university of groningen

Pupillary responses to pronoun manipulations in Dutch

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Overview

- Introduction
- Experimental Design
- Results
- Conclusions

Introduction

Children make mistakes in the interpretation of:

- *He washes him
- He washes himself

In Italian no such errors are made

Differences between Dutch/English and Italian?

Chien, Y. C., & Wexler, K. (1990). Children's Knowledge of Locality Conditions in Binding as Evidence for the Modularity of Syntax and Pragmatics. *Language Acquisition, 1*(3), 225-295.
McKee, C. (1992). A Comparison of Pronouns and Anaphors in Italian and English Acquisition. Language Acquisition, 2, 21-54.

Introduction

Italian: 2 types of subject pronouns

- Null subject (Ø)
- Overt subject

How much information does a subject hold?

-> How much 'freedom' is there when solving a pronoun?

➔ What are the effects of the presence and interpretation of subject pronouns on the processing and interpretation of object pronouns?

Experimental Design

Eye-tracking study looking at pupil size

- 40 Dutch adults
- 120 Stories, audio
- 2 Pictures
- Referent selection task

Conditions

- Pronoun vs. full NP as the **subject**
- Pronoun vs. reflexive as the **object**

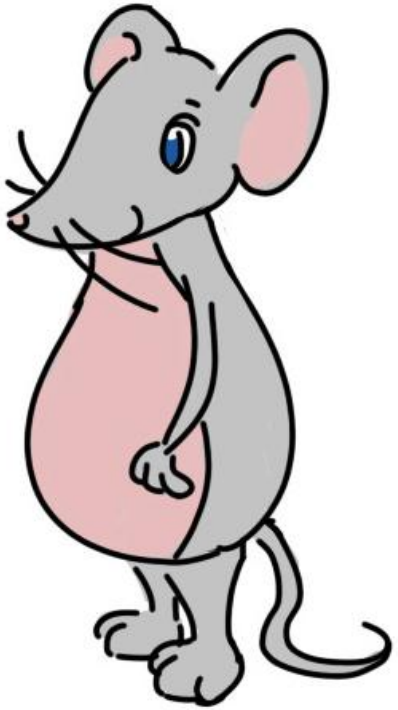
Experimental Design

Stories of 3 phrases

1 De egel heeft een boomhut gebouwd.
2 Afgelopen dinsdag liep de egel met de muis door het bos naar huis,
3 - terwijl hij/de egel hem volgde over een donker pad.
- terwijl hij/de egel zich haastte over een donker pad.

Afterwards, a question was asked about one of the characters

Experimental Design



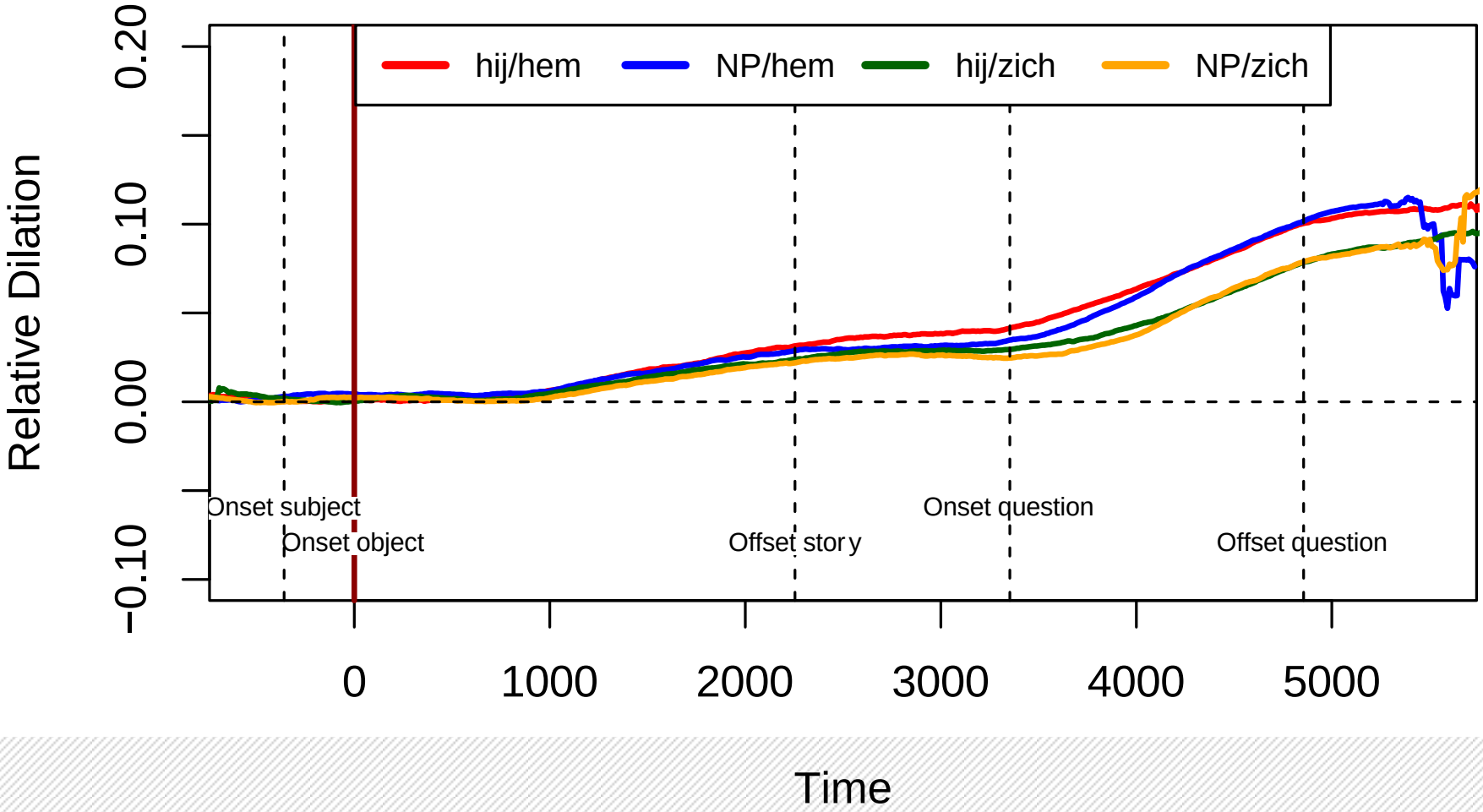
Hypotheses

1. A subject NP is easier to process than 'hij'
2. The object 'zich' is easier to process than 'hem'

3. An object pronoun is more difficult to resolve when following a subject pronoun than when following a subject NP,

i.e. The ambiguity of the subject plays a role in the processing of the object

Results


hij/hem
NP/hem
hij/zich
NP/zich
Relative Dilation
0.20
0.10
0.00
−0.10
Onset subject
Onset object
Offset story
Onset question
Offset question
0
1000
2000
3000
4000
5000
Time

Results

Linear mixed-effects models (lmer)

- Fixed effects and random effects (mixed effects)
- Useful with repeated measures
- Advantage in dealing with missing values (as opposed to repeated-measures ANOVA)
- Mixed-effects analysis is relatively easy to do and does not require a balanced design (which is generally necessary for repeated-measures ANOVA)

NB: t-values given. We assume t > 2 means there is an effect

Results

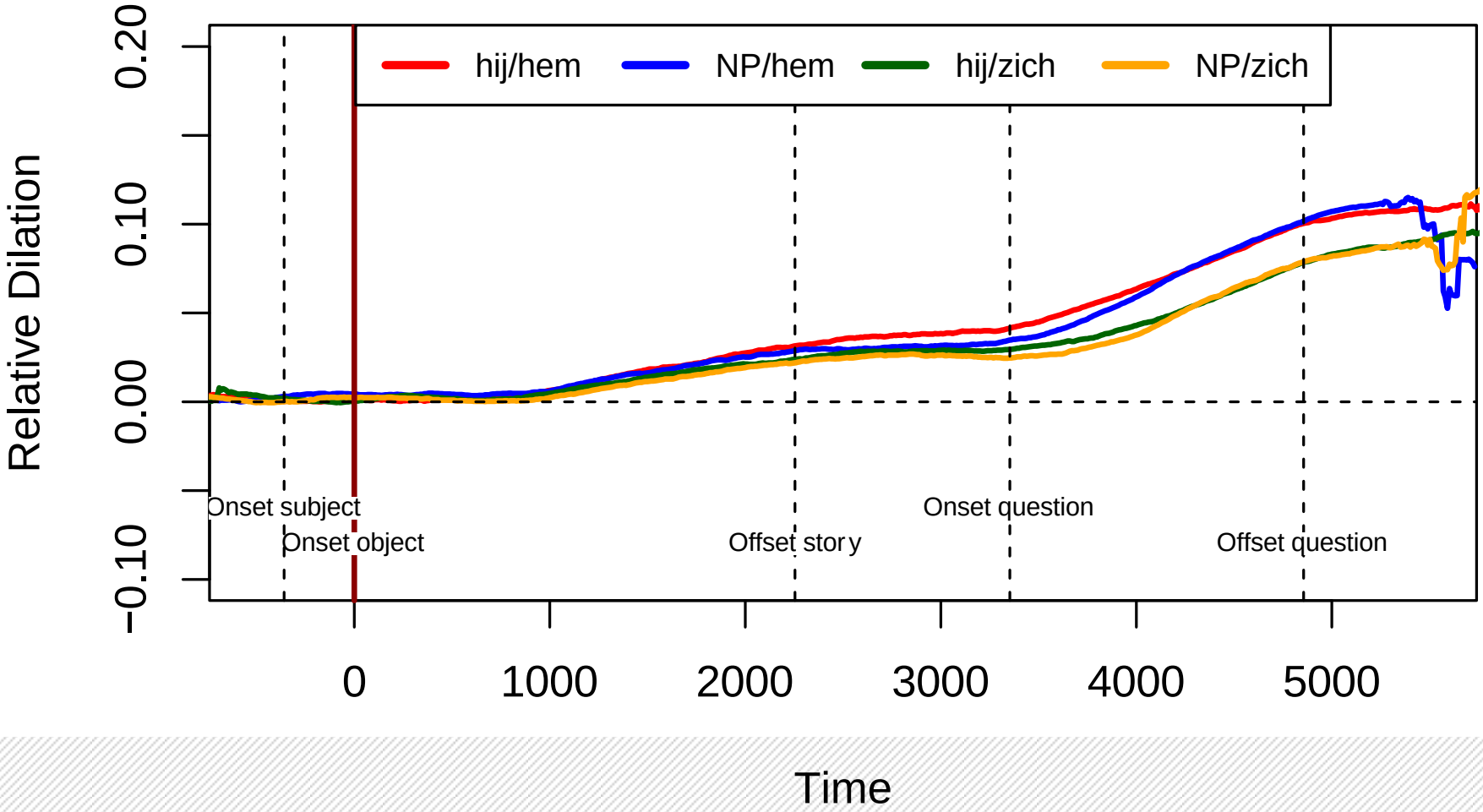
Testing the subject and object conditions at specific time points with an lmer:

At time after onset object == 2500, no differences between conditions (t = 1.26 subject, t = 1.03 object)

At time after onset object == 4500: t = 0.20 subject, **t = 3.90*** object

-> 'hem' more difficult than 'zich'

Results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0.10
0.00
−0.10
Onset subject
Onset object
Offset story
Onset question
Offset question
0
1000
2000
3000
4000
5000
Time

Results

1000ms after the start of the question:

No difference between question types (t = 0.78)

Difference between objects (**t = 2.45**)

No difference between subjects (t = 0.28)

Results

	NP/hem	NP/zich	hij/hem	hij/zich
0	33	26	92	61
1	1167	1174	1108	1139

Accuracy:

- NP easier than 'hij' (**p < 0.001**)
- 'zich' easier than 'hem' when the question refers to the subject (**p = 0.002**)

RT:

- Questions referring to the subject are answered faster (**t = -3.49**)
- Questions with an NP are answered faster (**t = -4.24**)
- 'zich' faster than 'hem' when the question refers to the subject (**t = -2.00**)

Results

Summary so far:

1.A subject NP is easier to process than 'hij'

-> found in RT and ACC but not DIL

2. The object 'zich' is easier to process than 'hem'

-> partially found in RT, ACC and DIL

3. An object pronoun is more difficult to resolve when following a subject pronoun than when following a subject NP

-> GAMs

Results

Generalized additive models (GAMs)

- the story examined over time

- linear predictor is specified in terms of a sum of non-parametric smooth functions of predictor variables

- Overfitting prevented by penalties on smoothing

- Can be used on eye-tracking data, EEG, fMRI

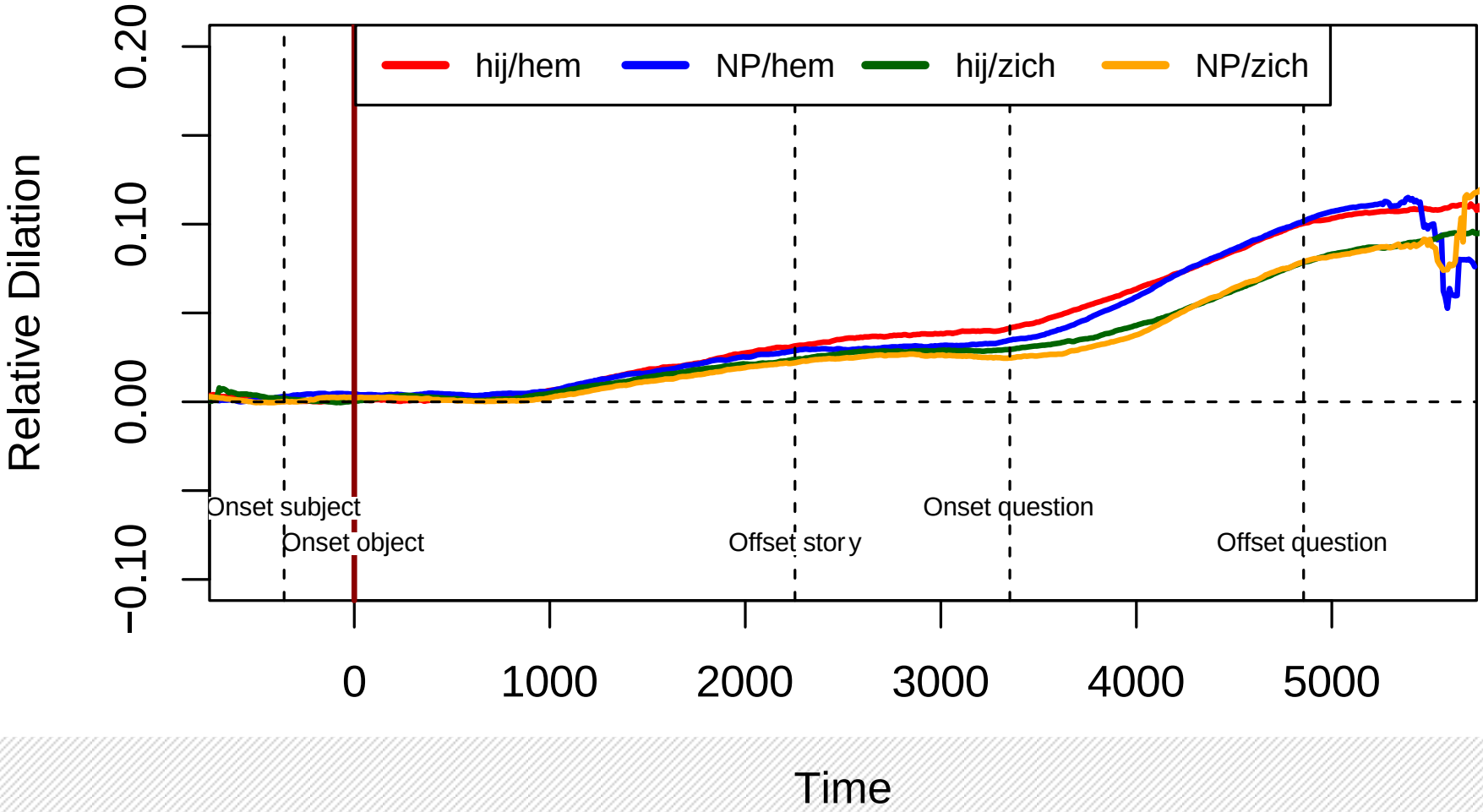
1 filter out the trend

2 fit the residuals for each condition

3 compare different models

Wood, S. N. (2006). *Generalized Additive Models: An Introduction with R*. Chapman & Hall/CRC. ISBN 978-1-58488-474-3

Results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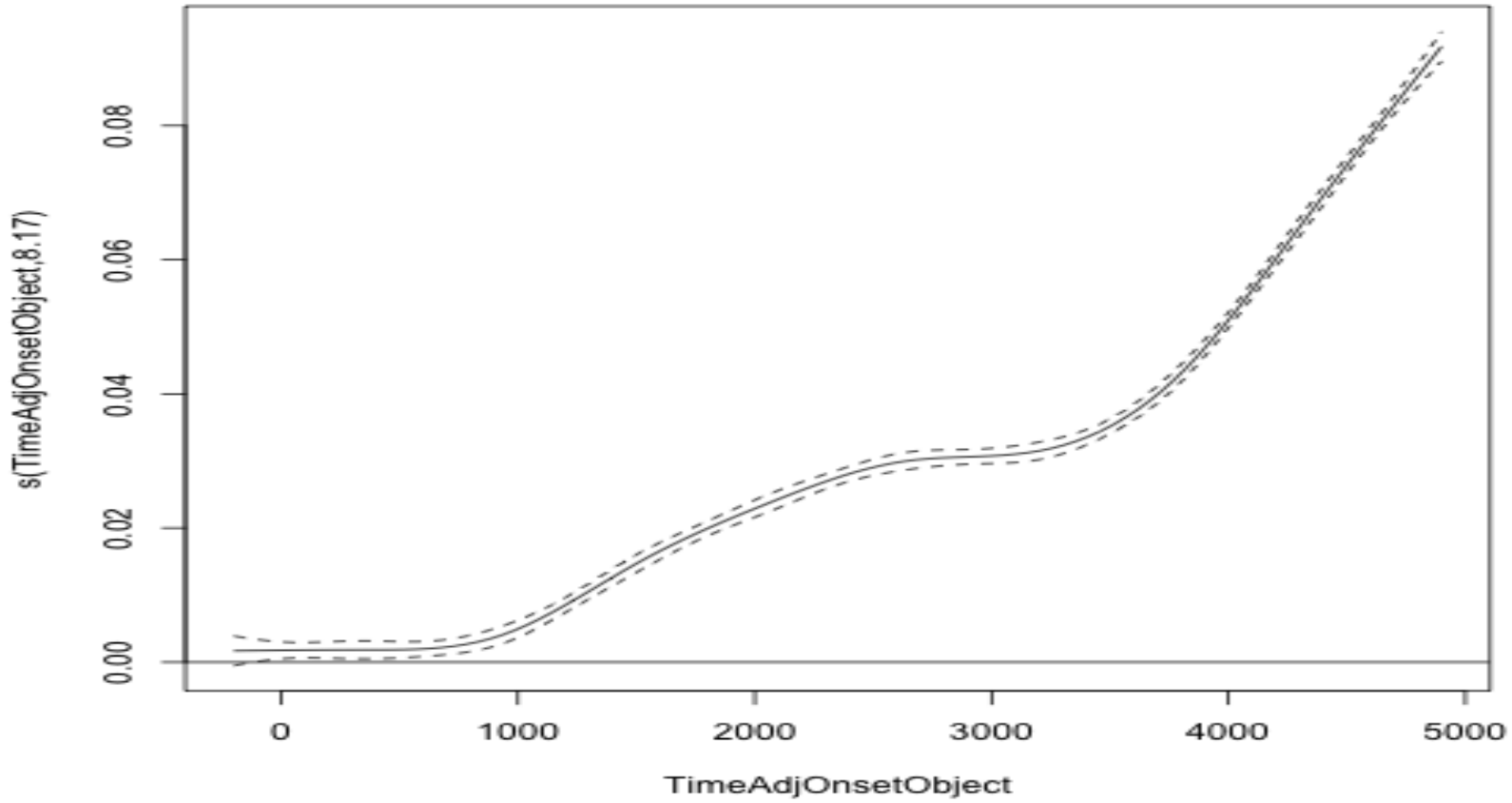
Results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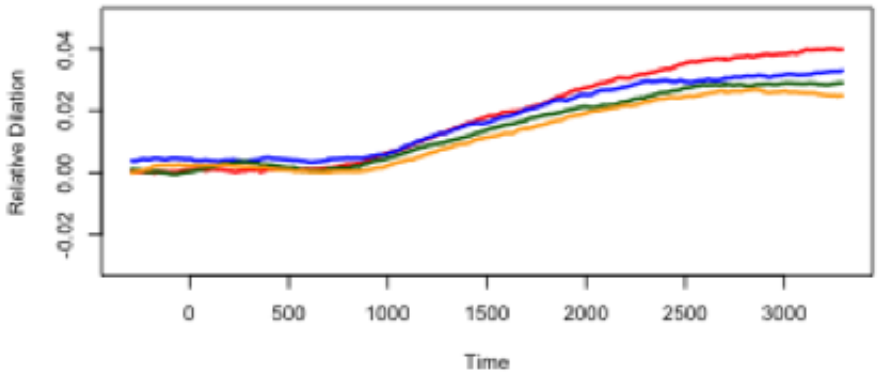
TimeAdjOnsetObject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0.00
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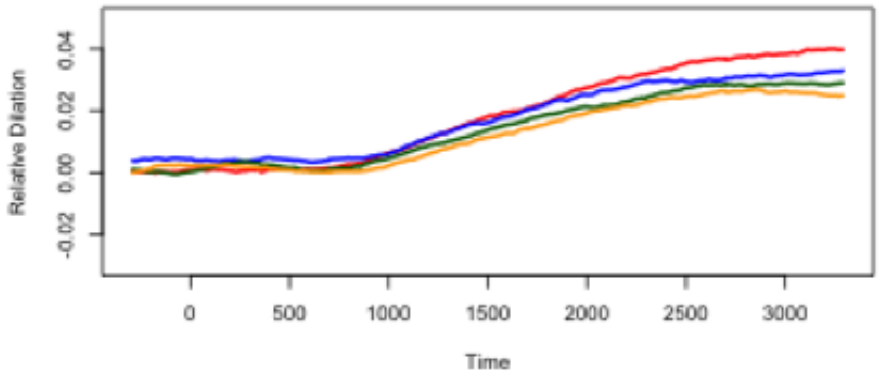
Time


Relative Dilation
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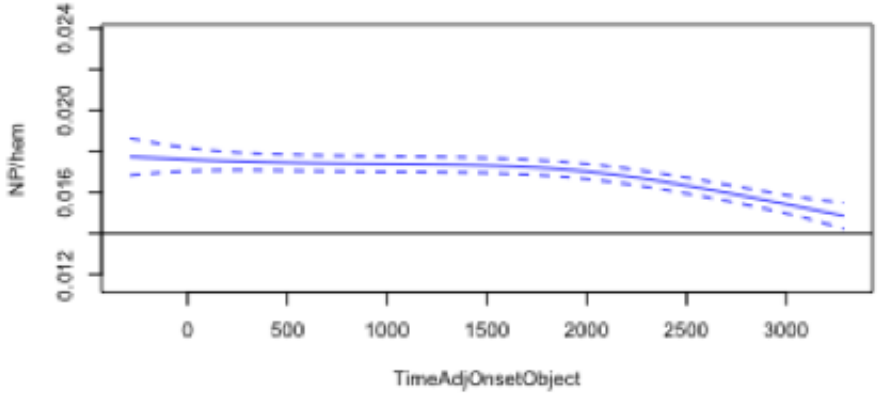
Time


NP/hem
0.012
0.016
0.020
0.024
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500
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2000
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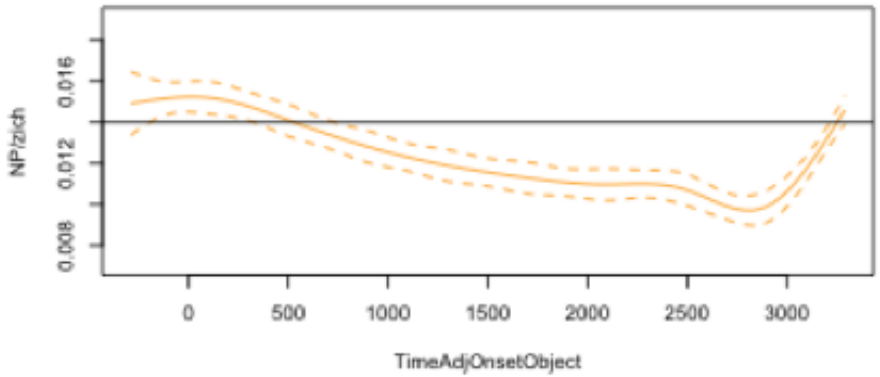
TimeAdjOnsetObject


NP/zich
0.008
0.012
0.016
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500
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2000
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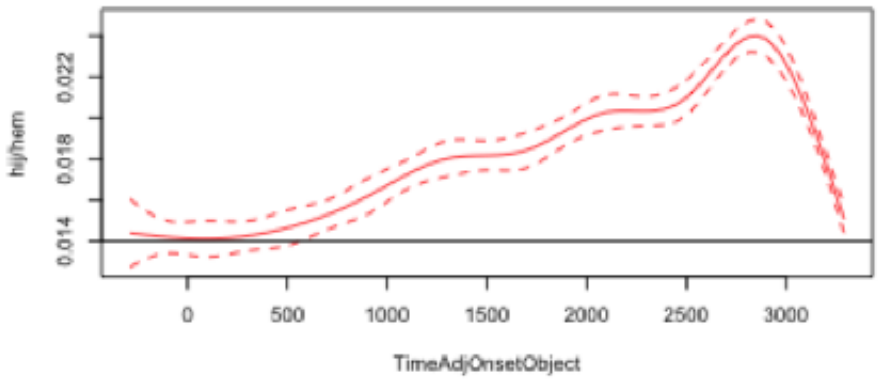
3000
TimeAdjOnsetObject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0.014
0.018
0.022
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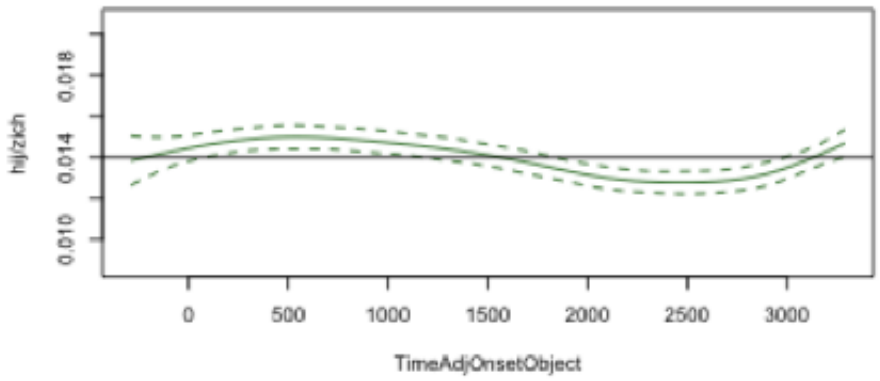
TimeAdjOnsetObject


hij/zich
0.010
0.014
0.018
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500
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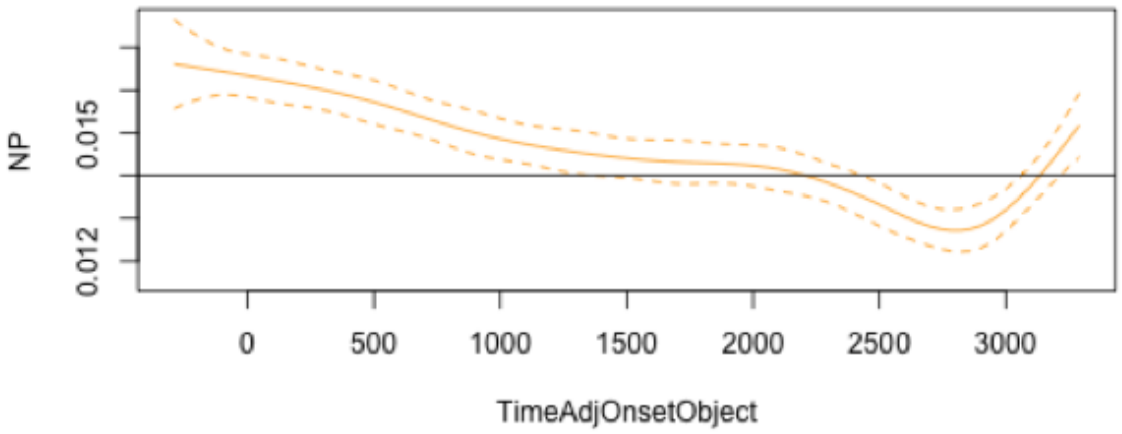
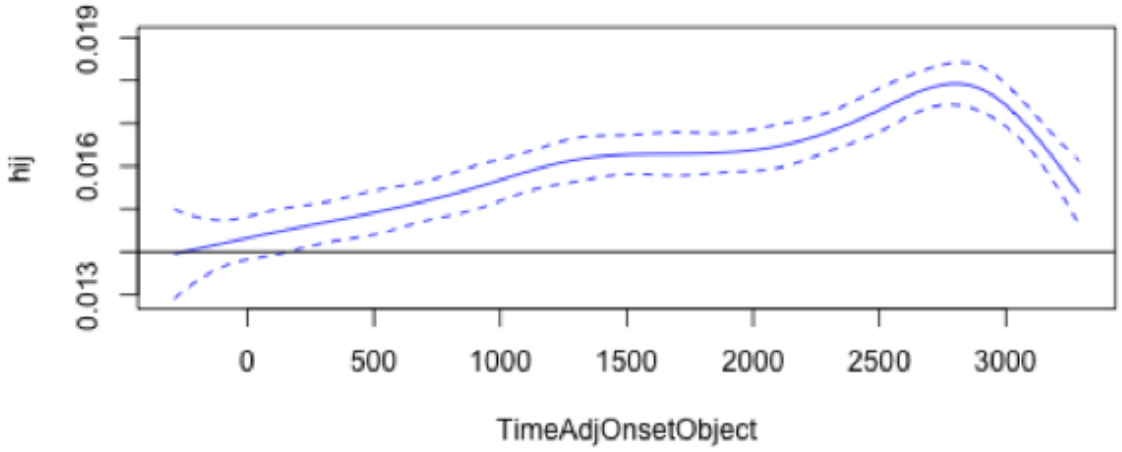
TimeAdjOnsetObject

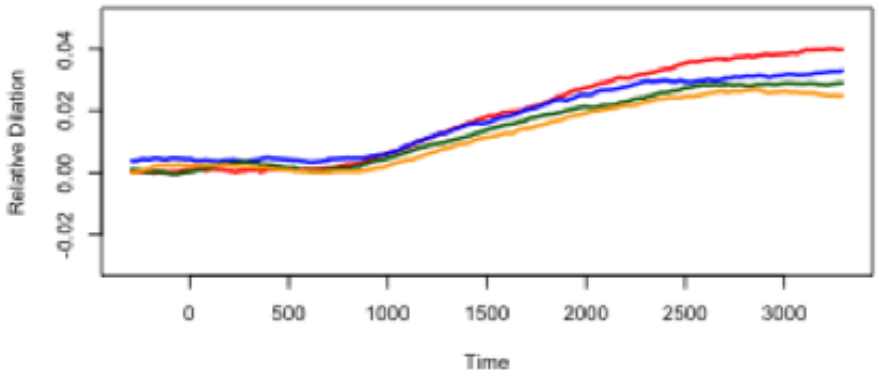
Results

Anova:
Full model vs. model **without** the the object condition





Full model is better ($p < 0.001$)


Relative Dilation
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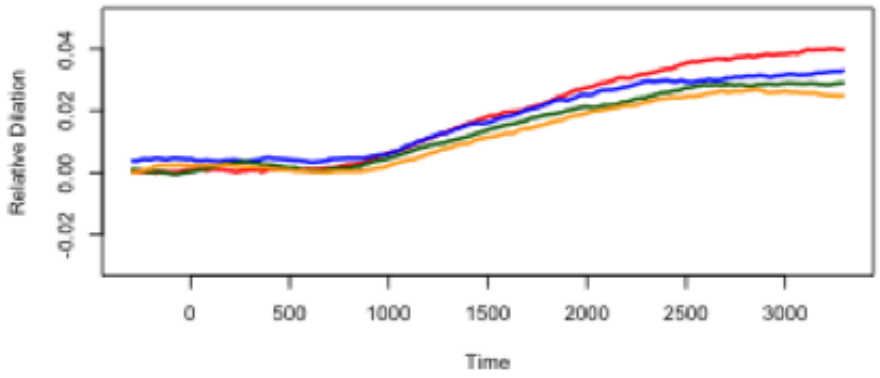
Time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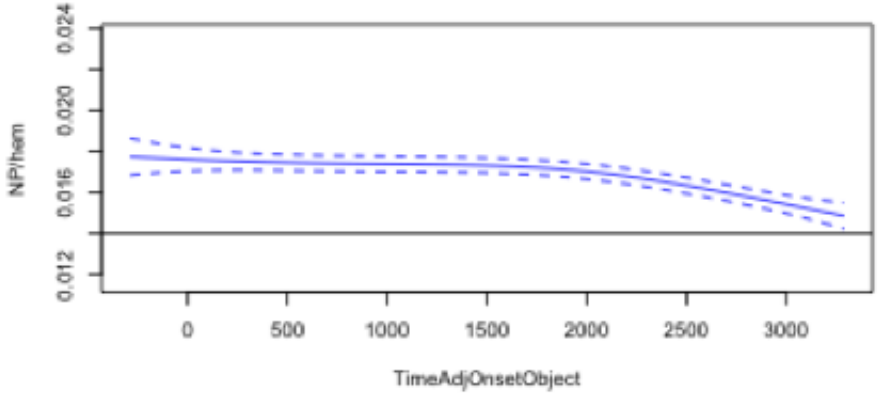
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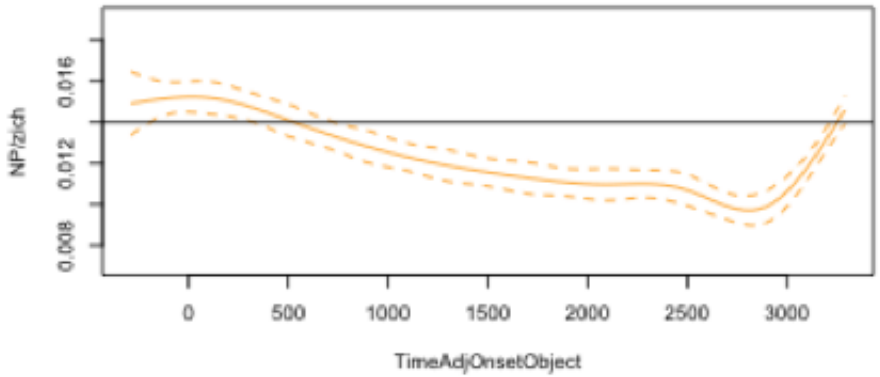
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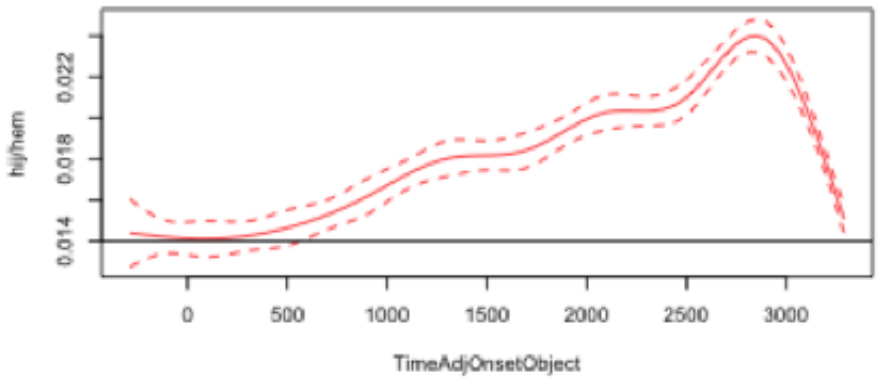
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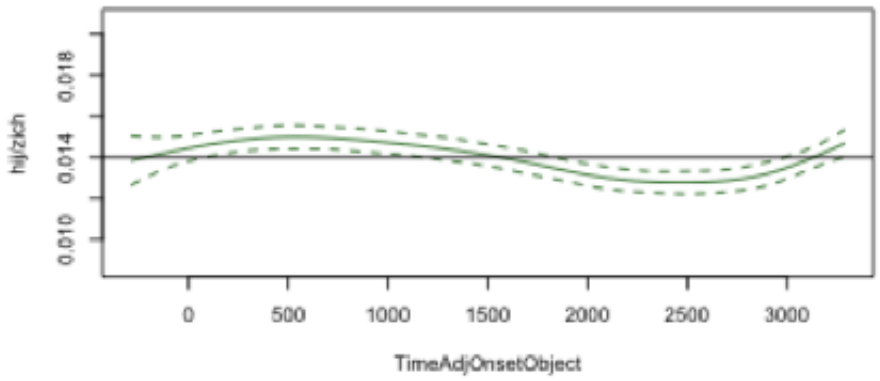
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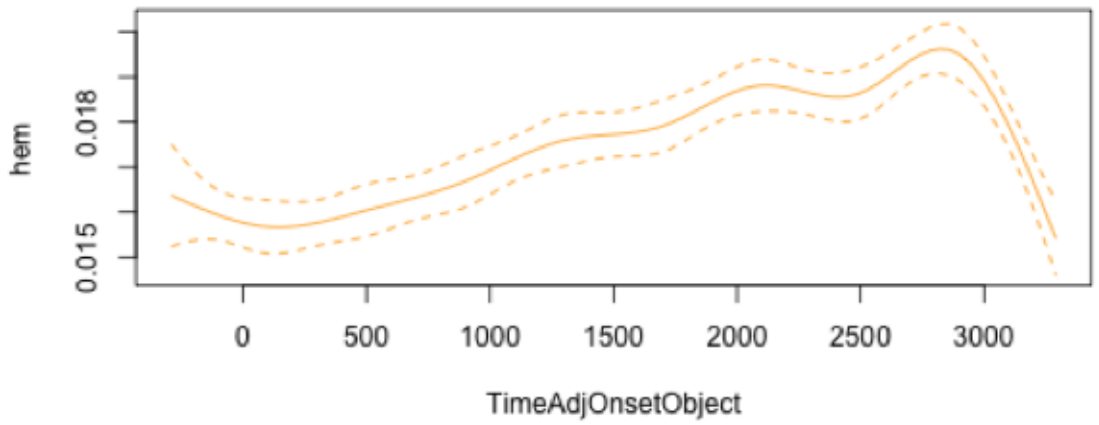

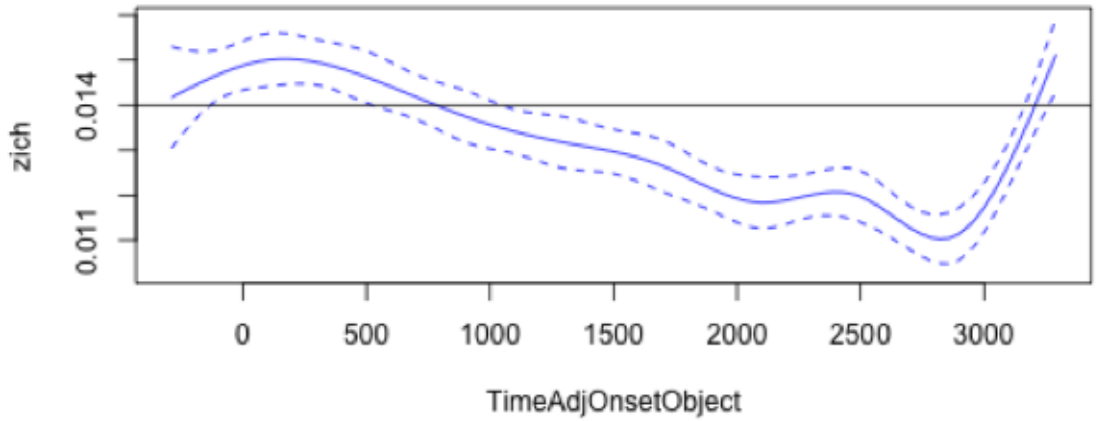

Full model is better
(p < 0.001)

Results

Interactions between all conditions found (**p = 0.01**), so the results were **not just additive**.

This is important to be able to say something about the influence of one condition on the other.

Results summary

1. A subject NP is easier to process than 'hij'
   -> found in RT, ACC and GAMs, but not DIL

2. The object 'zich' is easier to process than 'hem'
   -> partially found in RT, ACC and DIL, found in GAMs

3. An object pronoun is more difficult to resolve when following a subject pronoun than when following a subject NP
   -> interaction found in GAMs

Conclusions

More ambiguous/free pronouns are more diffucult to process (‘hem’ vs. ‘zich’, ‘hij’ vs. NP)

Ambiguity of the subject influences processing of the object