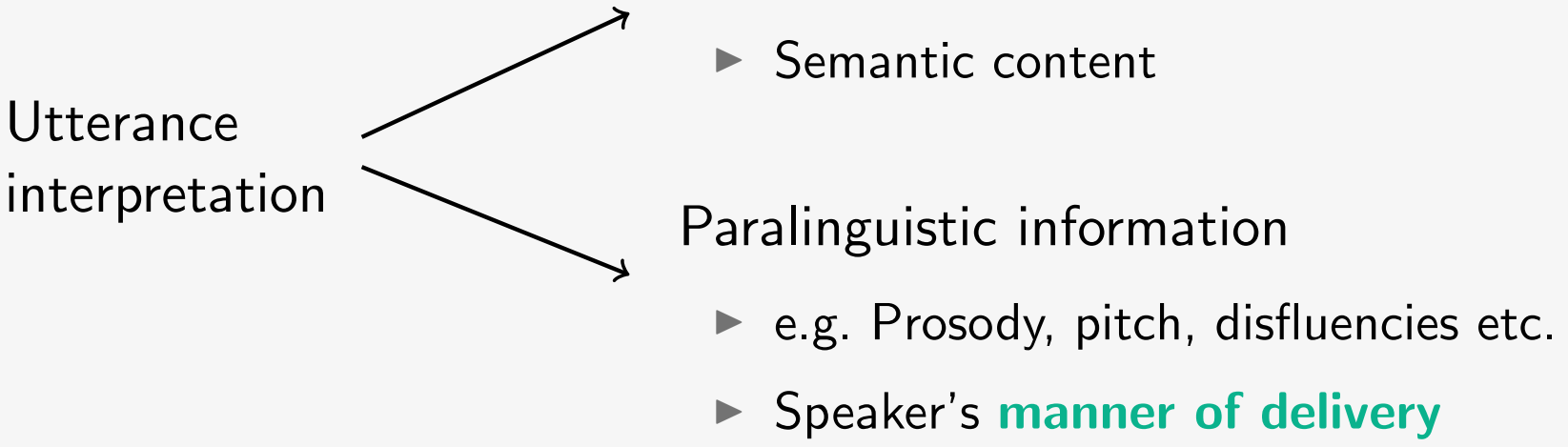
The truth about lying: Pragmatic judgements about speaker reliability are made online

Jia Loy, Hannah Rohde and Martin Corley

University of Edinburgh

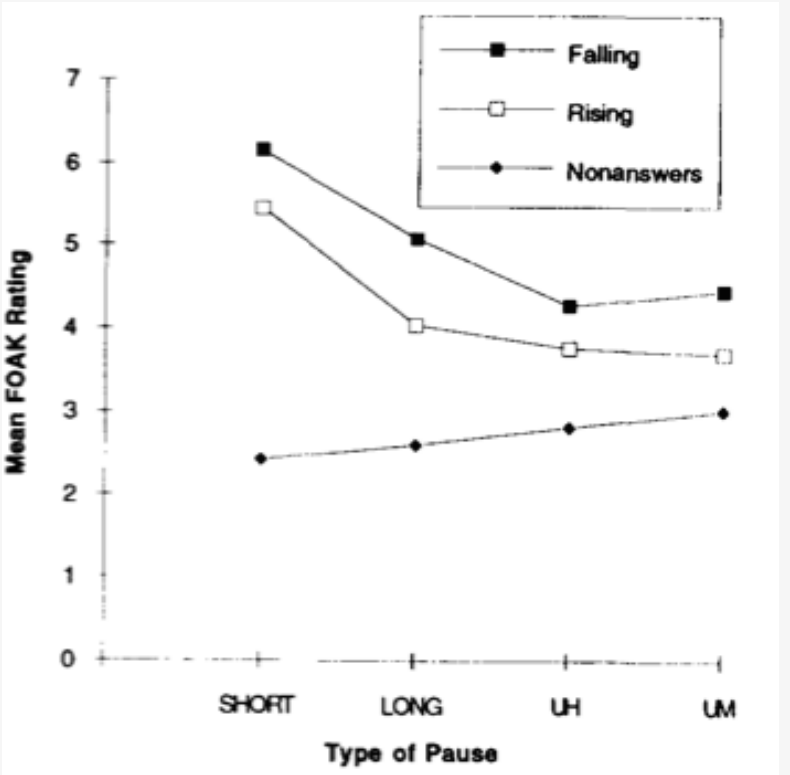
Background


Utterance interpretation
Linguistic message
Semantic content
Paralinguistic information
e.g. Prosody, pitch, disfluencies etc.
Speaker's manner of delivery

Background

What do we know about paralinguistic cues?

- Listeners are sensitive to these cues
- Feeling of Another's Knowing (FOAK) paradigm [1]
  - Listeners' estimation of speaker's confidence in their utterance
  - Lower FOAK ratings for utterances preceded by a filled pause (*um* or *uh*)



[1] Brennan & Williams (1995) J.Mem.Lang.

Background

- Listeners are sensitive to paralinguistic cues when detecting deception
- Filled pauses may be an indicator of deception
  - Meta-analysis of studies on deception [2]
  - Cues consistent across groups [3]
  - Studies do not agree [4]

Beliefs about Behaviors Associated with Deception in Self and Others

Behavior	Self-perception	Other-perception	F of difference df = 1,214	d of difference
Auditory channel				
Response latency	.70	.86	.31	.08
Response length	.16	.97	5.90*	.33
Speech rate	.97	1.55	5.10*	.31
Speech errors	1.13	1.99	16.60***	.56
Speech hesitations	.76	1.61	10.93***	.45
Pitch	.60	.98	2.64	.22
Negative statements	-.05	.12	.54	.10

Behavioral Correlates of a Target's Apparent Dishonesty to American and Jordanian Judges

Behavior	Reliability	American Judges	Jordanian Judges	All Judges
Length of segment	.99	.10	.00	.06
Eye contact	.86	−.33**	−.19*	−.31**
Smiling	.88	.04	.18	.13
Head movements	.90	−.40**	−.06	.28**
Blinking	.94	−.03	−.02	−.03
Self-touching	.93	.18	.13	.18*
Hand gestures	.96	−.29**	−.08	−.22*
Unfilled pauses	.99	.28**	.34**	.37**
Filled pauses	.98	.13	.05	.10
Negatives	.94	−.33**	−.18	−.31**

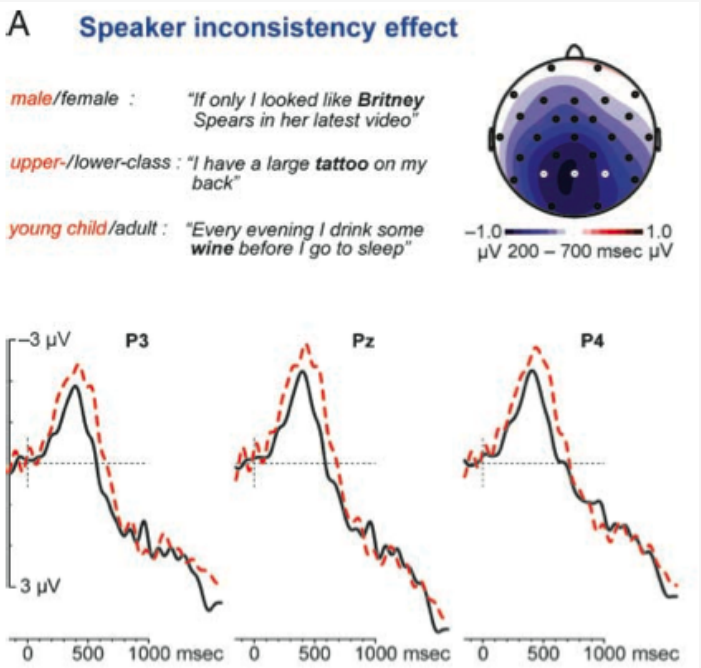
[2] Zuckerman et al. (1981) J.Nonverbal Behav. [3] Vrij et al. (2006) Legal Criminol.Psych. [4] Bond et al. (1990) J.Nonverbal Behav.

Background

When do listeners process this information?

- Off-line measures fail to capture time course of processing
- Traditional models of language comprehension
  - semantics → pragmatics
  - Non-literal interpretations take longer [5]

- Time sensitive measures provide counter evidence [6]
  - Comprehension of fluent speech – but how about disfluent?



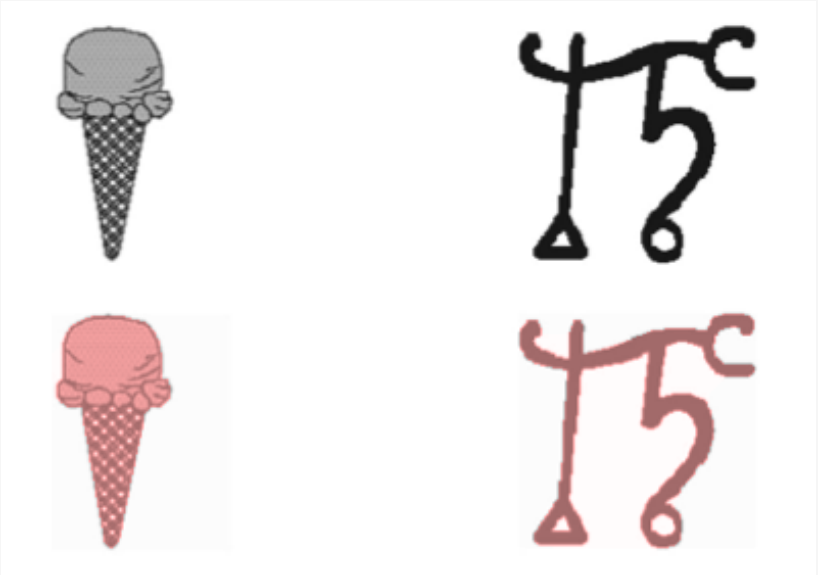
[5] Hamblin & Gibbs (2003) Discourse Process.

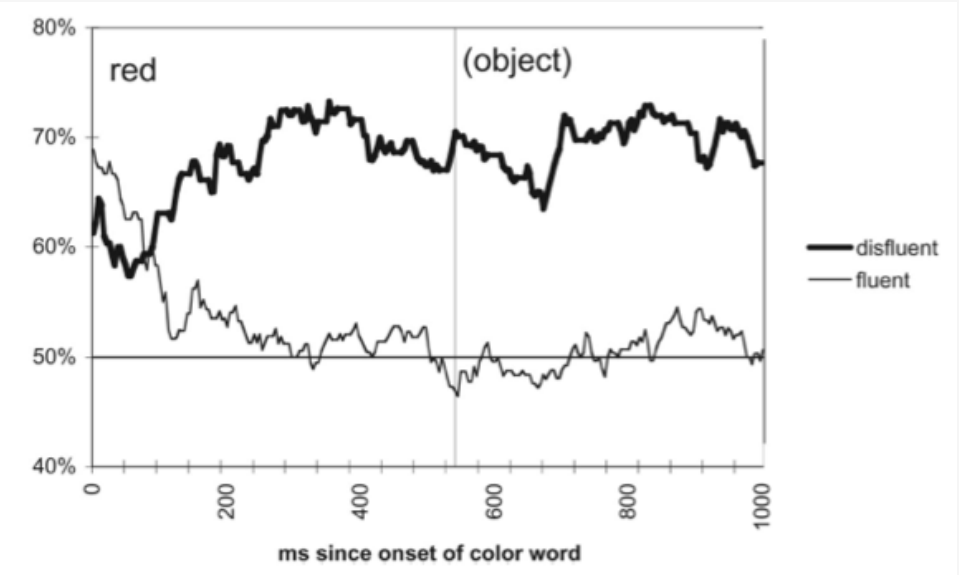
[6] Van Berkum et al. (2008) J.Cog.Neur.

Background

How do listeners process disfluencies during on-line comprehension?

- On-line effect of disfluency
  - Listener expectations with regard to upcoming semantic content [7,8]
  - Prediction of literal message, but not pragmatic updating





[7] Arnold et al. (2004) Psychol.Sci.

[8] Arnold et al. (2007) J.Exp.Psychol.

Current study

Research goals:

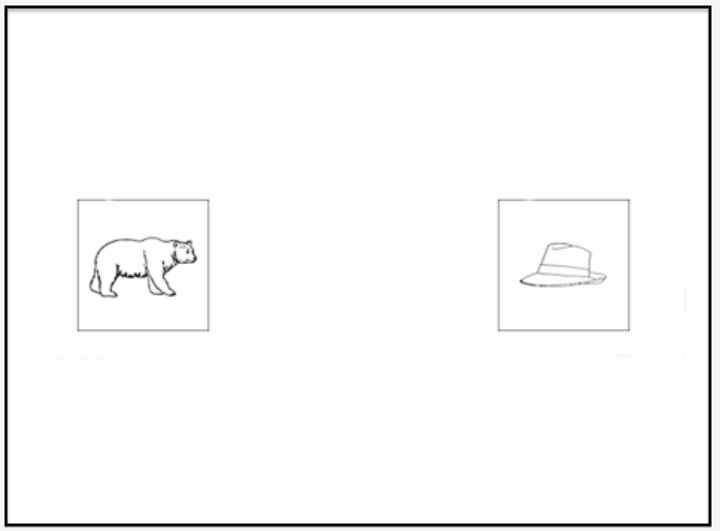
1. Investigate whether, and how, **manner of delivery** (fluent/disfluent) constrains judgement of **speaker reliability** (truthful/deceptive)
2. Explore the **time course** of processing

How did we do this?

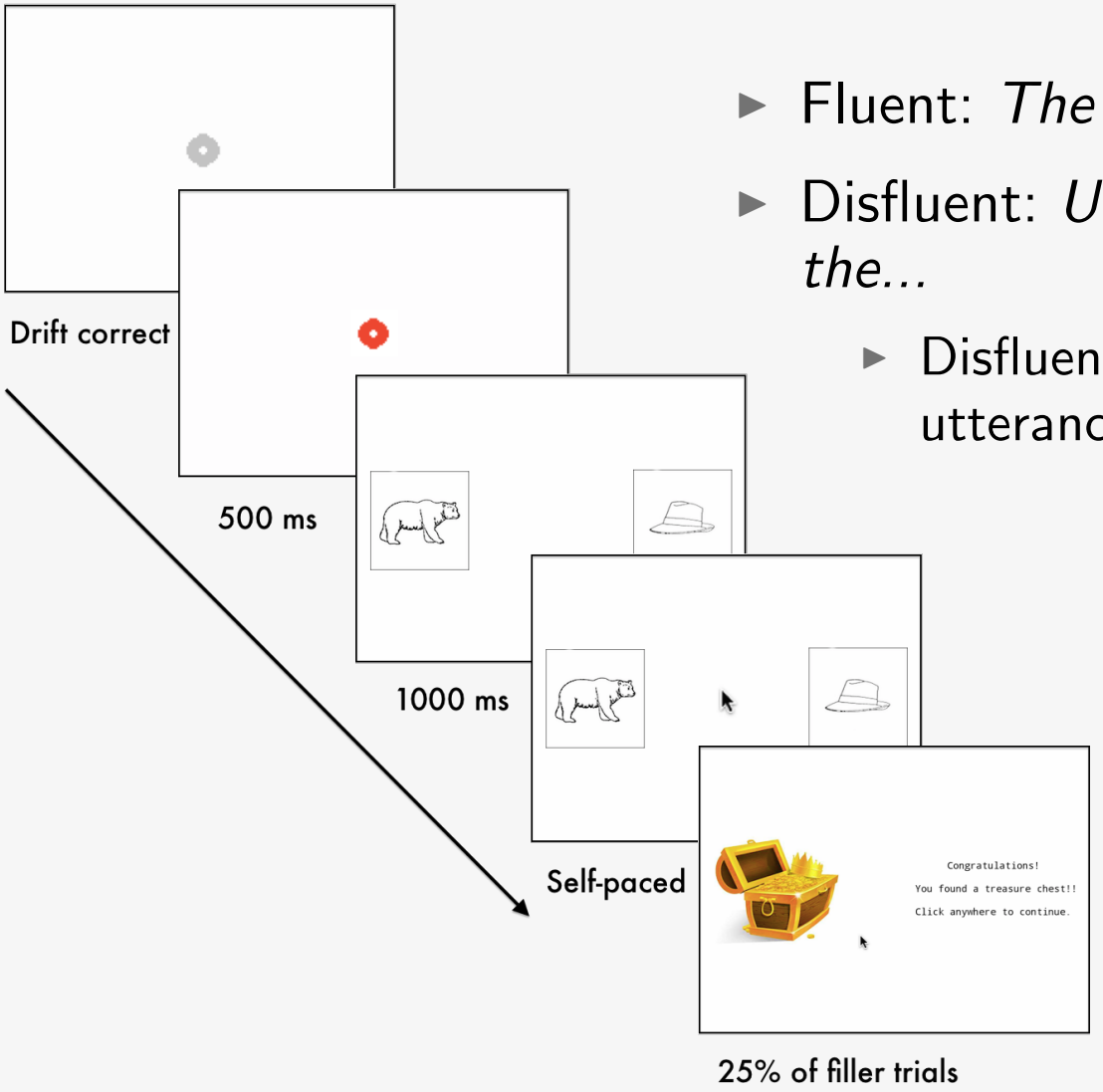
- Eye movements and mouse coordinates sampled at 500Hz
- Listeners heard fluent/disfluent utterances and made speaker reliability judgement
  - Experiment 1 (n=21): utterance-initial disfluency
  - Experiment 2 (n=22): utterance-medial disfluency

Experiment 1: Design

- 'Lie detection' study
- 2 object visual displays, prize purportedly hidden behind one
  - Speaker told to lie half the time about prize location
  - Task: Click on the object you think treasure is behind



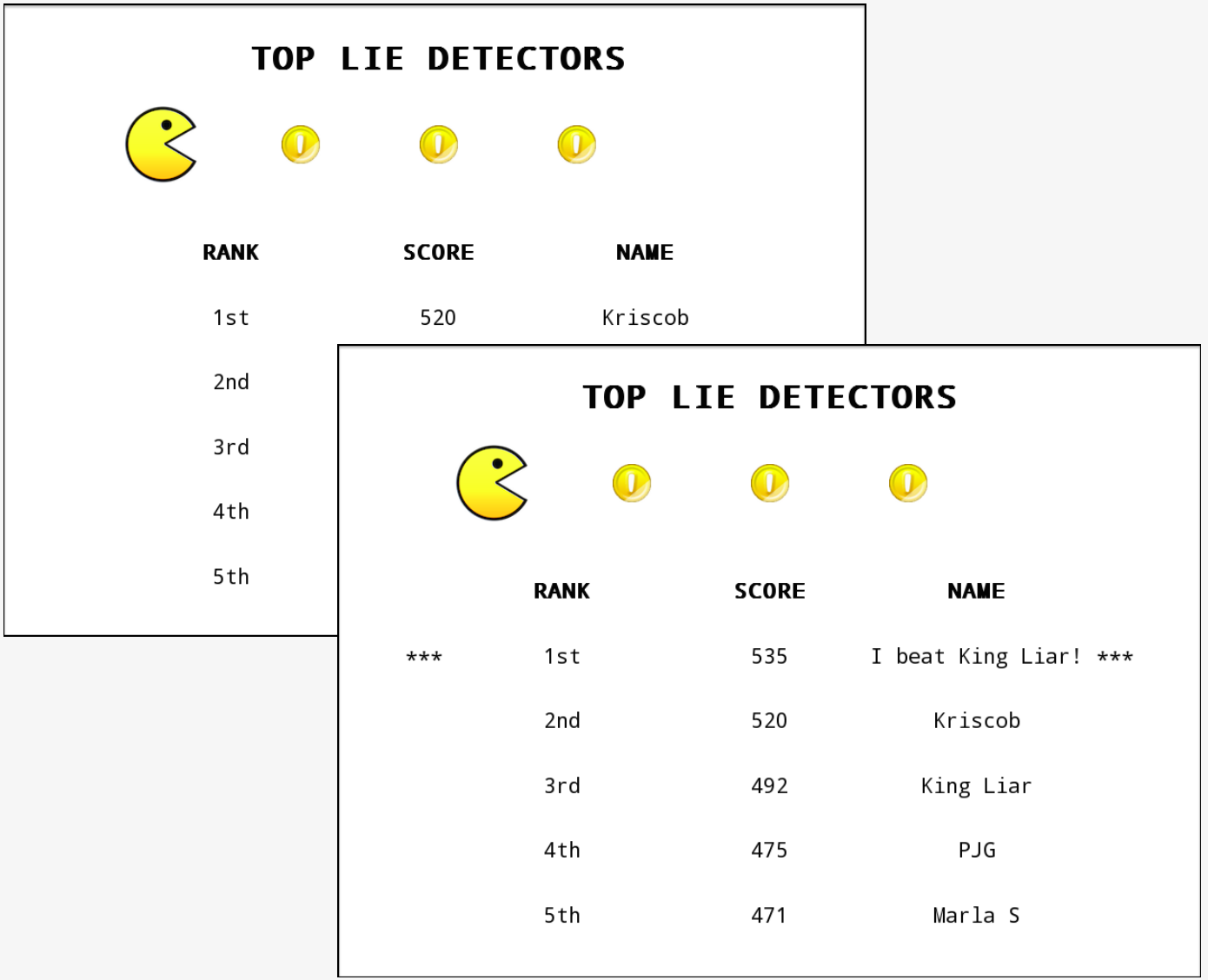
Experiment 1: Sample trial



- Fluent: *The treasure is behind the...*
- Disfluent: *Um, the treasure is behind the...*
  - Disfluency spliced onto each fluent utterance

Experiment 1: Sample trial

Experiment 1: Sample trial



TOP LIE DETECTORS

	RANK	SCORE	NAME
	1st	520	Kriscob
	2nd		
	3rd		
	4th		
	5th		

TOP LIE DETECTORS

	RANK	SCORE	NAME
***	1st	535	I beat King Liar! ***
	2nd	520	Kriscob
	3rd	492	King Liar
	4th	475	PJG
	5th	471	Marla S

Experiment 1: Design

- 'Lie detection' study
- 2 object visual displays, prize purportedly hidden behind one
  - Speaker told to lie half the time about prize location
  - Task: Click on the object you think treasure is behind
- 2 conditions: fluent/disfluent
- 20 critical + 40 filler trials
  - Fillers included plausible lexical or disfluency manipulations
- Visual stimuli: Images from Snodgrass & Vanderwalt (1980)
  - Ease of naming (H value< 1)*
  - Familiarity rating (> 3.5)*
  - No overlapping onset

*Values from Snodgrass & Vanderwalt (1980)

Analysis

- Measures of interest:
  - Final object clicked on (referent or distractor)
  - Visual fixations to referent across time
  - Mouse movements to referent across time (X coordinates)
- Window of analysis: 0-800 ms post noun onset
  - 20 ms bins
- Empirical logit regression framework [9]
  - Fixed effects: time * manner of delivery
  - Subject and item random intercepts and slopes for time

[9] Barr (2008) J.Mem.Lang.

Experiment 1: Results

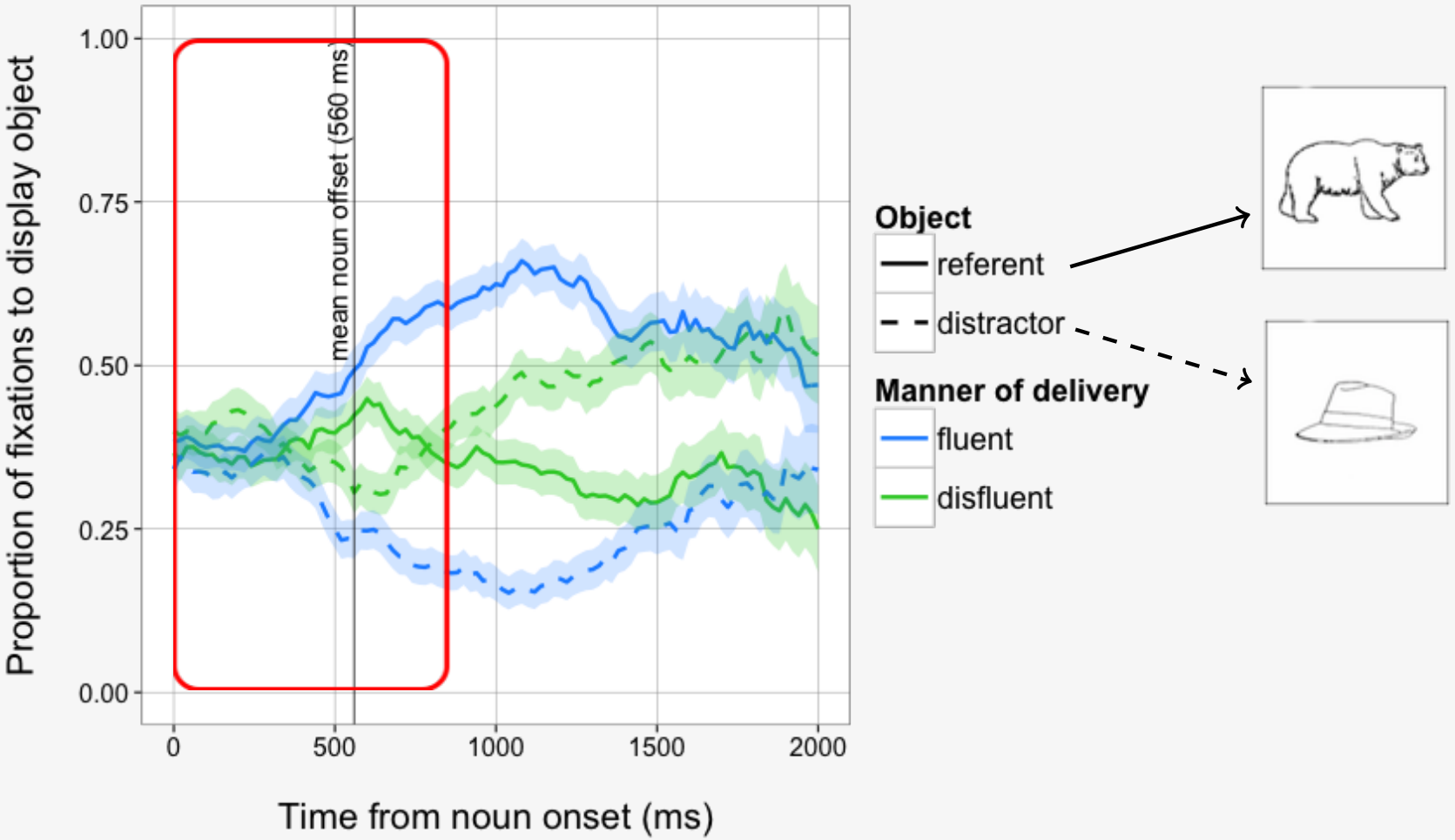
Object clicks by manner of delivery

- Effect of manner of delivery

  β=2.30, SE=0.48, p<.001

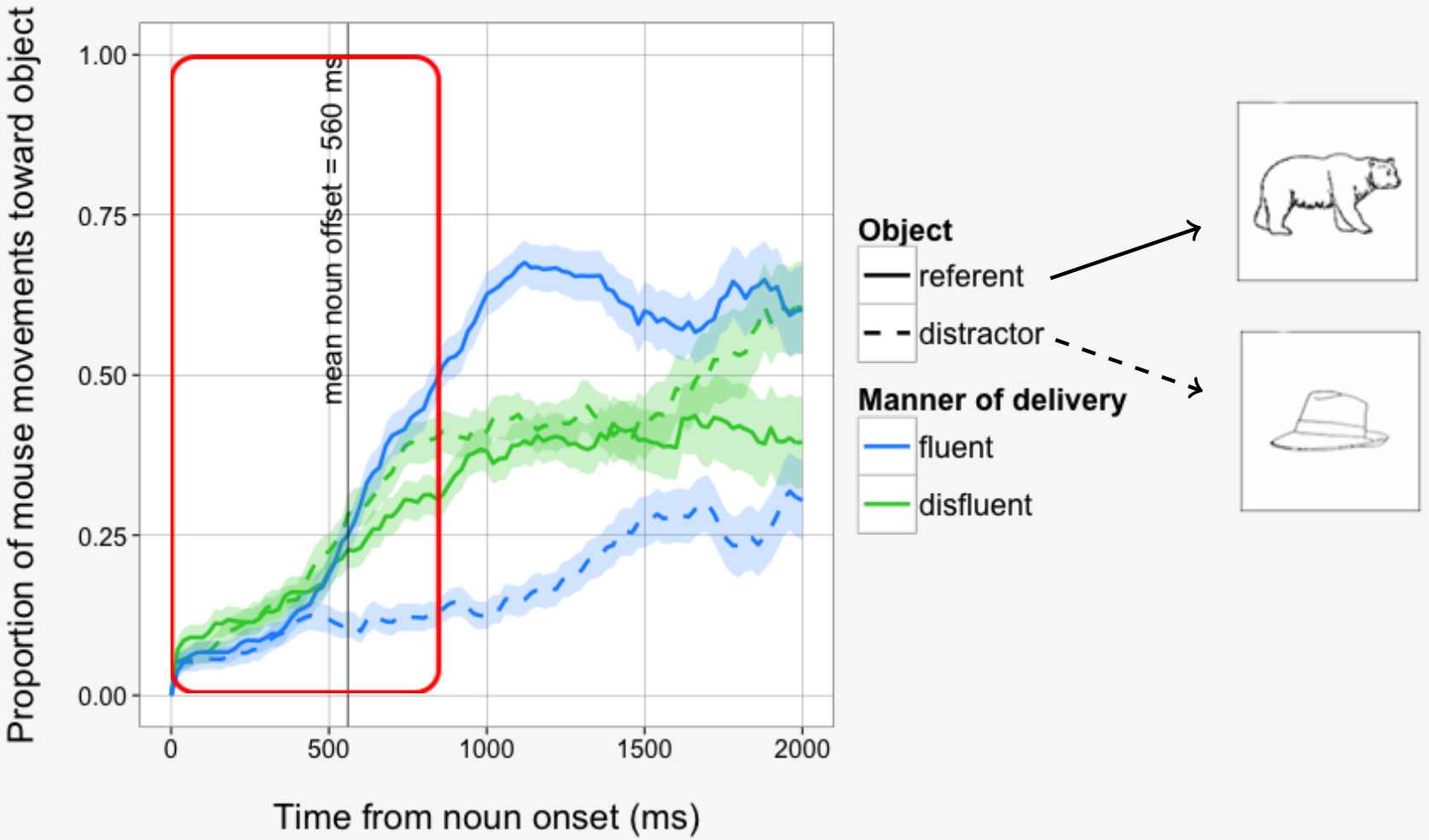
Experiment 1: Results

Fixations across time



Experiment 1: Results

Mouse movements across time



(Interim) Summary...

- Manner of delivery influences perception of speaker reliability
  - Fluent $\rightarrow$ truthful; disfluent $\rightarrow$ deceptive
- Effect emerges shortly after onset of disambiguating noun
- Mouse movements follow eye movements
  - Consistent with previous mouse-tracking studies [10]

...How about utterance-medial disfluencies?

[10] Farmer, Cargill & Spivey (2008) J.Mem.Lang.

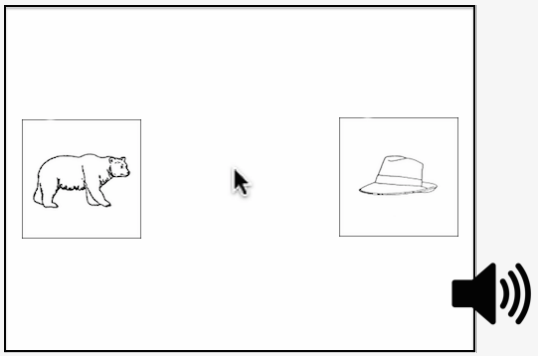
Experiment 2: Motivation

What do we know about disfluency location?

- From a production perspective:
  - Utterance-initial $\rightarrow$ Global planning difficulty [11]
  - Utterance-medial $\rightarrow$ Local, lexical retrieval issues [12]
- Comprehension studies to date align with production accounts

Are listeners also sensitive to **utterance-medial** disfluencies?

- Replication of Exp 1 + disfluency moved to mid utterance

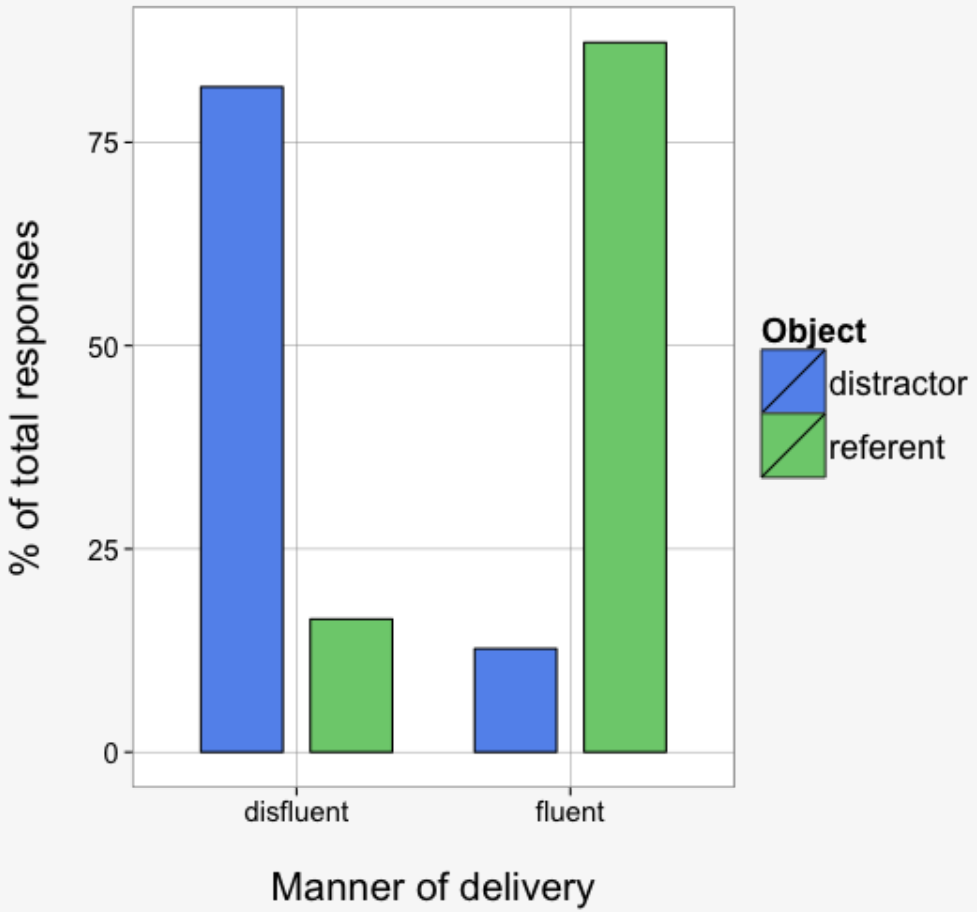


- Disfluent: *The treasure is behind thee, uh...*

[11] Clark & Fox Tree (2002) Cognition [12] Beattie & Butterworth (1979) Lang.Speech

Experiment 2: Results

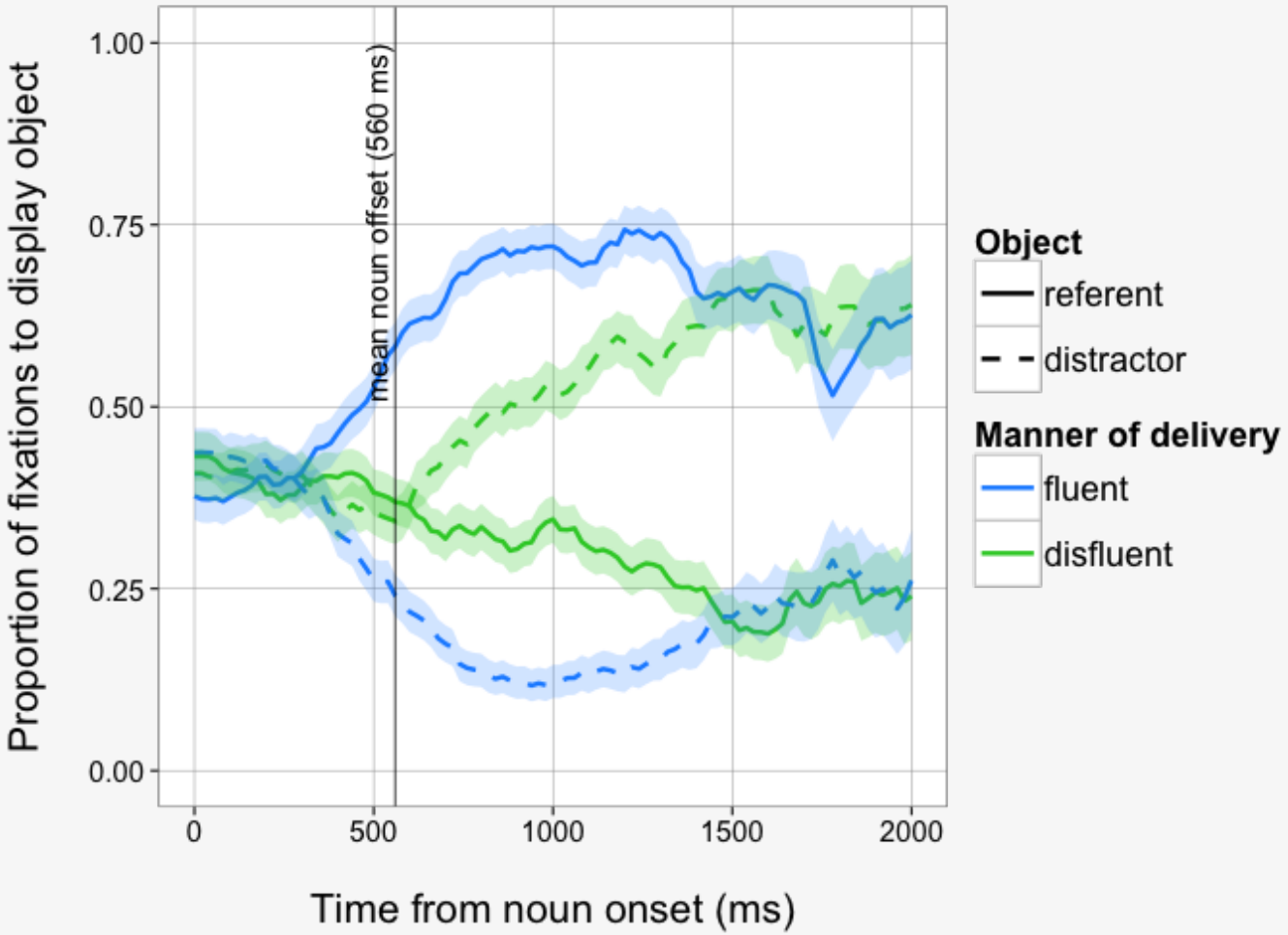
Object clicks by manner of delivery



- Effect of manner of delivery
  β=4.06, SE=0.60, p<.001

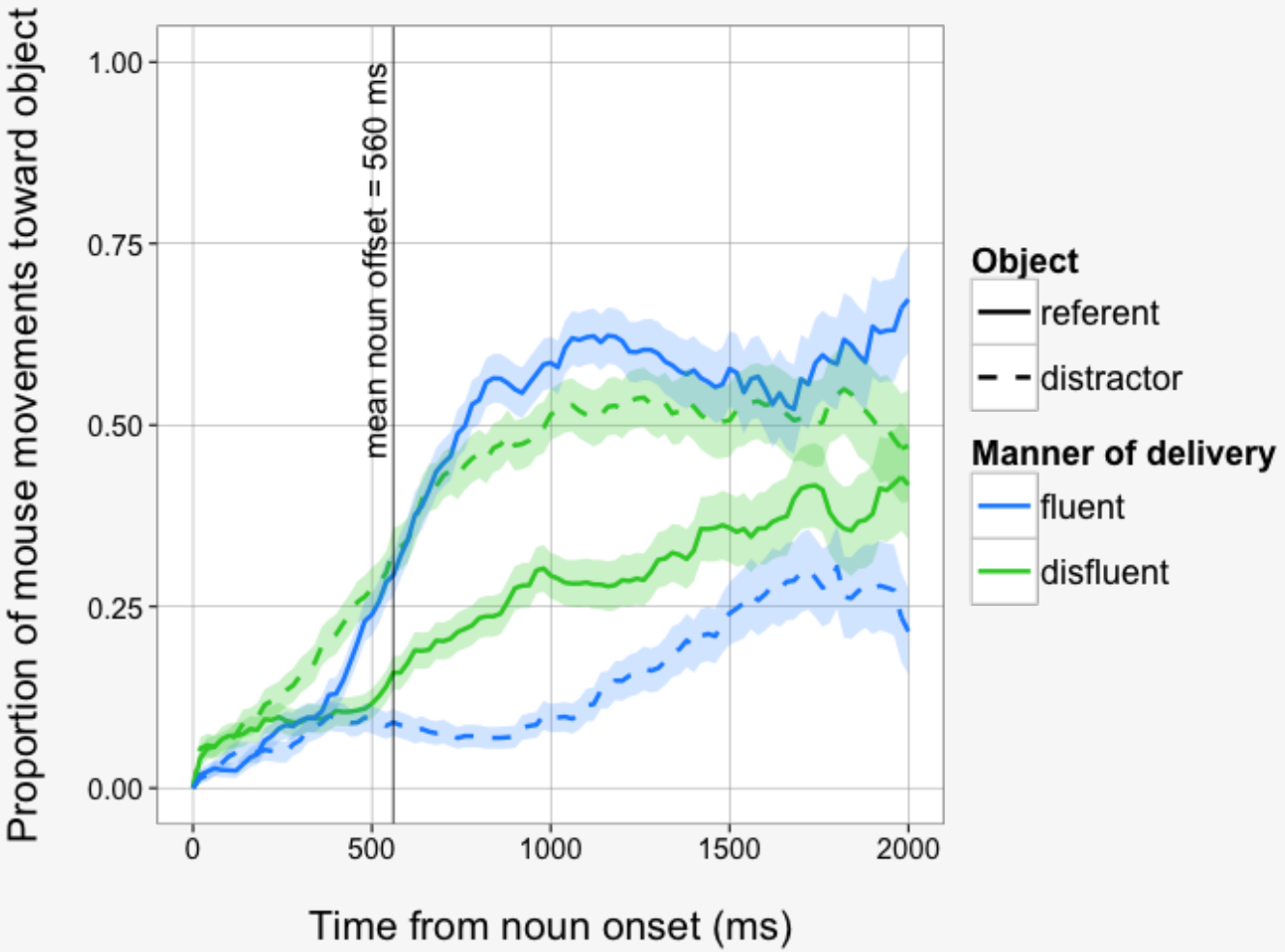
Experiment 2: Results

Fixations across time



Experiment 2: Results

Mouse movements across time



Conclusions

Effect of manner of delivery?

- Listeners make pragmatic judgements based on the manner in which the message is conveyed

When do listeners make these judgements?

- Bias emerges during early moments of comprehension
- Supports existing research showing early pragmatic effects

What can we say about disfluency location?

- Listeners sensitive to both utterance-initial and utterance-medial disfluency
- Comprehension accounts may be more than an extension of production theories

Thank you

Models (eye-tracking)

Table: Eye-tracking results for Experiments 1 and 2

Experiment	Analysis	Fixed effects	β	SE	t
1	by subjects	(Intercept)	-0.64	0.22	-2.93
		time	0.19	0.62	-0.30
		manner	-0.16	0.30	-0.53
		time:manner	1.72	0.70	2.47
1	by items	(Intercept)	-0.63	0.14	-4.54
		time	0.33	0.29	1.13
		manner	-0.14	0.19	-0.74
		time:manner	1.01	0.39	2.58
2	by subjects	(Intercept)	-0.67	0.48	-1.39
		time	-0.29	0.96	-0.30
		manner	-0.68	0.53	-1.28
		time:manner	3.82	1.33	2.86
2	by items	(Intercept)	-0.28	0.21	-1.35
		time	-0.65	0.42	-1.56
		manner	-0.67	0.30	-2.26
		time:manner	2.96	0.59	5.02

Models (mouse-tracking)

Table: Mouse-tracking results for Experiments 1 and 2

Experiment	Analysis	Fixed effects	β	SE	t
1	by subjects	(Intercept)	1.31	1.32	0.10
		time	-2.01	2.06	-0.98
		manner	-1.59	1.87	-0.85
		time:manner	7.47	2.91	2.56
1	by items	(Intercept)	0.05	1.71	0.03
		time	-0.83	2.52	-0.33
		manner	0.83	2.42	0.34
		time:manner	3.47	1.50	2.30
2	by subjects	(Intercept)	0.24	0.91	0.26
		time	-4.23	1.90	-2.22
		manner	-1.11	1.29	-0.86
		time:manner	11.04	2.69	4.10
2	by items	(Intercept)	-1.41	1.43	-0.99
		time	-1.33	2.05	-0.65
		manner	1.40	1.72	0.82
		time:manner	6.73	2.82	2.39

Models (mouse-tracking)

Table: Inter-experimental comparison of mouse-tracking

Analysis	Fixed effects	β	SE	t
by subjects	(Intercept)	1.31	1.14	1.15
	time	-2.01	2.01	-1.00
	manner	-1.59	1.61	-0.99
	exp	-1.07	1.59	-0.67
	time:manner	7.47	2.84	2.63
	time:exp	-2.22	2.80	-0.79
	manner:exp	0.47	2.25	0.21
	time:manner:exp	3.57	3.97	0.90
by items	(Intercept)	-0.37	1.06	-0.35
	time	0.20	0.90	0.22
	manner	2.00	1.48	1.35
	exp	-1.39	1.50	-0.93
	time:manner	0.07	1.25	0.05
	time:exp	0.43	1.27	0.34
	manner:exp	1.86	2.10	0.89
	time:manner:exp	-0.23	1.77	-0.13