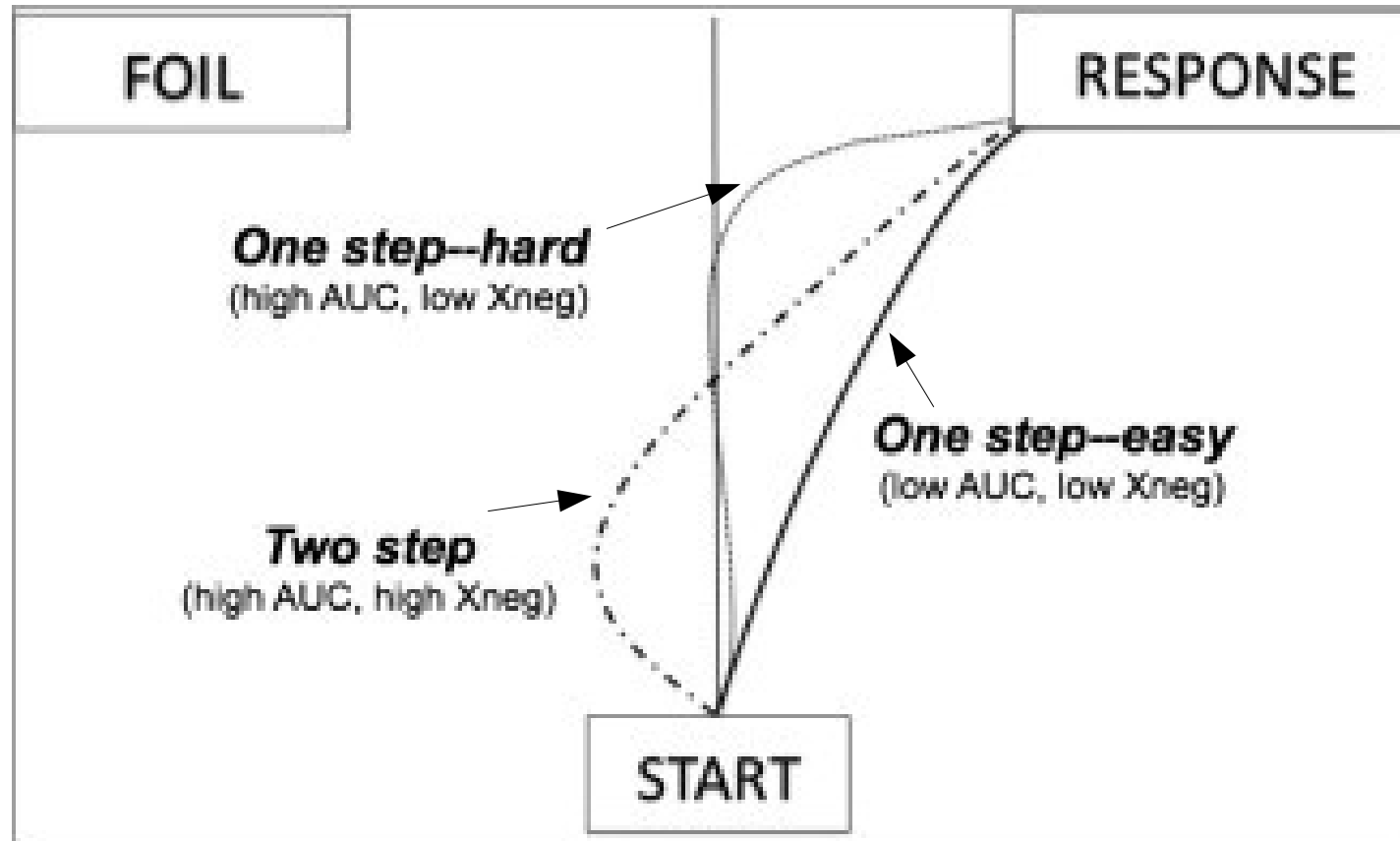


Image from Freeman, Dale & Farmer (2011)

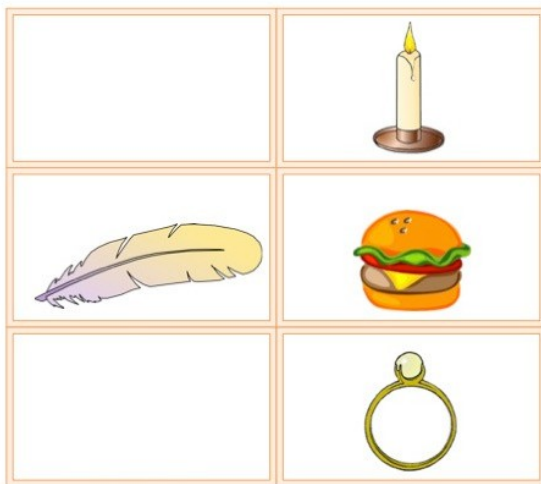
# Mouse-tracking in negation processing

Table 1

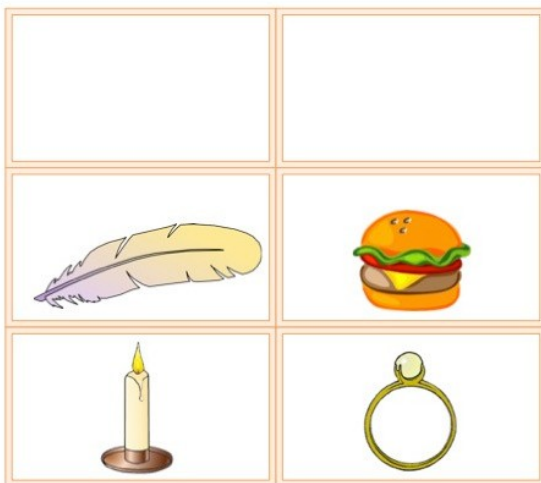
Experiment 1: Means and effect estimates

Condition	<i>x</i> -flips (#)	AC (#)
T/no negation	1.13	1.56
T/negation	1.71	2.86
F/no negation	1.24	2.16
F/negation	1.34	2.27
Estimate <sub>negation</sub>	0.35***	0.70***
Estimate <sub>T/F</sub>	0.13	0.31
Estimate <sub>N × T/F</sub>	0.47**	1.16***

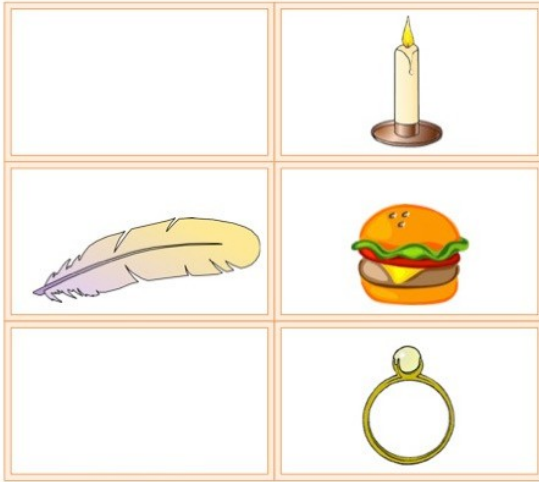
# Design



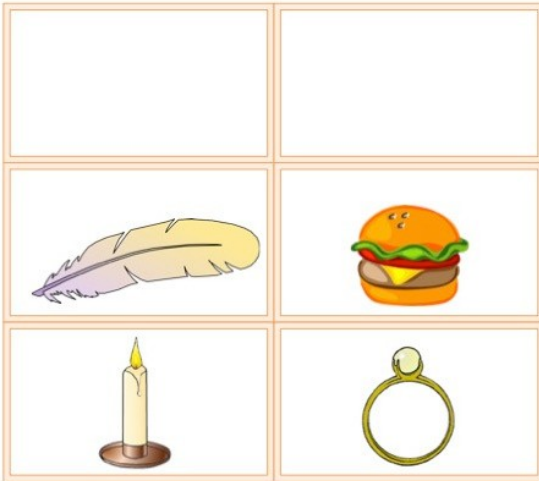
Visual contexts precede sentences to manipulate predictability of critical word



# Design



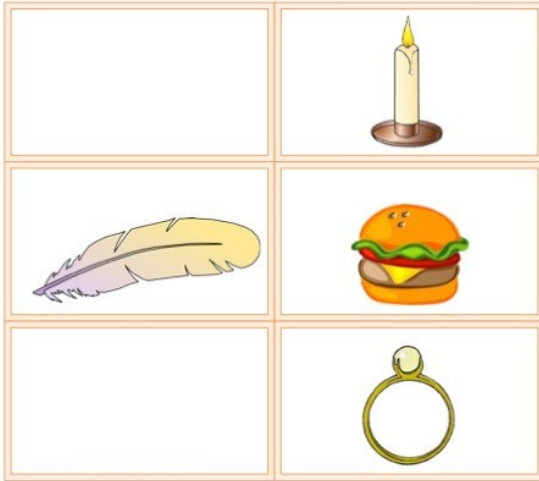
Predictable



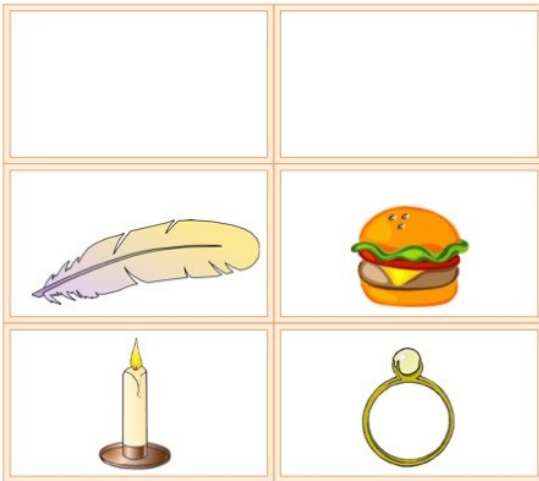
Unpredictable

Visual contexts precede sentences to manipulate predictability of critical word

# Design



Predictable



Unpredictable

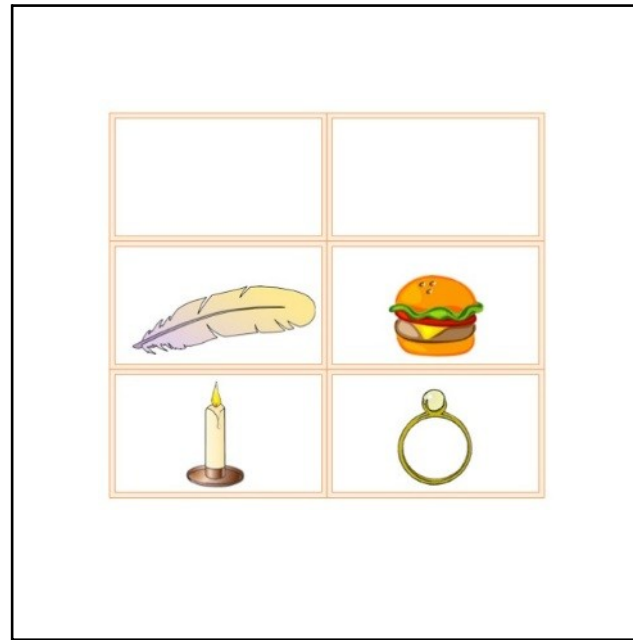
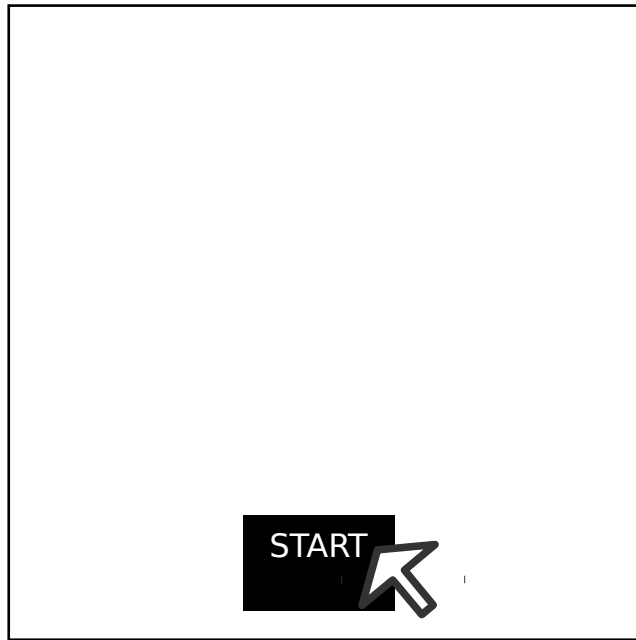
Affirmative:

The left side contains the feather / burger

Negation:

The right side doesn't contain the feather / burger

# Design



The left side  
doesn't contain  
the feather

TRUE

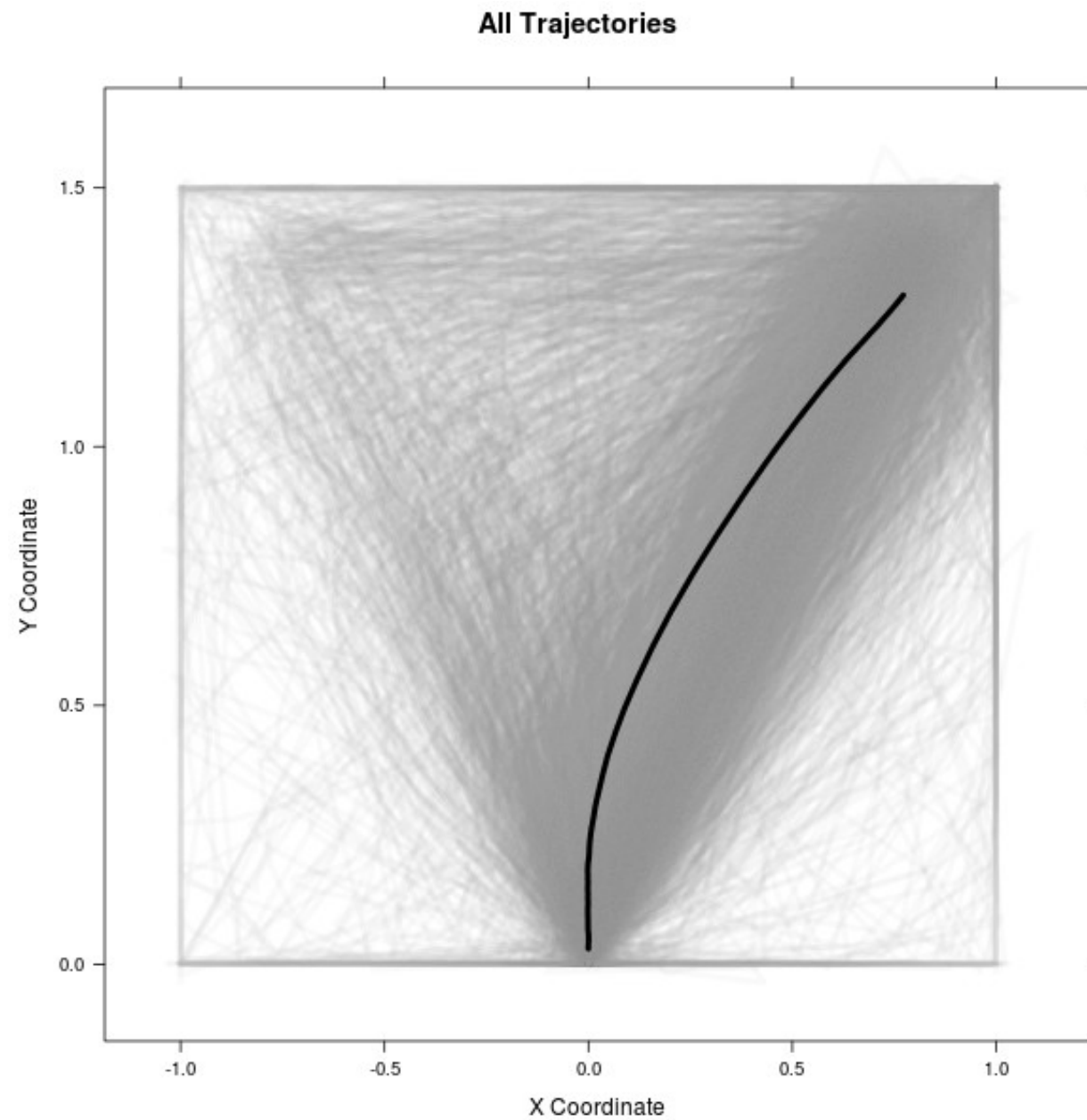
FALSE



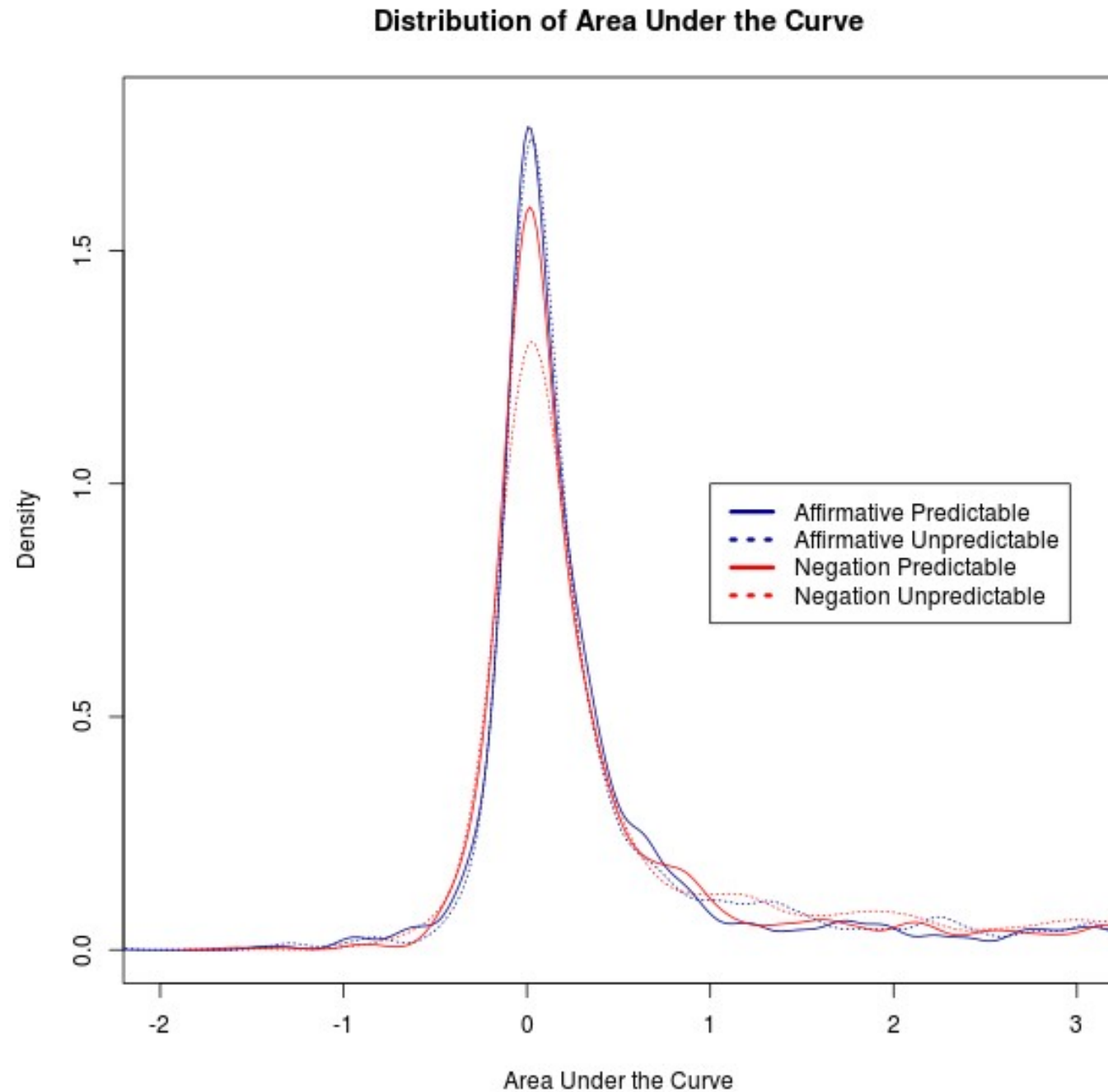
3000 ms



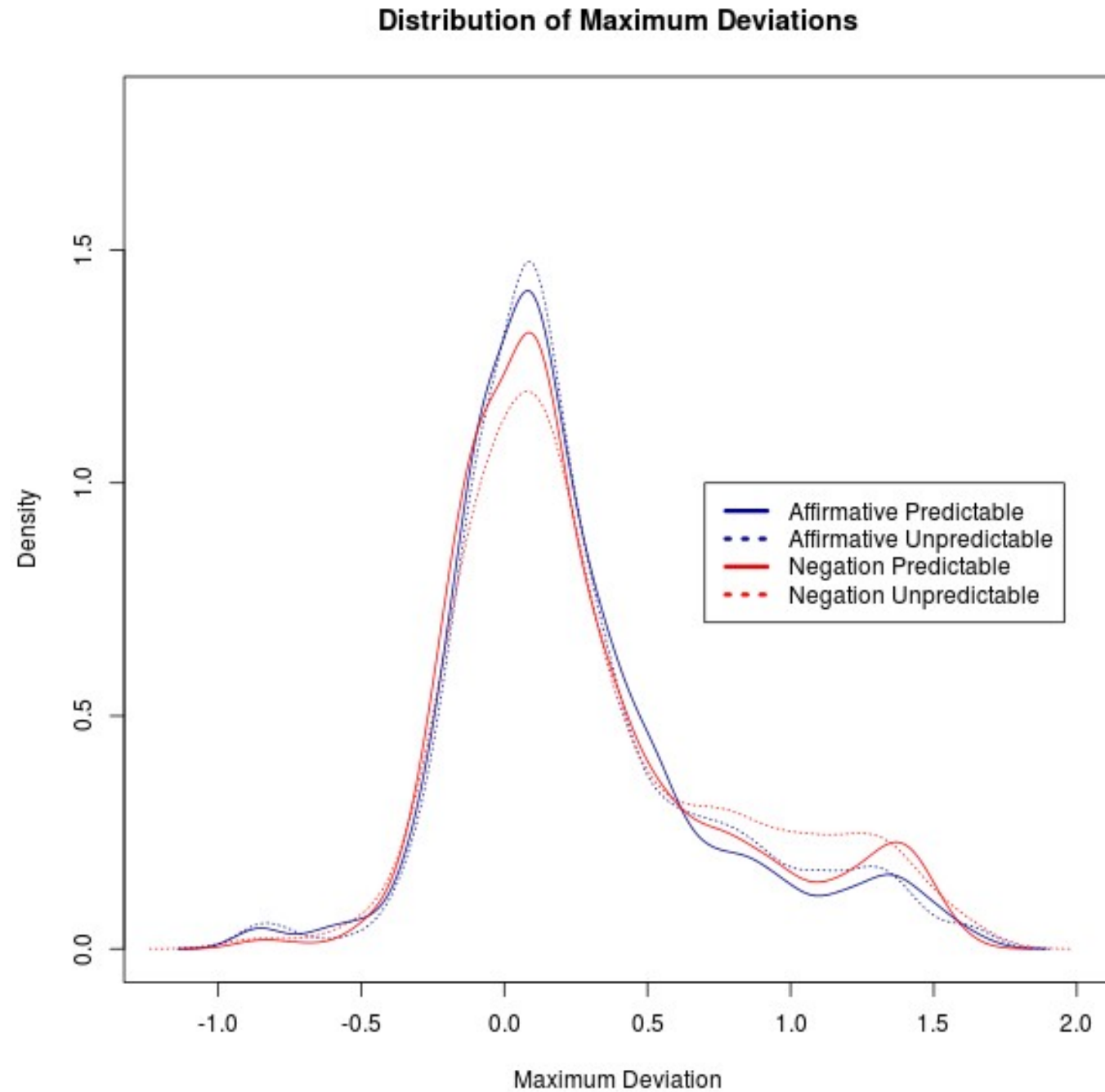
# Results



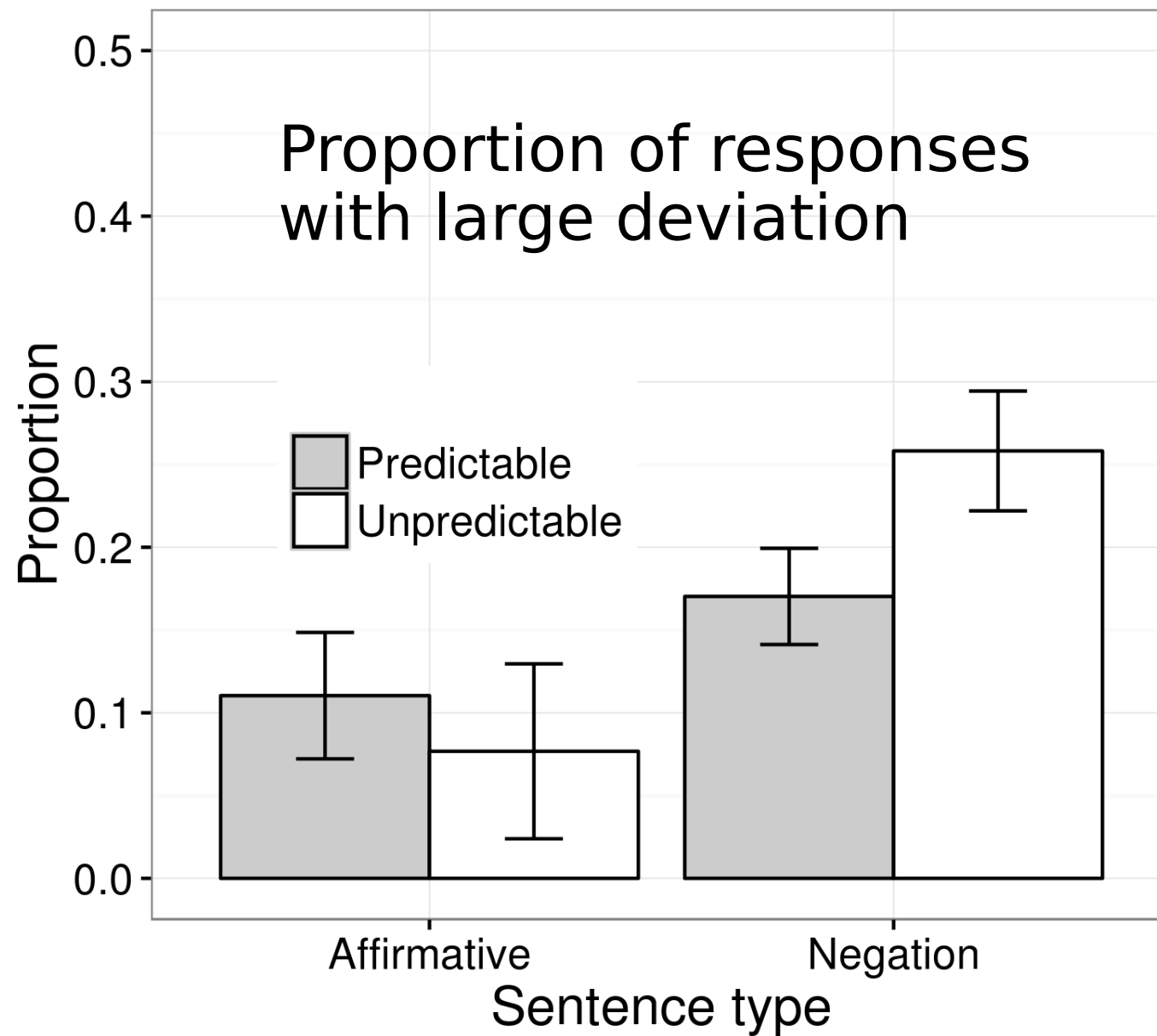
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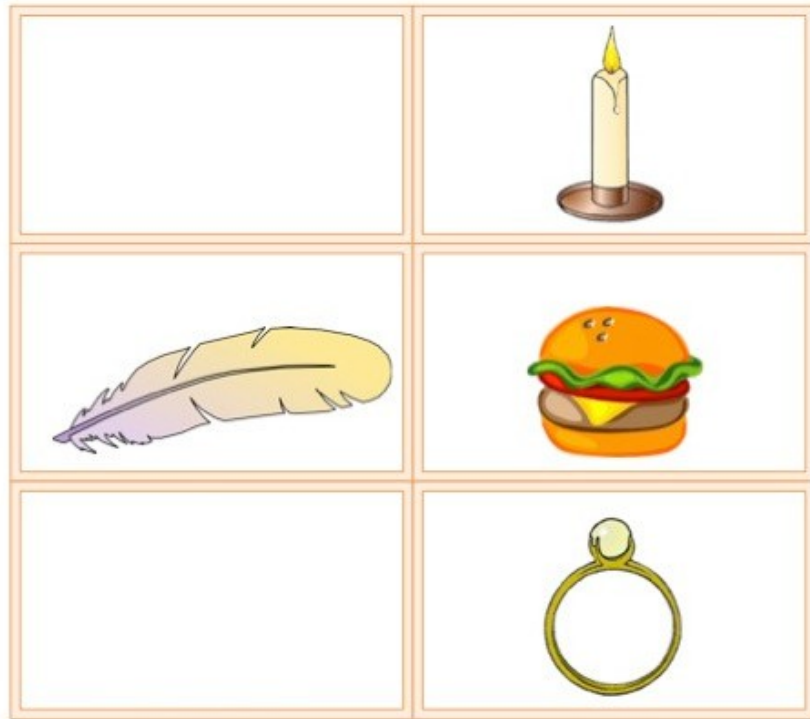
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# Discussion

- Predictability of important words in a sentence seems to be a critical factor for how easily negating elements can be incorporated incrementally
- This is an effect beyond the correlation between predictability and pragmatic felicity (all sentences are felicitous in the context)
- Why is this? Two possible interpretations:
  - Predictability facilitates processing in a similar way to pragmatic felicity
  - The apparent ease of processing is an illusion produced by people employing an anti-prediction strategy where available



# Anti-prediction strategy masks lack of incrementality?

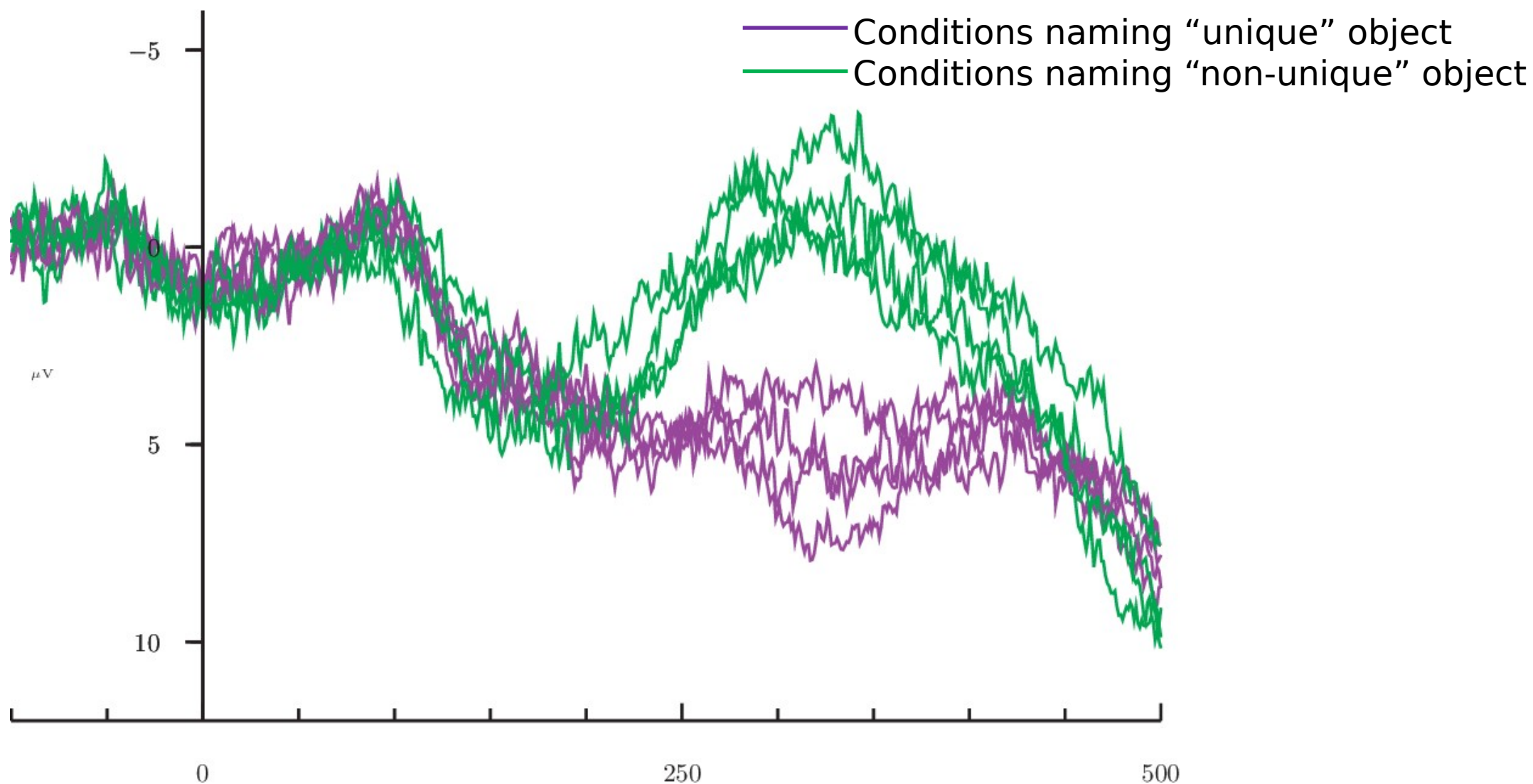


Predictable

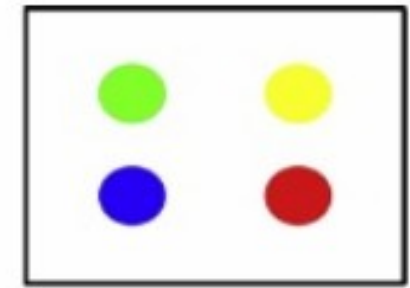
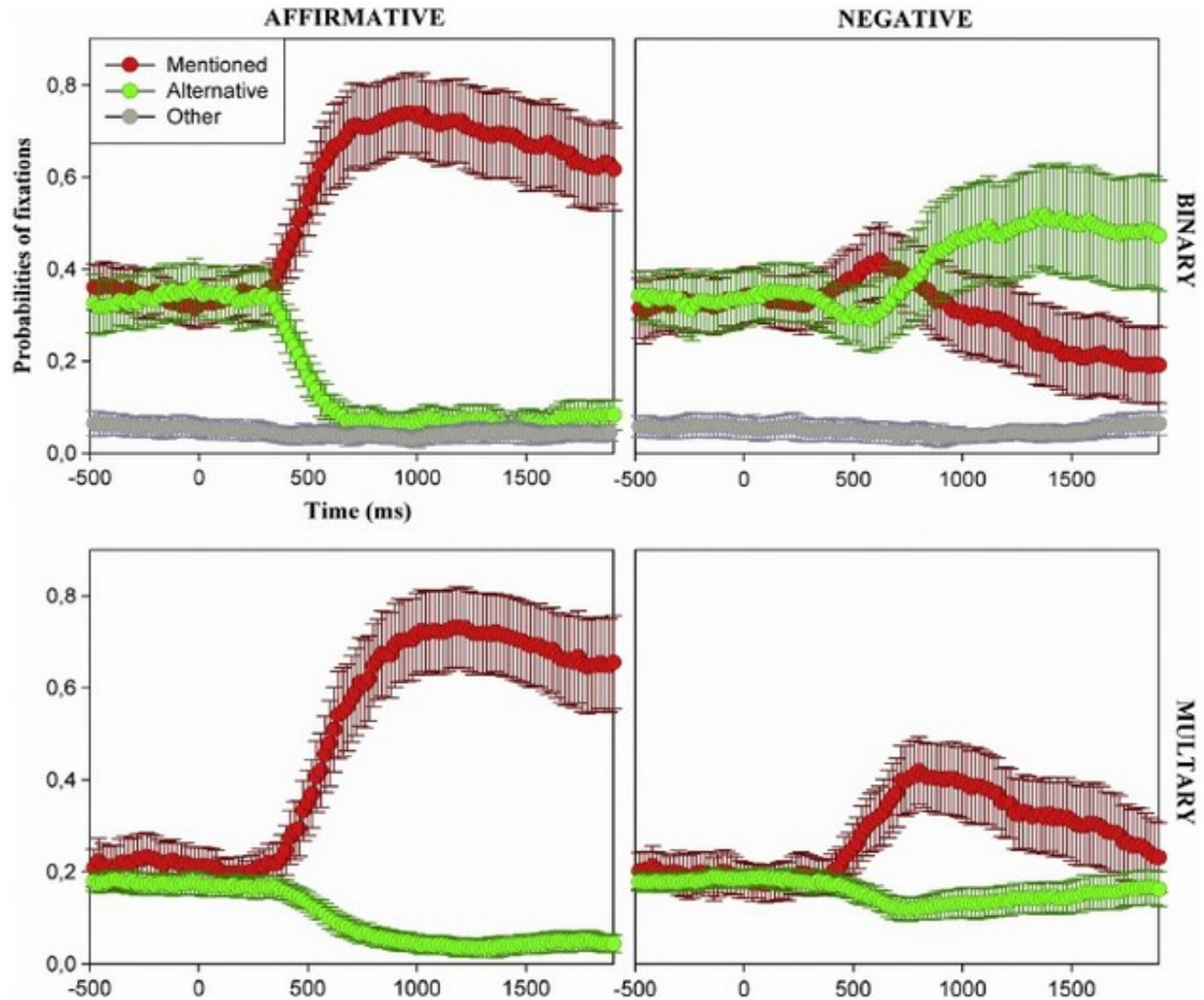
The right side doesn't contain...

Right side...  
Anything but the feather!

# Anti-predictions in ERPs?

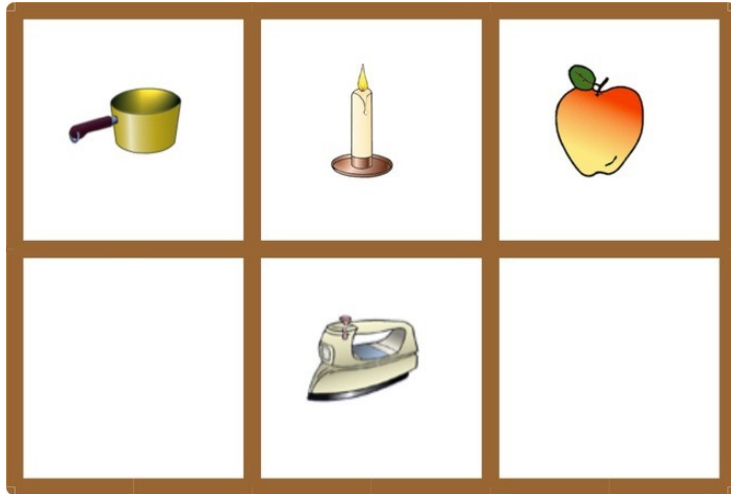


# Other evidence for anti-predictions

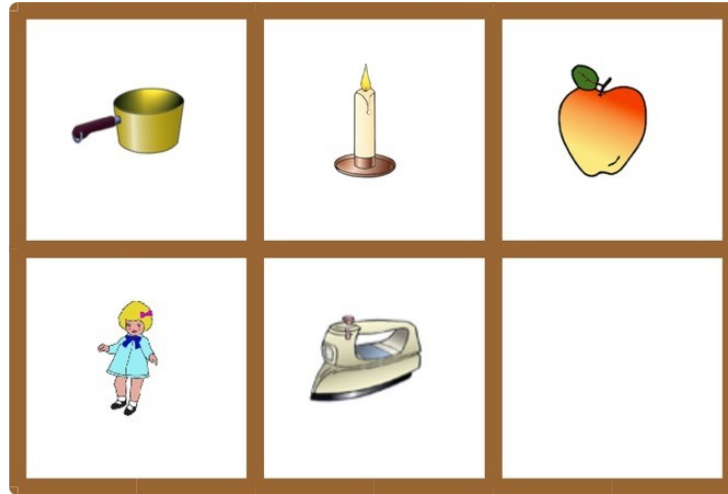


Orenes et al (2014)

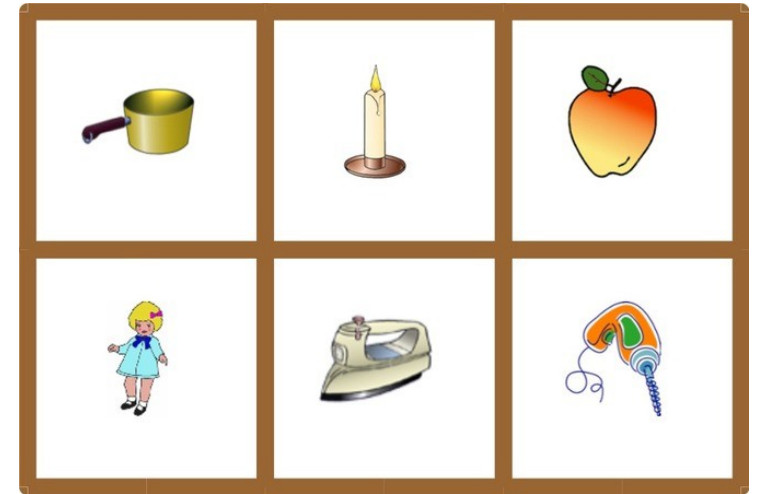
# Next experiment: direct effect of predictability, or anti-predictions?



Anti-prediction 1



Anti-prediction 2



Anti-prediction 3

# Thank you



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AND FRIENDS**

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**THE ALUMNI FOUNDATION**

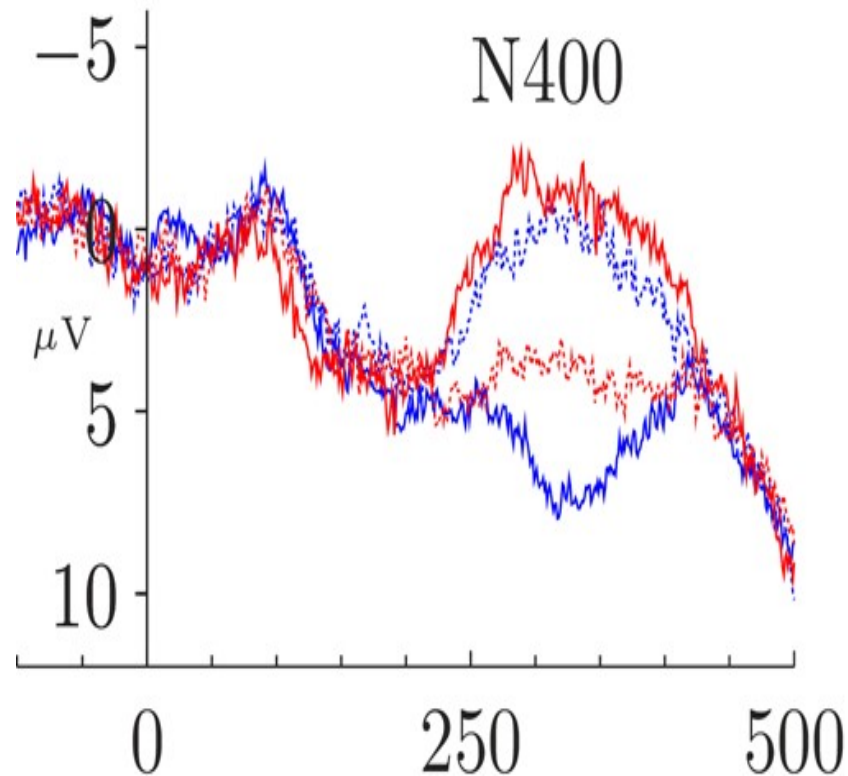
# References

- Dale, R. & Duran, N. D. 2011. The cognitive dynamics of negated sentence verification. *Cognitive Science* 35 (5), 983-996.
- Federmeier, K. D. & Kutas, M. 1999. A rose by any other name: long-term memory structure and sentence processing. *Journal of Memory and Language* 41, 469-495.
- Fischler, I., Bloom, P. A., Childers, D.G., Roucos, S. E., & Perry, NW Jr. 1983. Brain potentials related to stages of sentence verification. *Psychophysiology* 20 (4), 400-409.
- Nieuwland, M. S. & Kuperberg, G. R. 2008. When the truth isn't too hard to handle: An event-related potential study on the pragmatics of negation. *Psychological Science* 19 (12), 1213-1218.
- Orenes, I., Beltrán, D., & Santamaría, C. 2014. How negation is understood: Evidence from the visual world paradigm. *Journal of Memory and Language* 74, 36-45.

# ERPs to affirmatives / negations with varying predictability

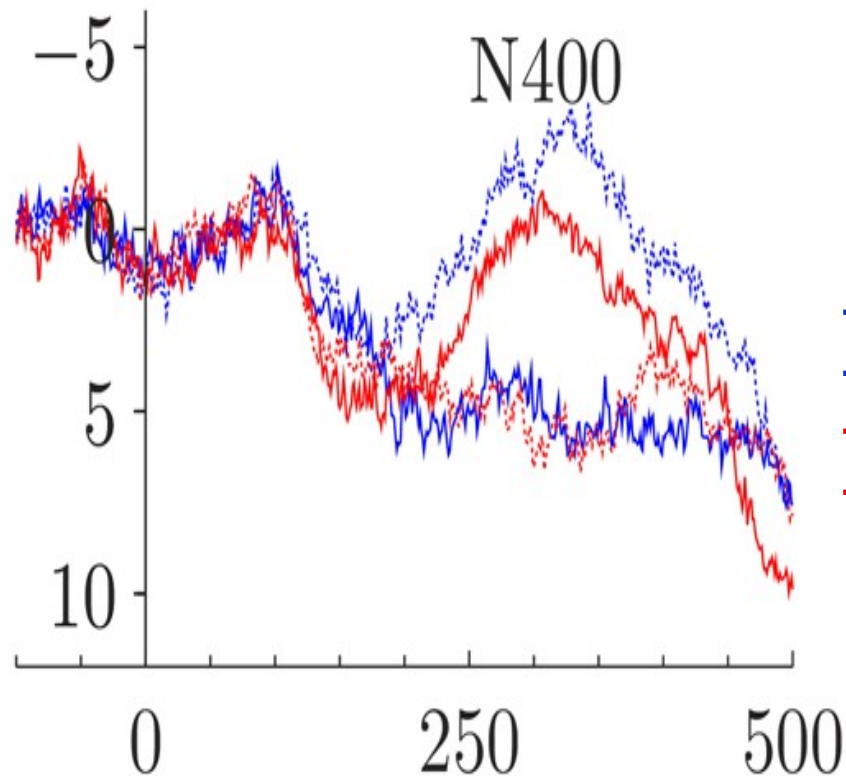
affirmatives

N400



negations

N400



- True, strong prediction
- ... True, weak prediction
- False, strong prediction
- ... False, weak prediction