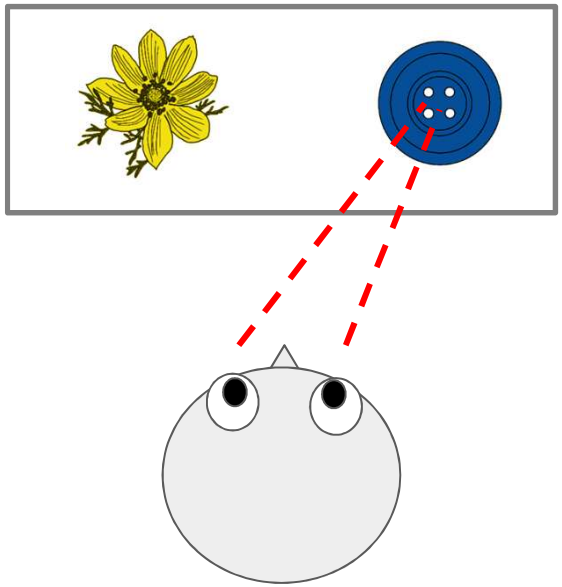
Individual variability in the timecourse of predictions

Kate Stone and Sol Lago

People predict upcoming words

“Klicke auf den…”



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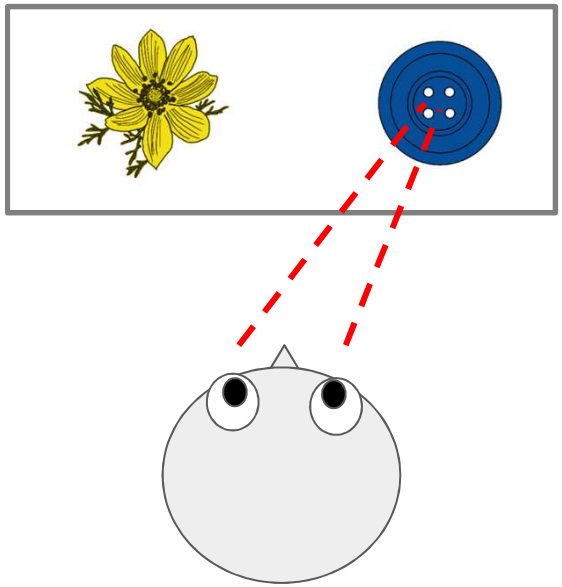
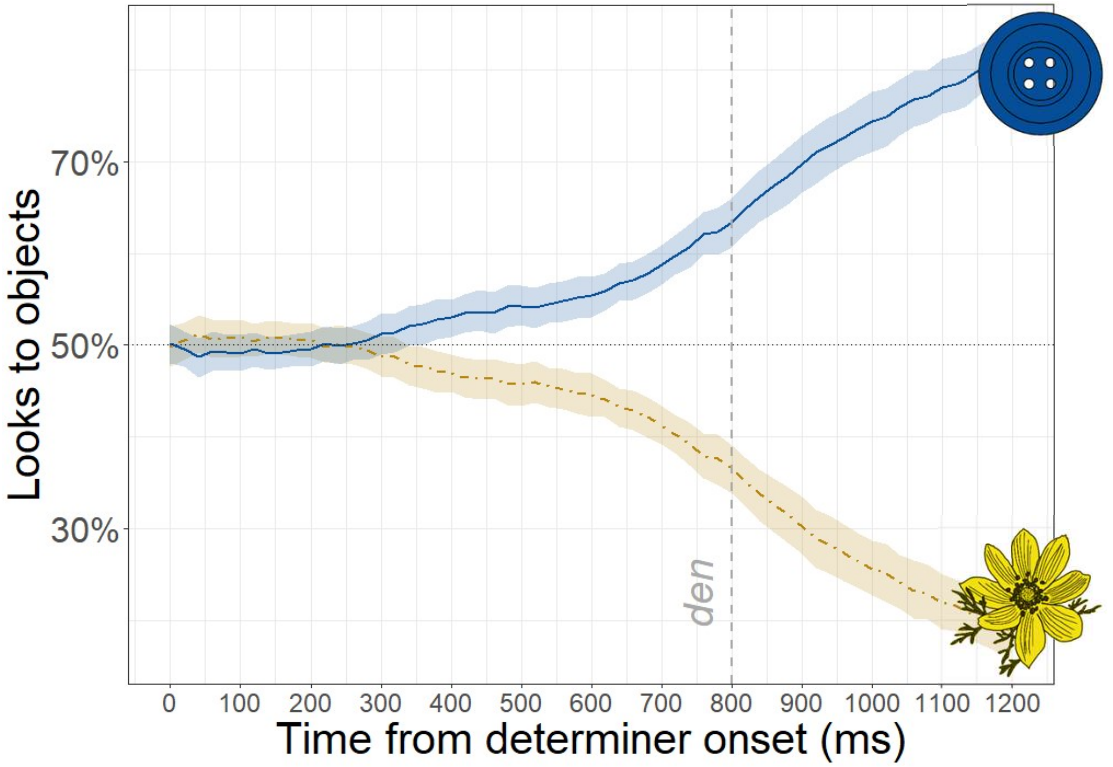
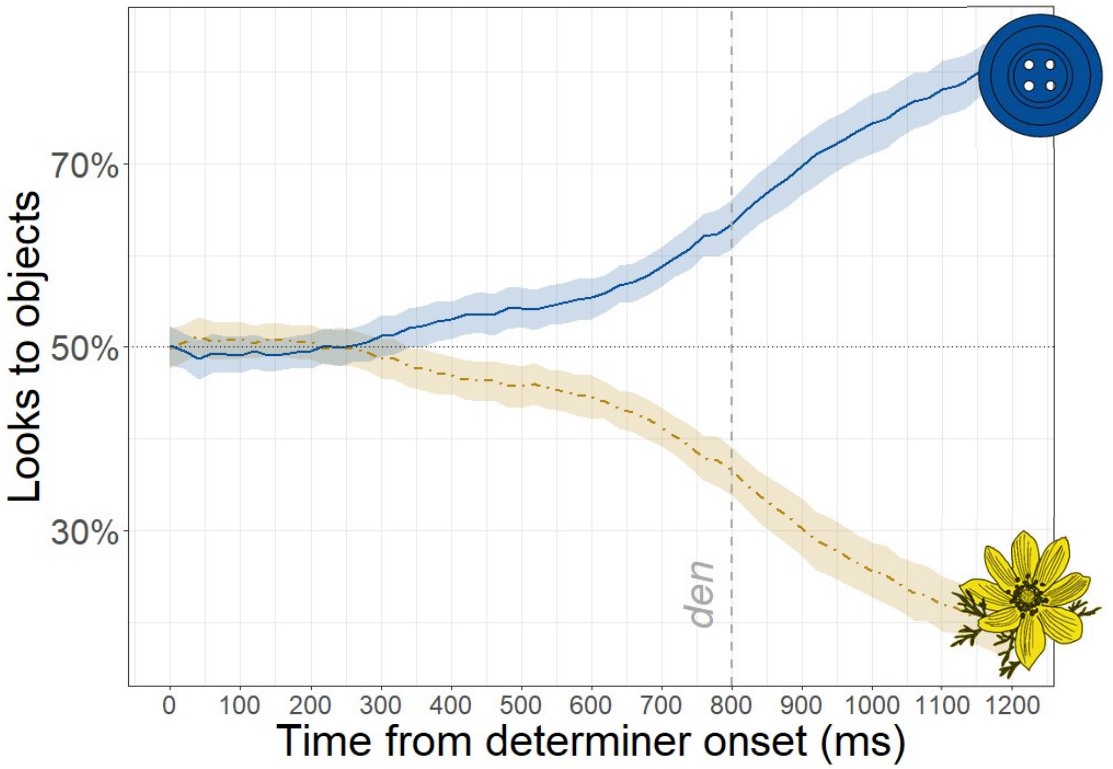




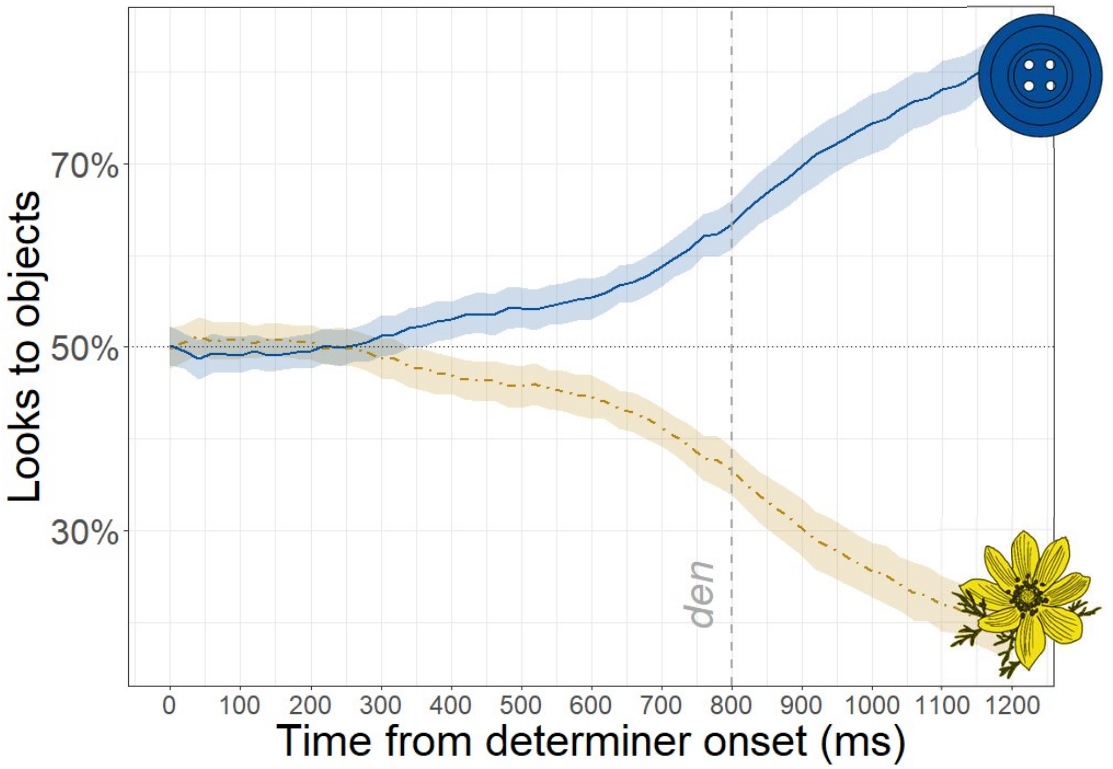
Existing methods



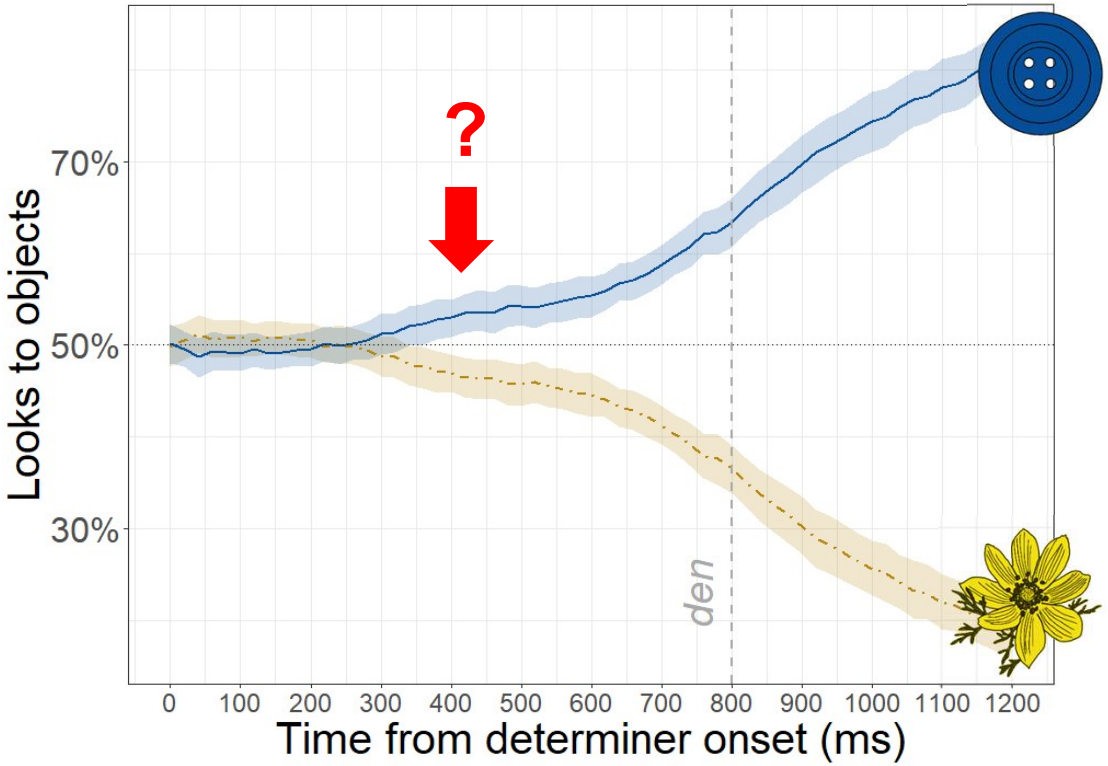
Existing methods

- Was there a prediction?
- In what time window was the predictive effect significant?

e.g. Barr et al, 2014; Seedorff et al, 2017



When do we first see evidence of a predictive effect?



Goals for this talk

- Present a bootstrapping method that allows us to identify when a predictive effect began.

- Apply the method to study prediction speed in native and non-native German speakers.

Structure of the talk

1. Provide background on gender predictions in non-native speakers

2. Apply the bootstrapping method to groups of native and non-native speakers

3. Show how the method can be applied at an individual subject level

Structure of the talk

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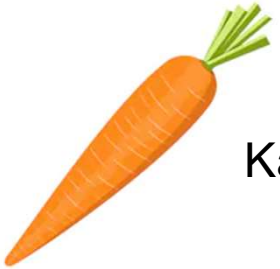
Native speakers use syntactic gender to predict

"Der Hase frisst den… "

The rabbit eats the.MASC…



Karrotte.FEM

Kohl.MASC

Dussias et al., 2013; Grüter et al., 2012; Hopp, 2013; Hopp & Lemmerth , 2018; Lemmerth & Hopp, 2018

Non-native speakers are not as good at predicting

Encuentra **la** pelota

Find the.fem ball

Same gender	Different gender
	
"**la** galleta"	"**el** zapato"

Grüter et al., 2012

Non-native speakers are not as good at predicting

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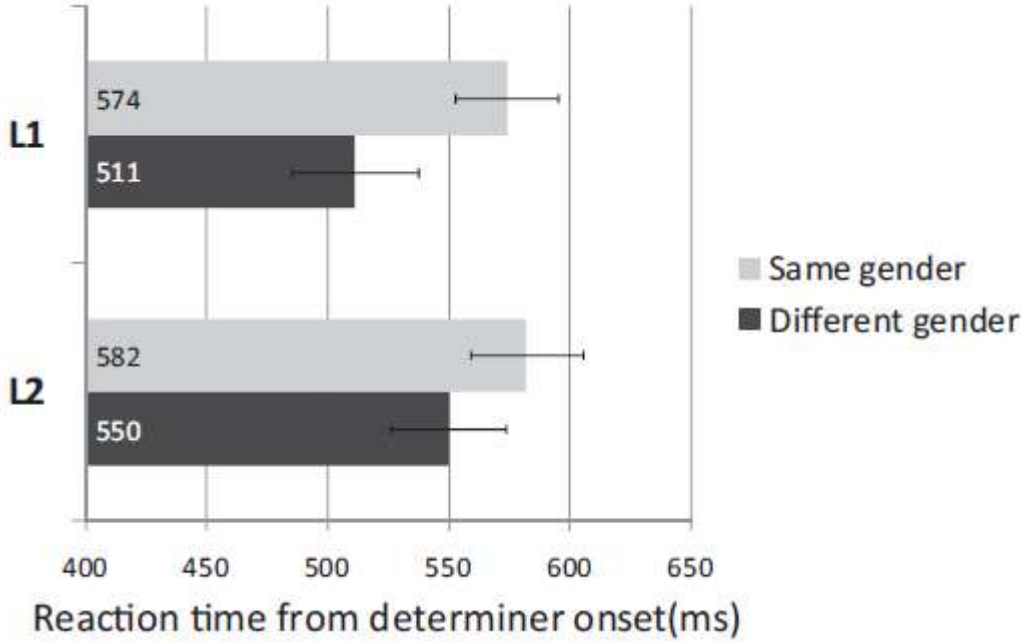
Find the.fem ball

Same gender	Different gender
	

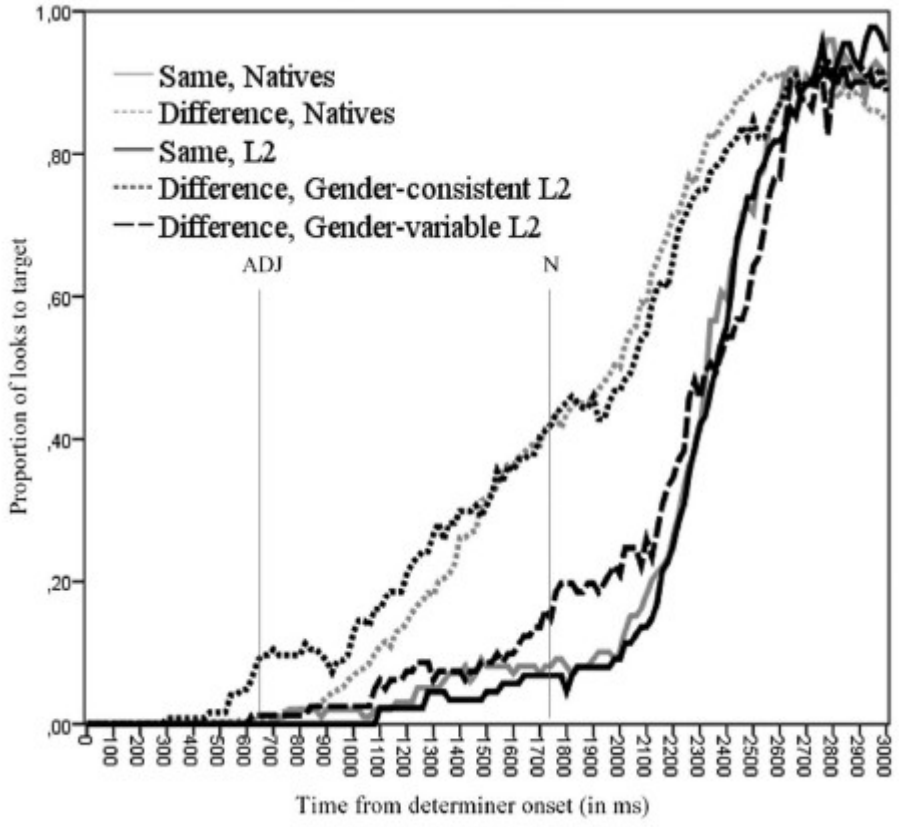


Grüter et al., 2012

Non-native speakers are not as good at predicting

Wo ist der/die/das gelbe…?

Where is the.masc/fem/neut yellow…?



Hopp, 2013

Key point: L2 predictive ability is variable

- What determines predictive ability?
  - Accurate gender representations (vocabulary knowledge)
  - Familiarity with a gender system in the L1?

- Having a way to quantify prediction speed at the group and individual level would help us decide which factors are important!

How much slower are non-native
than native predictions?

How much does non-native speakers' L1
impact prediction speed?

Structure of the talk

1. Provide background on gender predictions in L2
    - What do we know about L2 gender predictions
    - Our experiment
2. Introduce the bootstrapping method at a group level
3. Show how the method can be applied at an individual subject level

Syntactic gender predictions

A visual world experiment

Martin and Sarah have to clean up the house before their parents get home

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A visual world experiment

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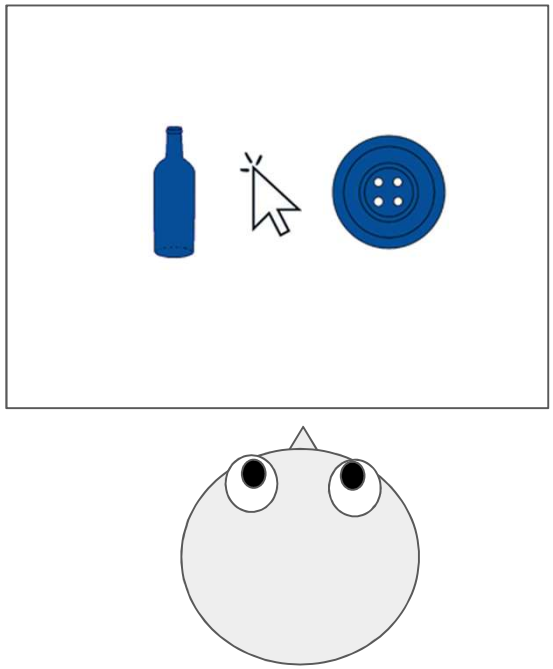
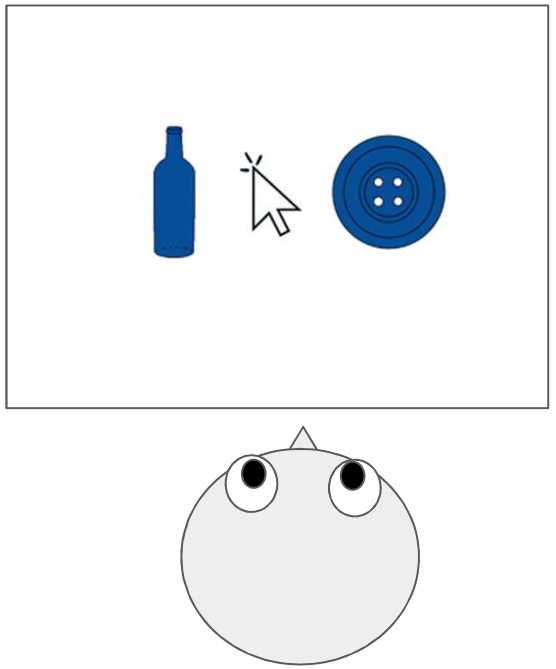


Martin and Sarah have to clean up the house before their parents get home

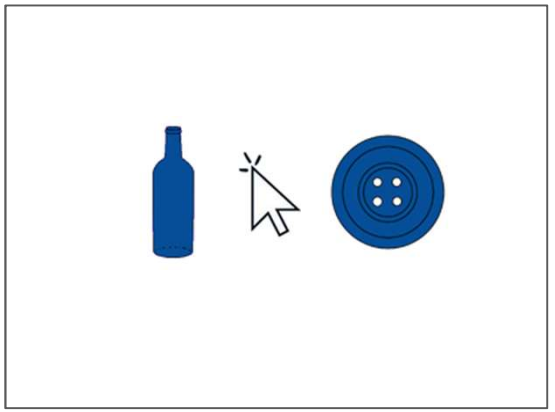
“Klicke auf seinen blauen Knopf”



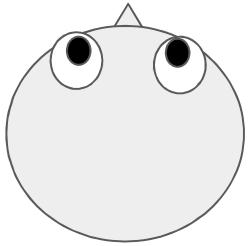
Martin and Sarah have to clean up the house before their parents get home

“Klicke auf seinen blauen Knopf”

die Flasche.fem
COMPETITOR



der Knopf.masc
TARGET

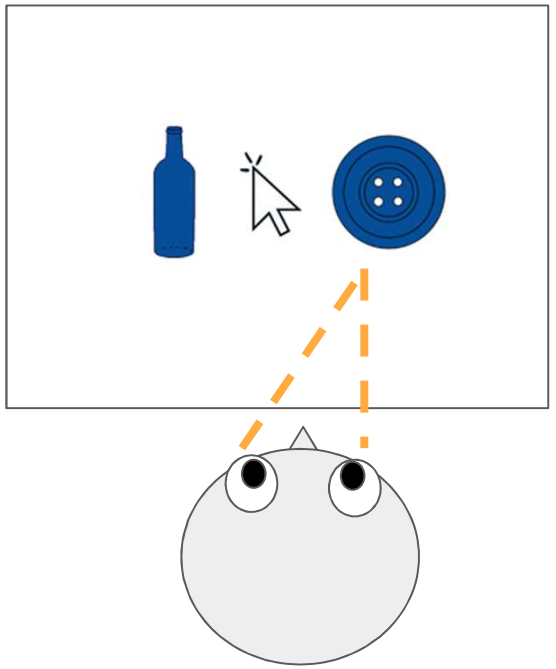


Martin and Sarah have to clean up the house before their parents get home

Critical window

“Klicke auf seinen blauen Knopf”

die Flasche.fem
COMPETITOR



der Knopf.masc
TARGET

Three speaker groups:

74 German native speakers

63 Spanish learners of German (L1 with gender)

66 English learners of German (L1 without gender)

Three speaker groups:

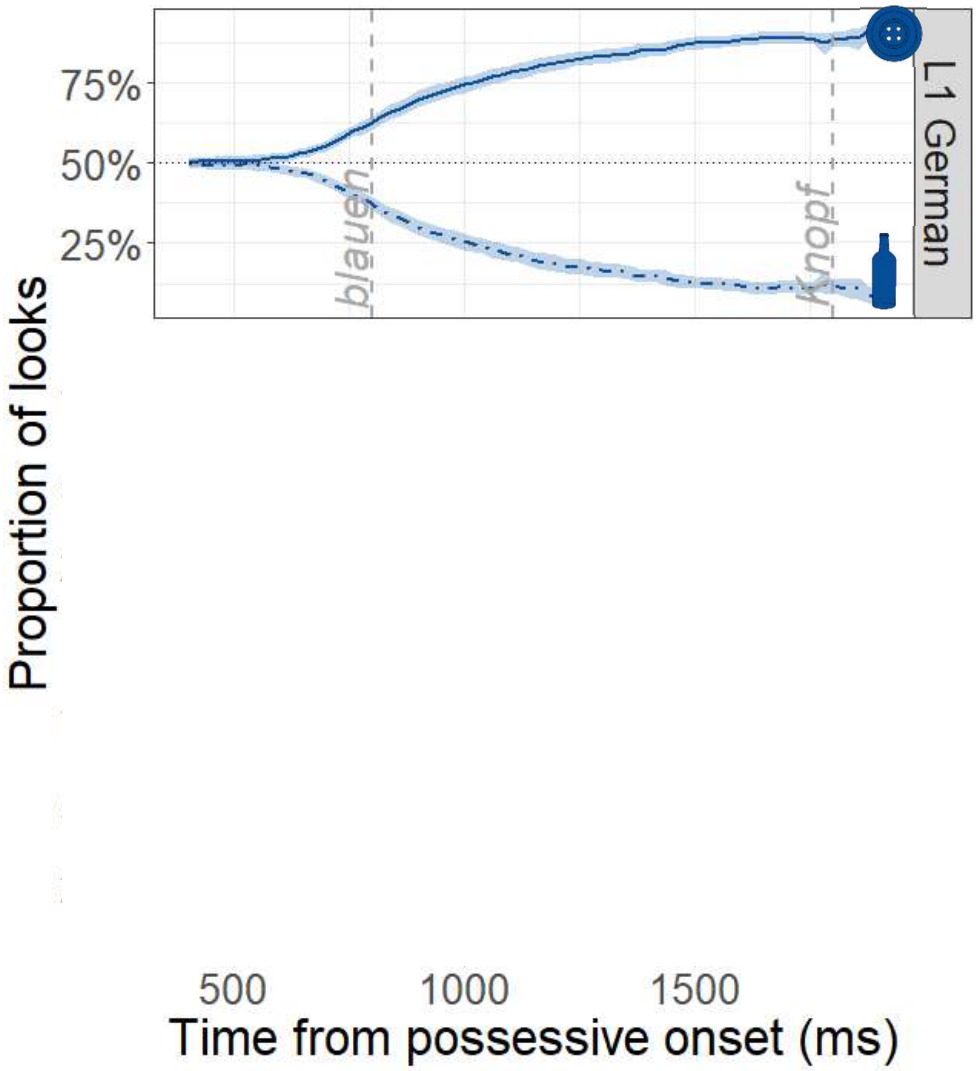
74 German native speakers

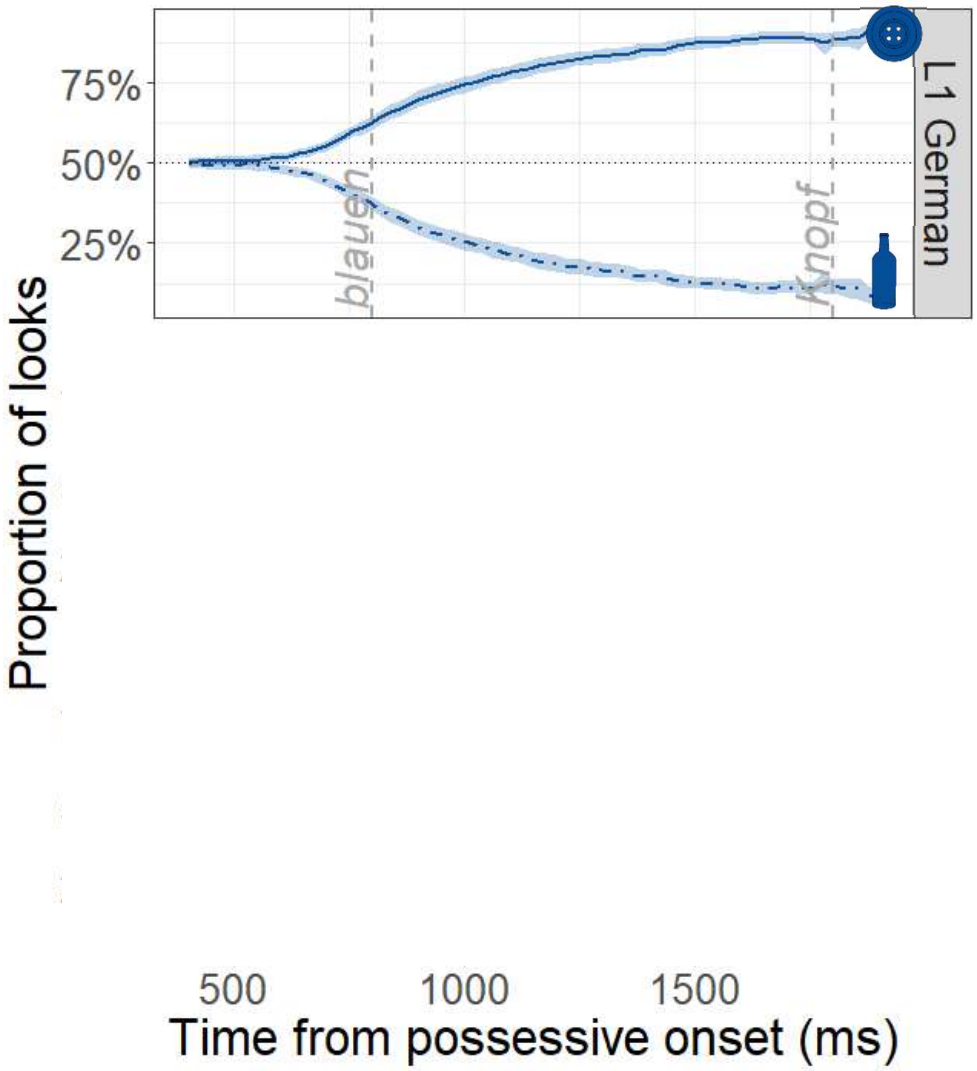
63 Spanish learners of German (L1 with gender)

Intermediate-advanced German (min. B2)

66 English learners of German (L1 without gender)

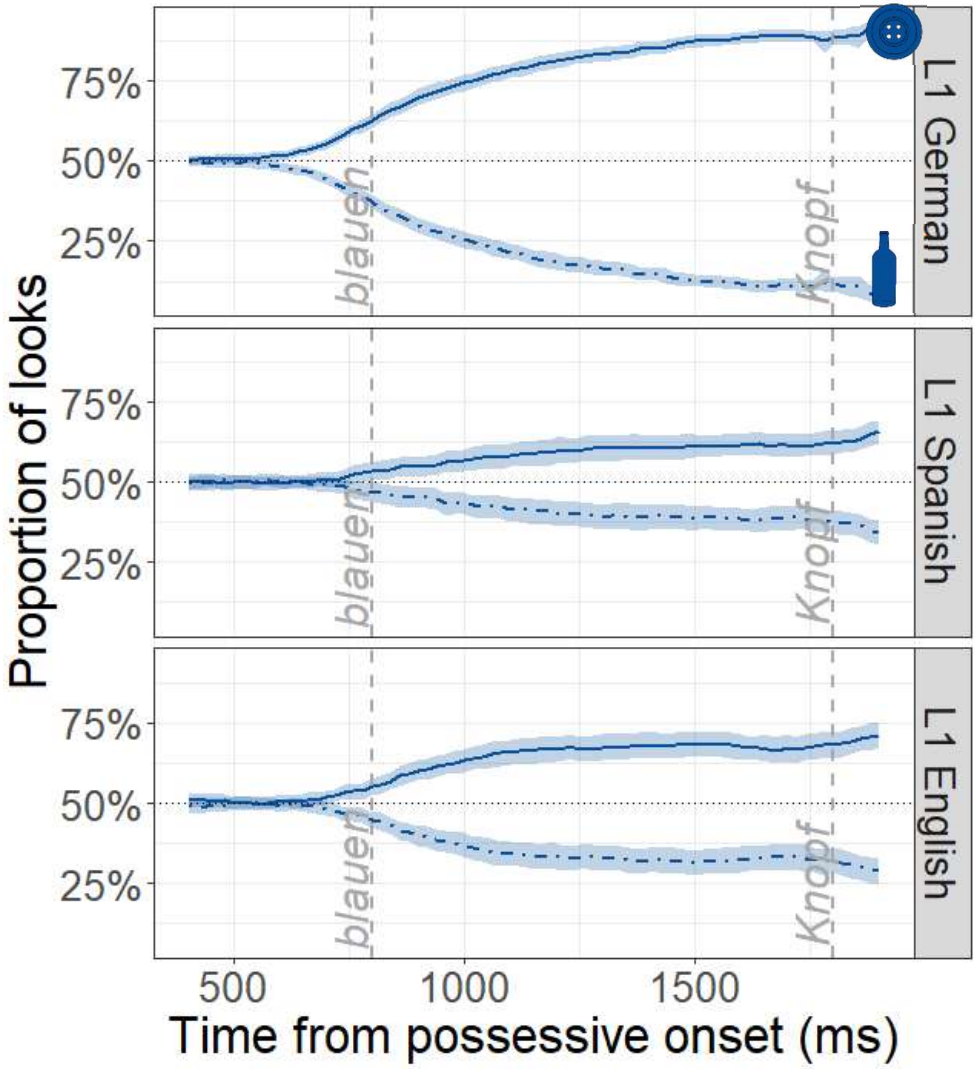
Results


75%
50%
25%
blauen
Knopf
L1 German
Proportion of looks
500
1000
1500
Time from possessive onset (ms)



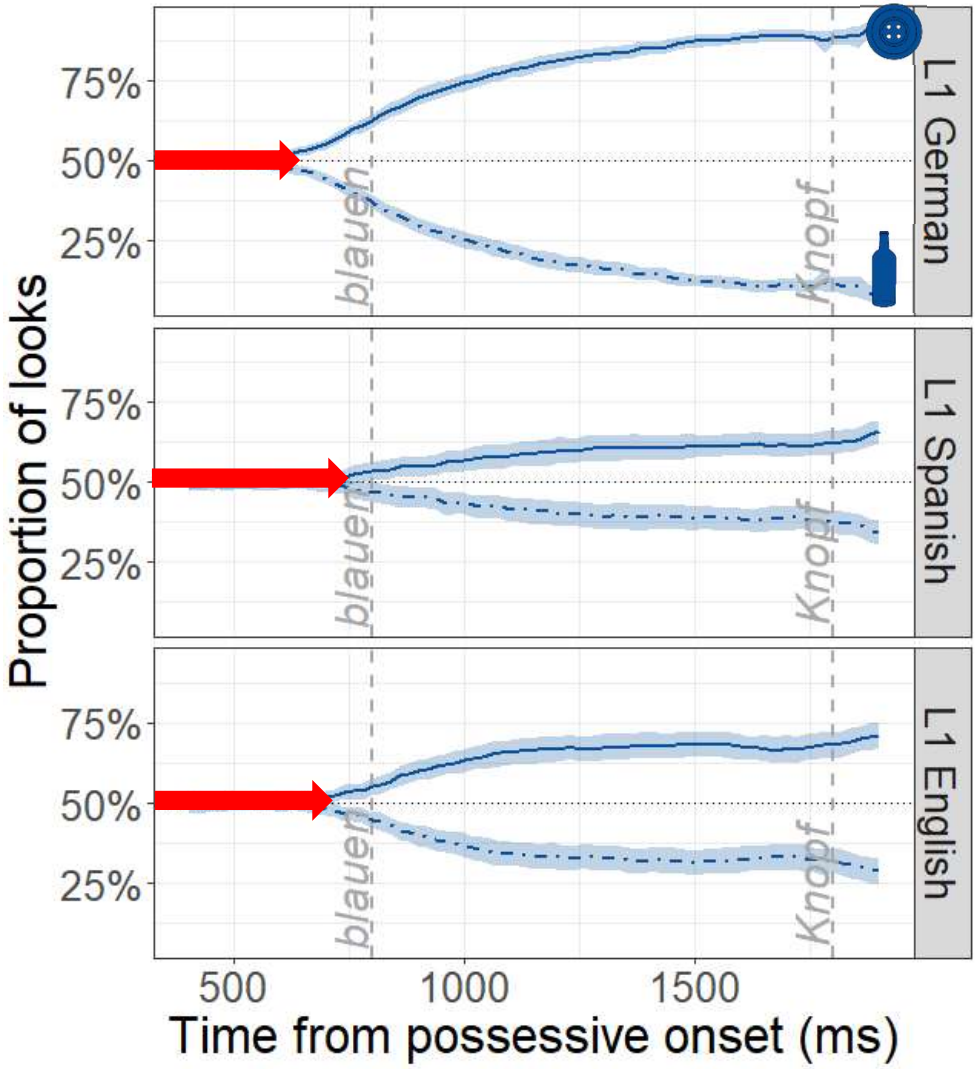
Results

- Native speakers predicted the noun



Results

- Native speakers predicted the noun
- Non-native speakers also predicted



Results

- Native speakers predicted the noun

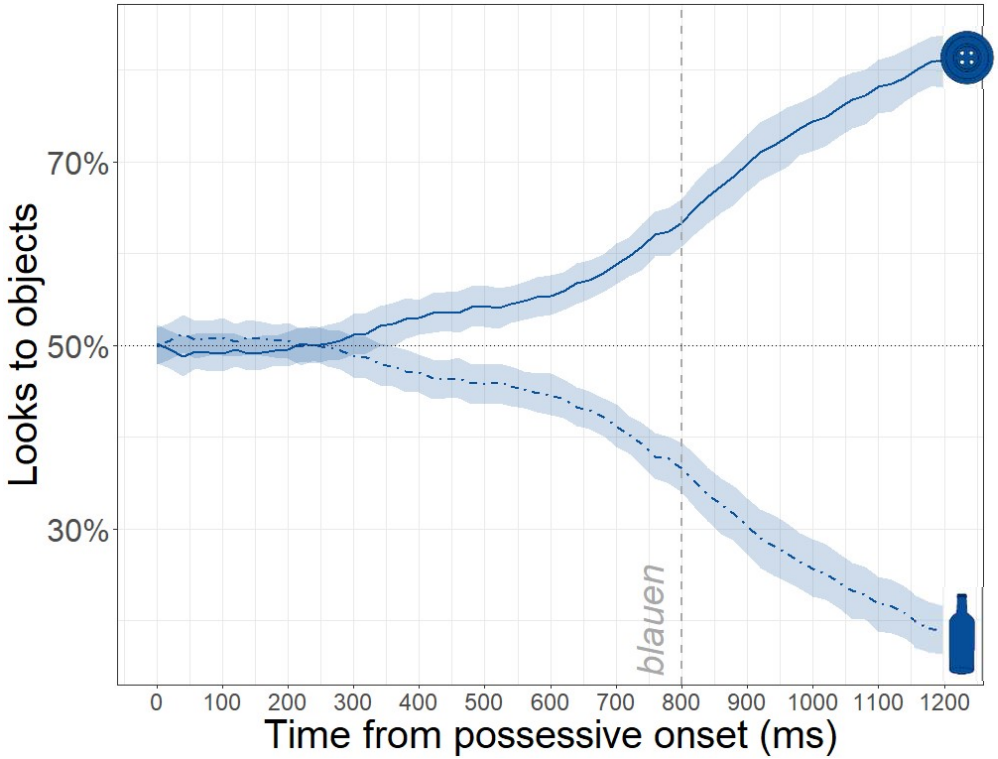
- Non-native speakers also predicted
- Slower predictions in non-native speakers

Structure of the talk

1. Provide background on morphosyntactic gender predictions in L2
2. Introduce the bootstrapping method to participant groups
3. Show how the method can be applied at an individual subject level

A bootstrapping approach

Adapted from Sheridan & Reingold 2012; Reingold & Sheridan, 2014



Steps:

Stone, Lago & Schad (under review)

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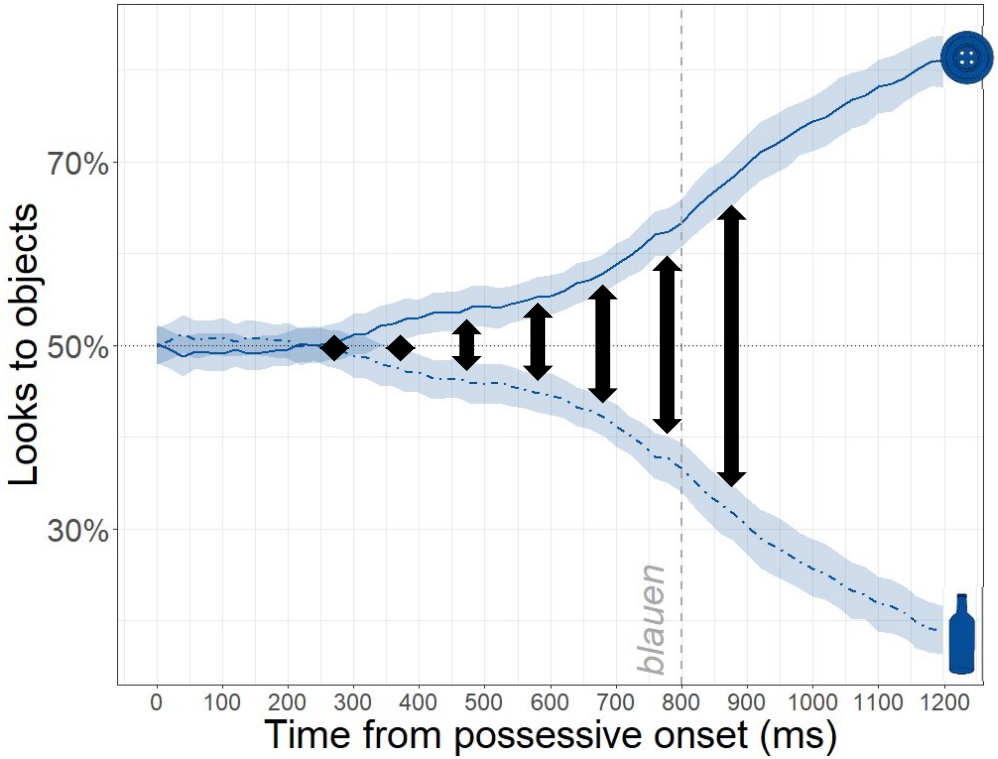

Steps:

1. Test between curves at each timepoint

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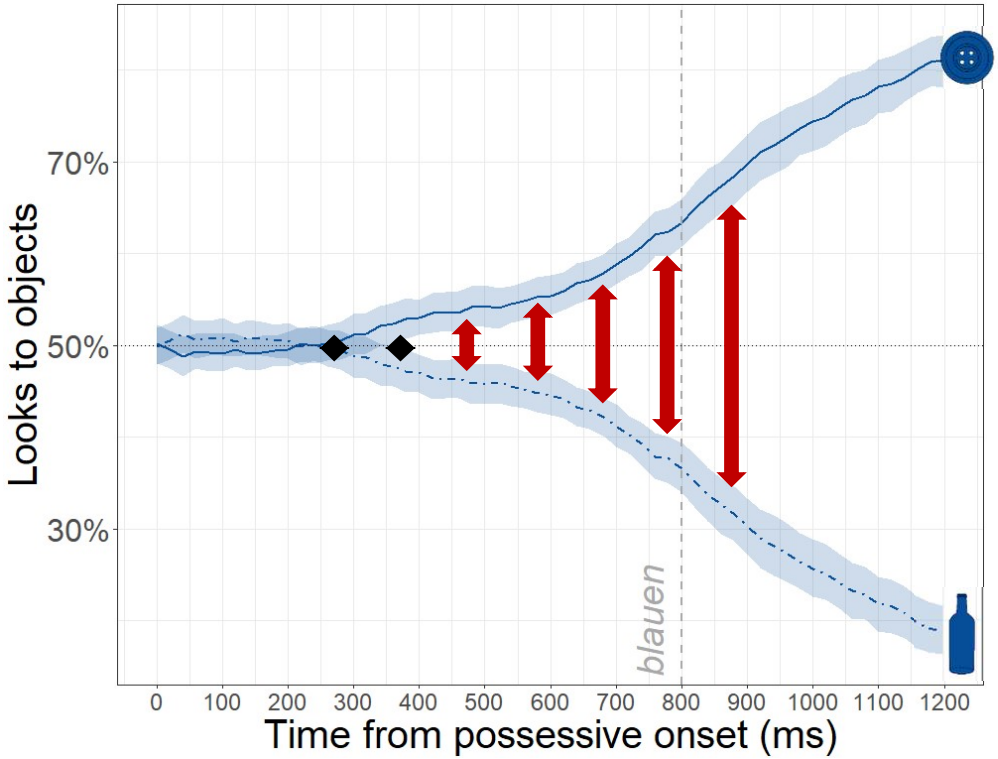

Steps:

1. Test between curves at each timepoint

2. Find the **first** significant test statistic in a run of five

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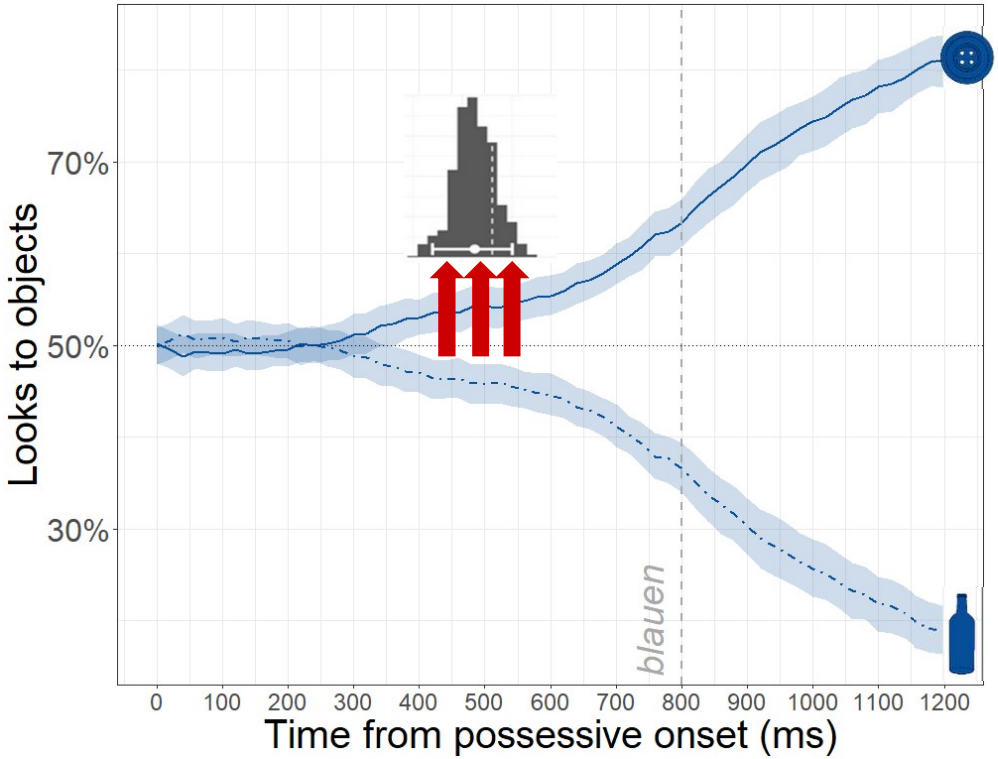
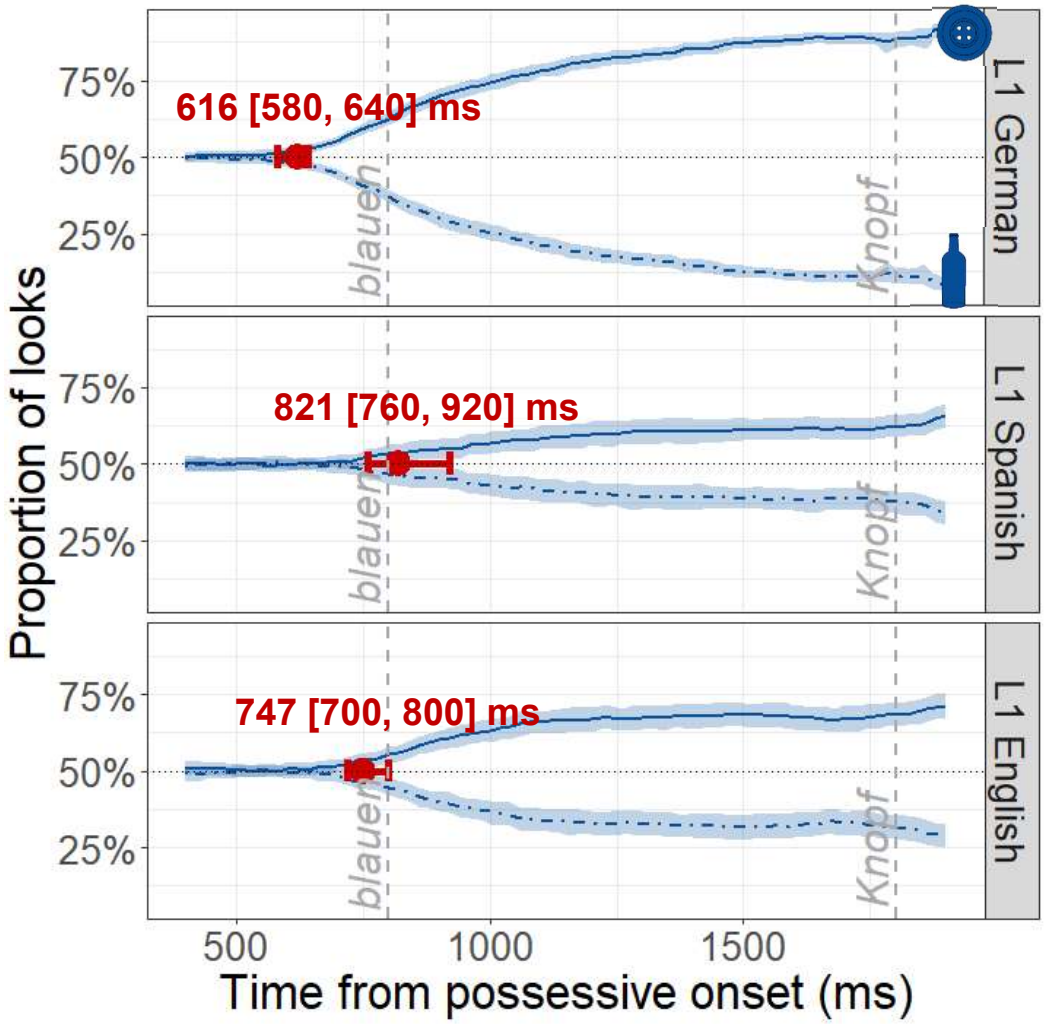
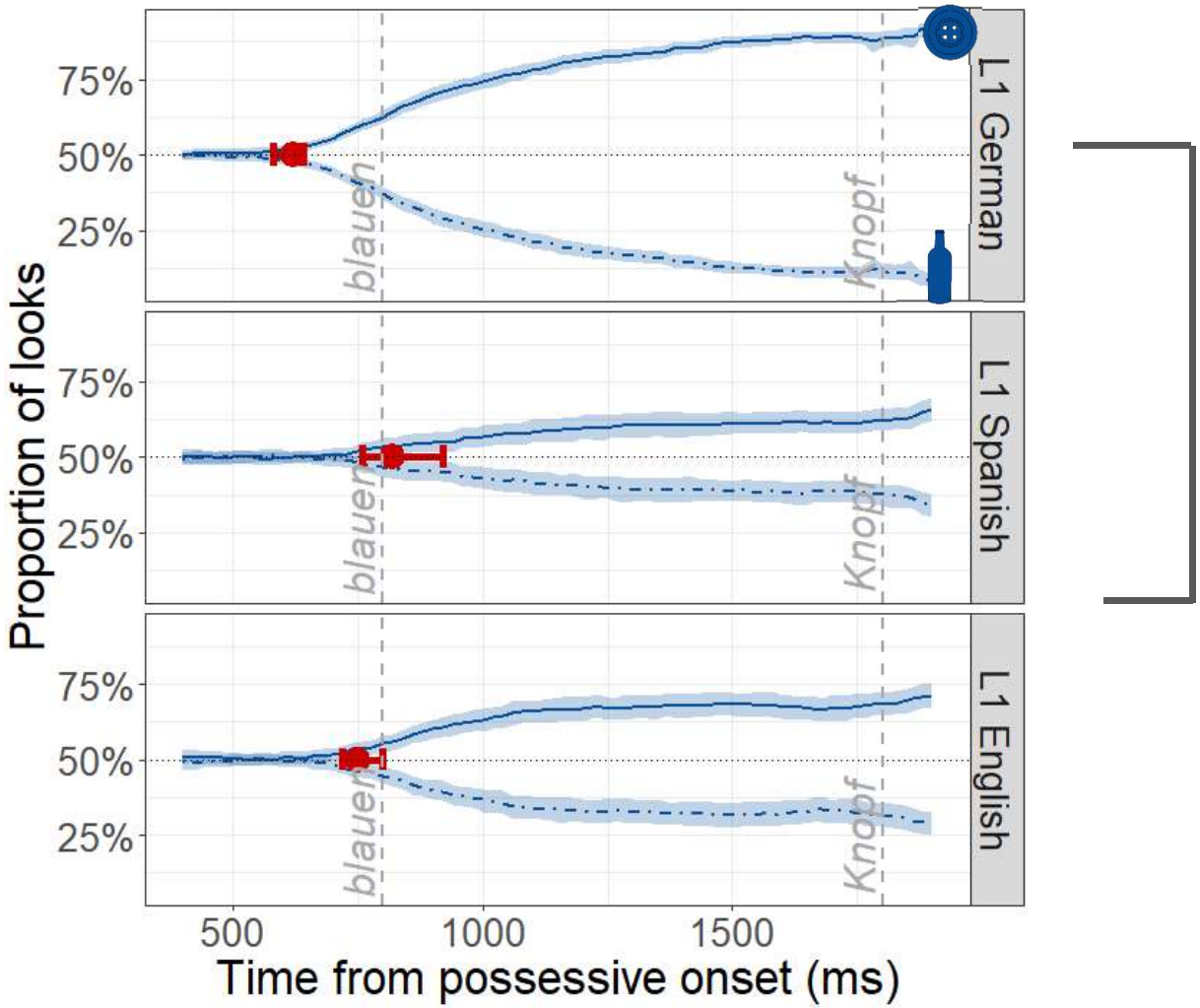


Steps:

1. Test between curves at each timepoint
2. Find the **first** significant test statistic in a run of five
3. Resample the data, repeat 2000 times

Stone, Lago & Schad (under review)


Proportion of looks
75%
50%
25%
616 [580, 640] ms
blauen
Knopf
L1 German
821 [760, 920] ms
L1 Spanish
747 [700, 800] ms
L1 English
500
1000
1500
Time from possessive onset (ms)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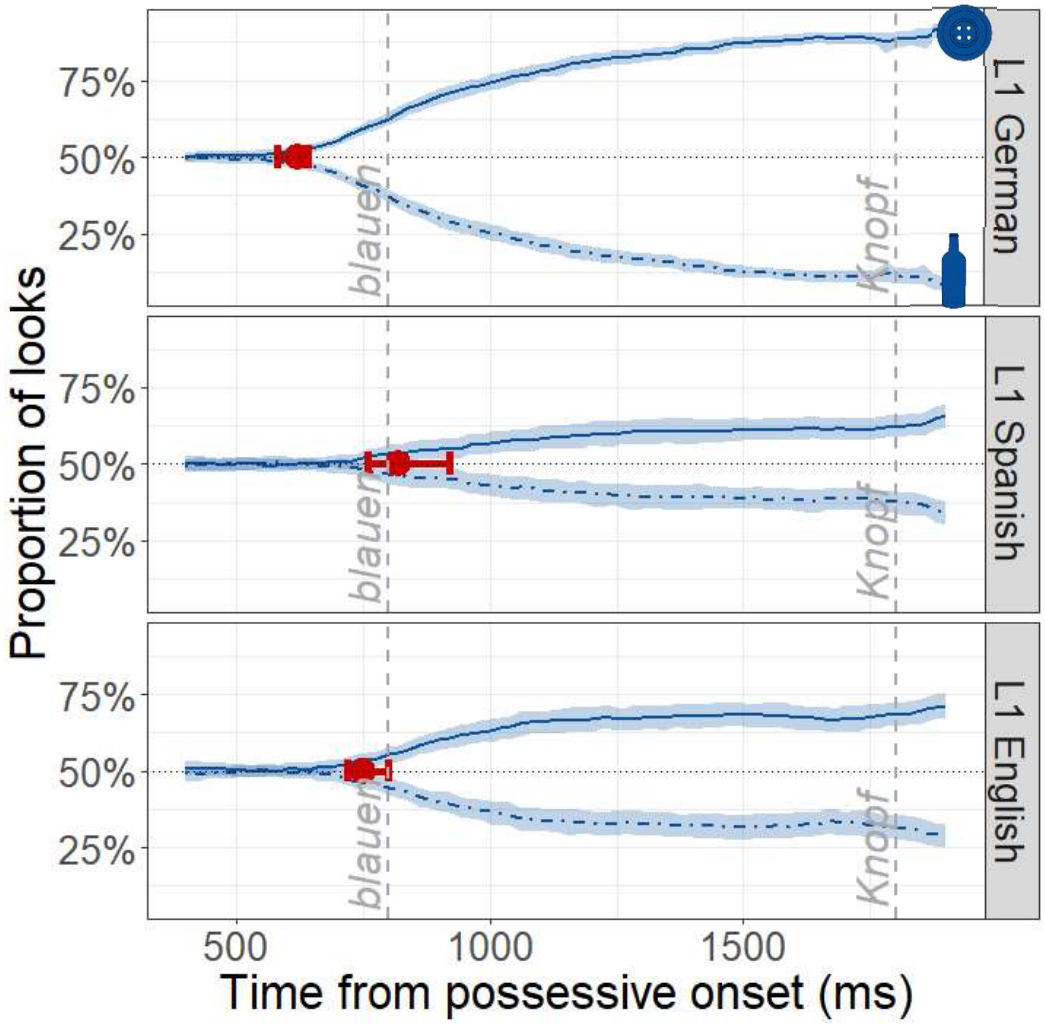
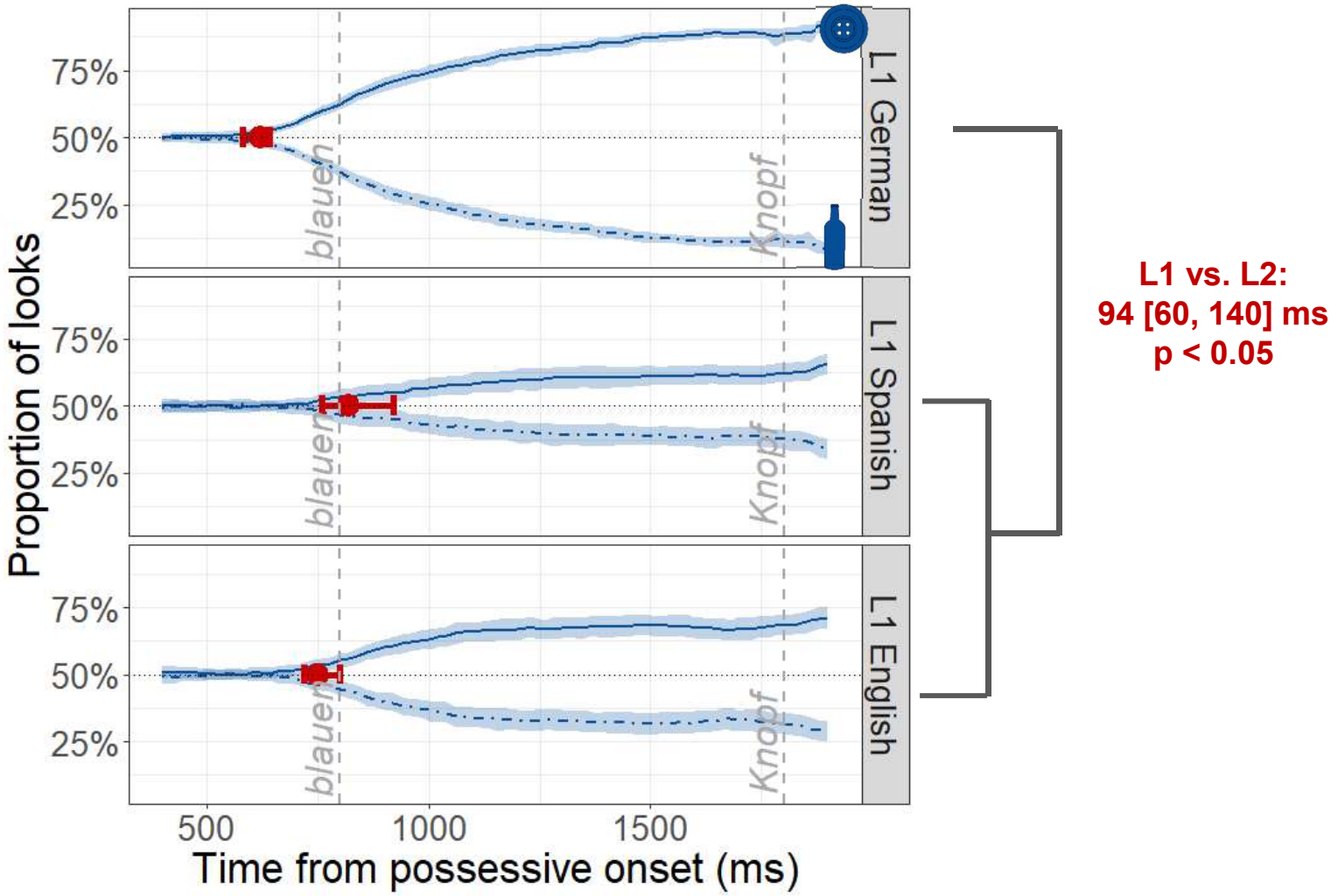


L1 vs. L2:
94 [60, 140] ms
$p < 0.05$



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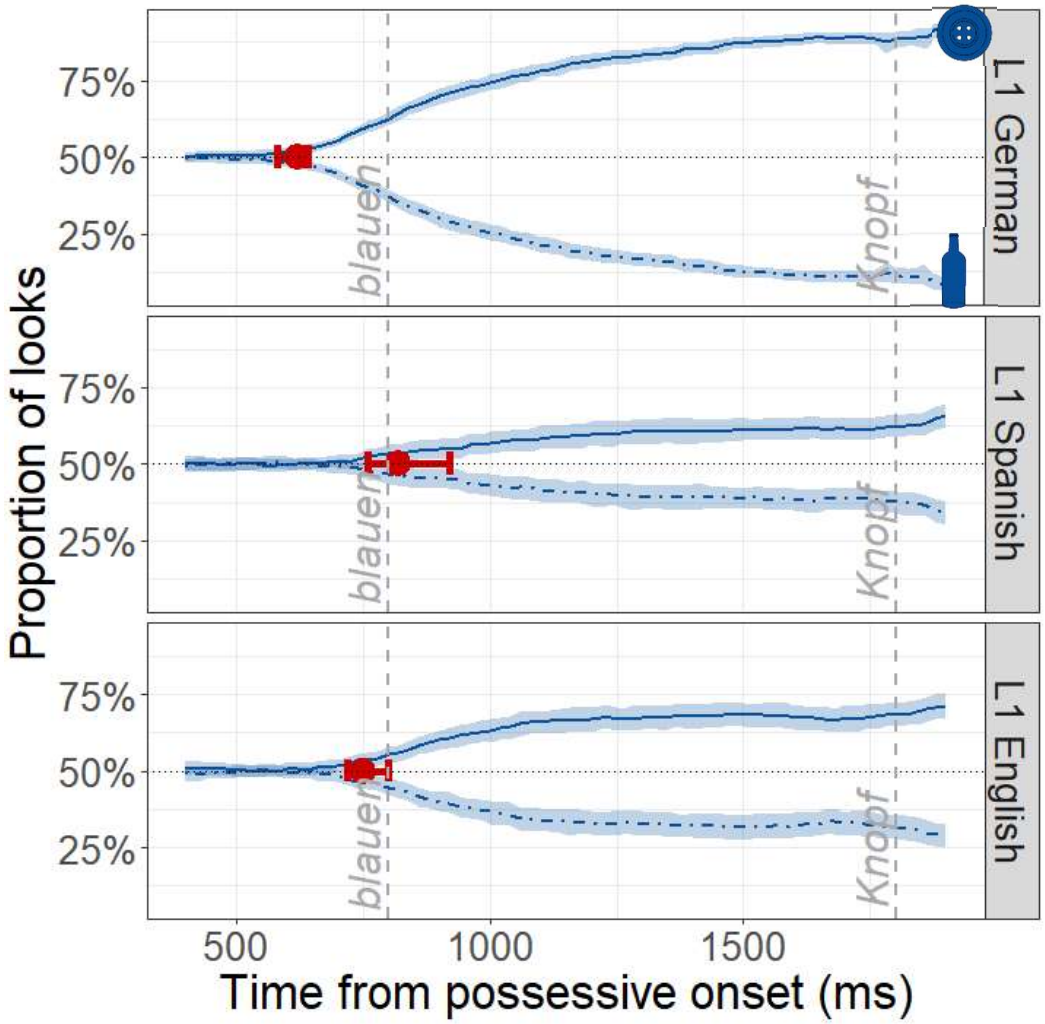


L1 vs. L2:
94 [60, 140] ms
p < 0.05

Spanish vs. English:
51 [-40, 160] ms
p > 0.05

Structure of the talk

1. Provide background on morphosyntactic gender predictions in L2
2. Introduce the bootstrapping method at a group level
3. Show how the method can be applied at an individual subject level

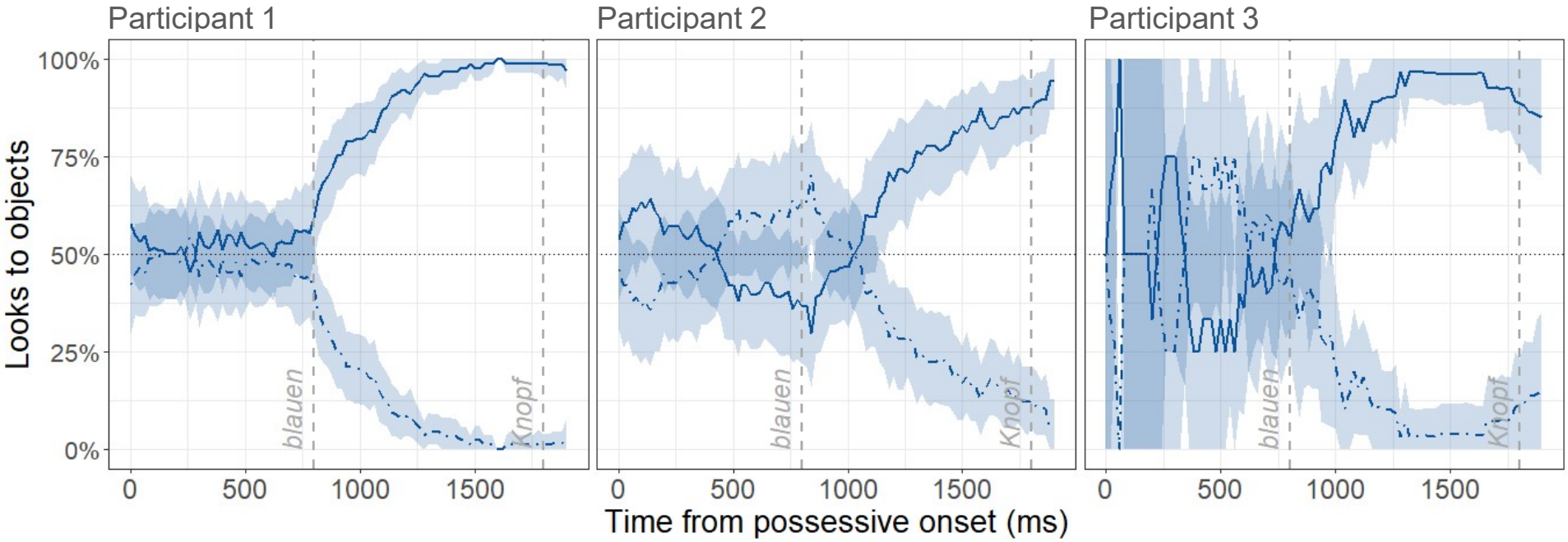
Individual variability

a) Can we detect prediction onsets in individual datasets?

b) Can we link individual prediction speed to individual factors like:

- Proficiency?
- Age of acquisition?
- How often a speaker uses German?
- Object naming accuracy?

Problem: Individual data is really noisy



Solution: Stricter criteria

Adapted from Reingold & Sheridan, 2014

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- Lots of items

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- Exclude participants did not pick up on the cue in the auditory instruction

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- Stricter criteria for defining the onset

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Solution: Stricter criteria

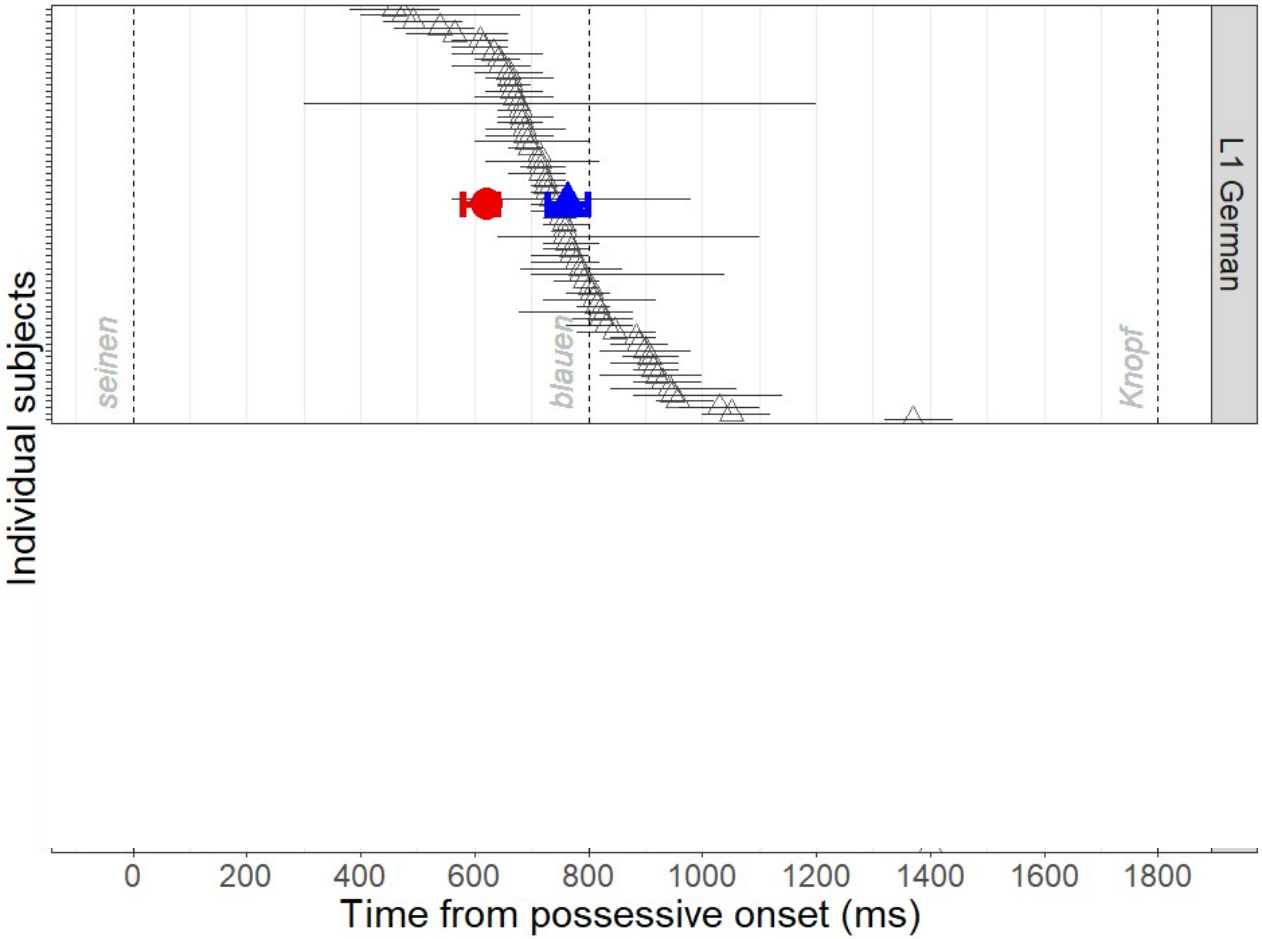
- Lots of items
- Exclude participants did not pick up on the cue in the auditory instruction
- Exclude participants for whom an onset could not be reliably estimated
- Stricter criteria for defining the onset

~50 % of data excluded

Remaining participants:
73 L1 German
19 L1 Spanish
51 L1 English

Adapted from Reingold & Sheridan, 2014

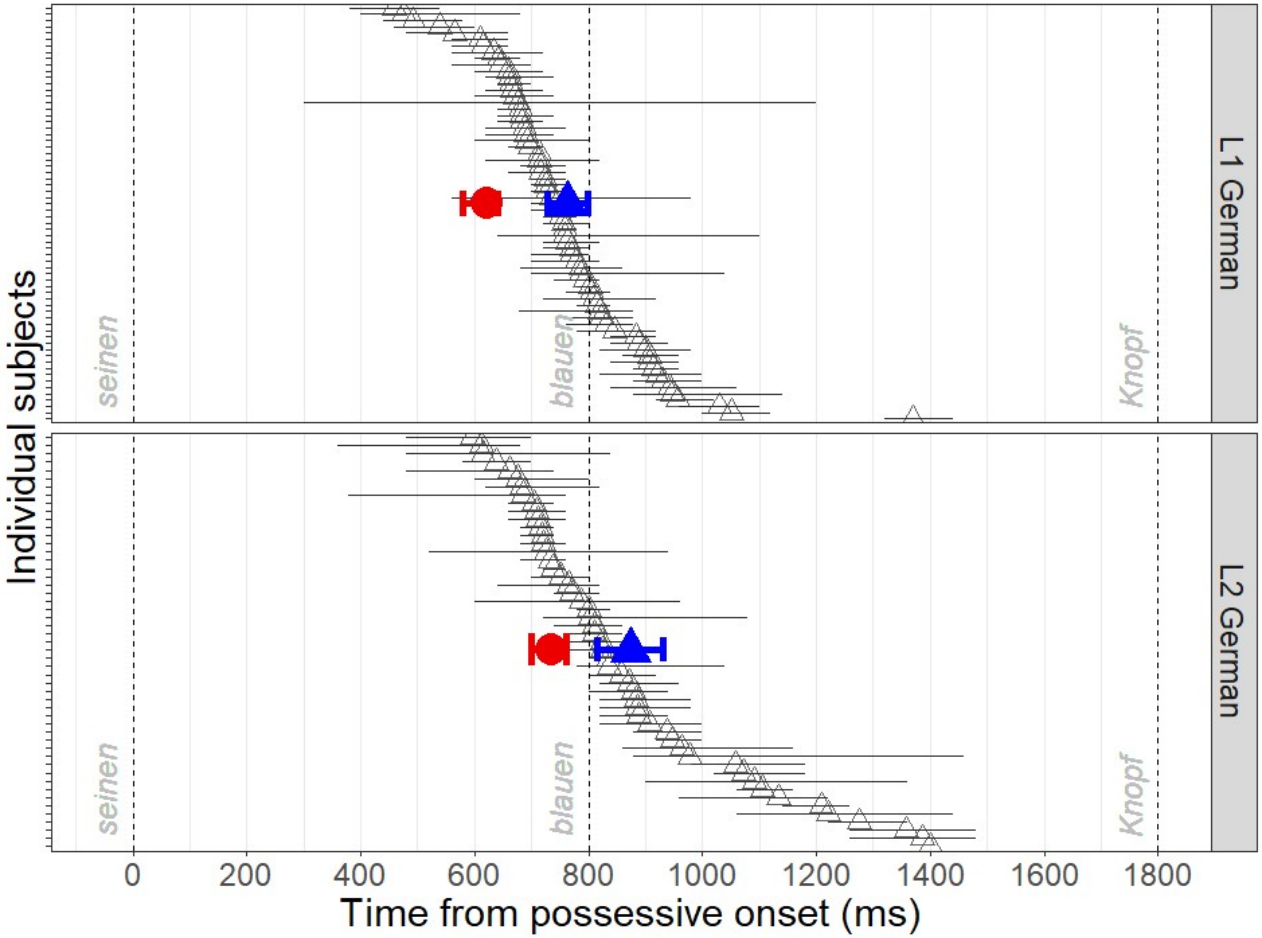
Individual prediction onsets



Group mean onset

Mean of individual onsets

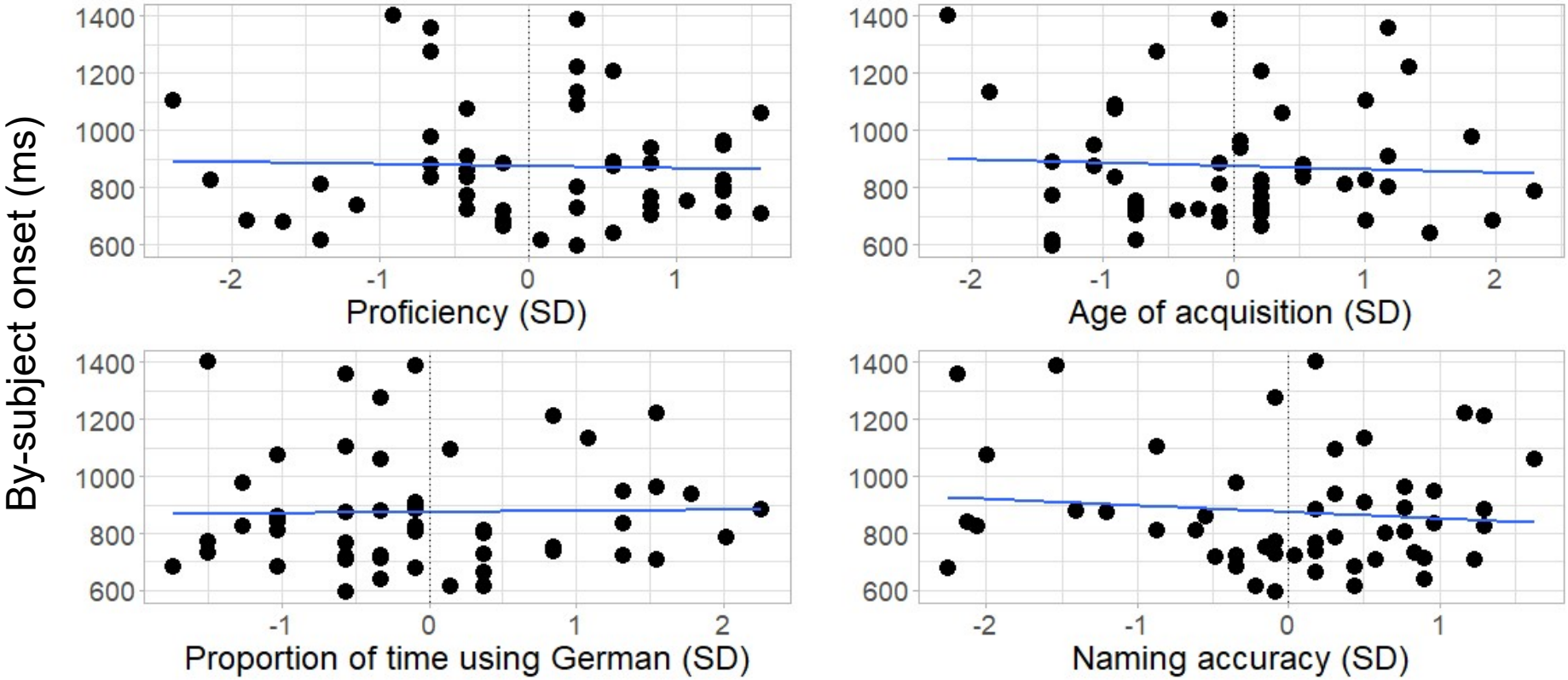
Individual prediction onsets



Group mean onset

Mean of individual onsets

Individual variability



Summary

- Using estimates of the onset of a predictive effect:
  - Non-native speakers were ~100 ms slower to predict than native speakers
  - But having an L1 with gender (Spanish) did not appear to be an advantage
  - We found no link between individual prediction speed and demographic factors

Discussion

- Why were Spanish speakers no faster than English speakers?
    - Interference from mismatching Spanish gender? (but only very few items)
    - Perhaps having two gender representations for each lexical item results in a global lexical access slow-down?

Discussion

- Why were Spanish speakers no faster than English speakers?
  - Interference from mismatching Spanish gender? (but only very few items)
  - Perhaps having two gender representations for each lexical item results in a global lexical access slow-down?
- Why did none of the individual factors predict onset time?
  - Perhaps cognitive factors are more predictive, e.g. lexical access speed, object naming speed rather than accuracy
  - Or perhaps person-specific rather than language-specific factors, e.g. processing speed or attentional factors

Future directions

- Does L1 gender really predict L2 gender performance? If so, how?
- Is individual L2 predictive variability better explained by cognitive factors?
- Link L2 prediction speed directly to L2 processing accounts:
    - E.g. General slowing in L2 due to capacity limitations (Dekydtspotter & Renaud, 2014; Hopp, 2013; McDonald, 2006), or variable speed in different operations (Clahsen & Felser, 2018; Cunnings, 2017)
- Provide parameters for future computational models of L2 processing

Thank you!

DFG Deutsche Forschungsgemeinschaft

Projekt:

Kongruenz in Erst- und Zweitsprachverarbeitung

Sol Lago

Elise Oltrogge