

Interfaces between morphology and phonology in the acquisition of a second language

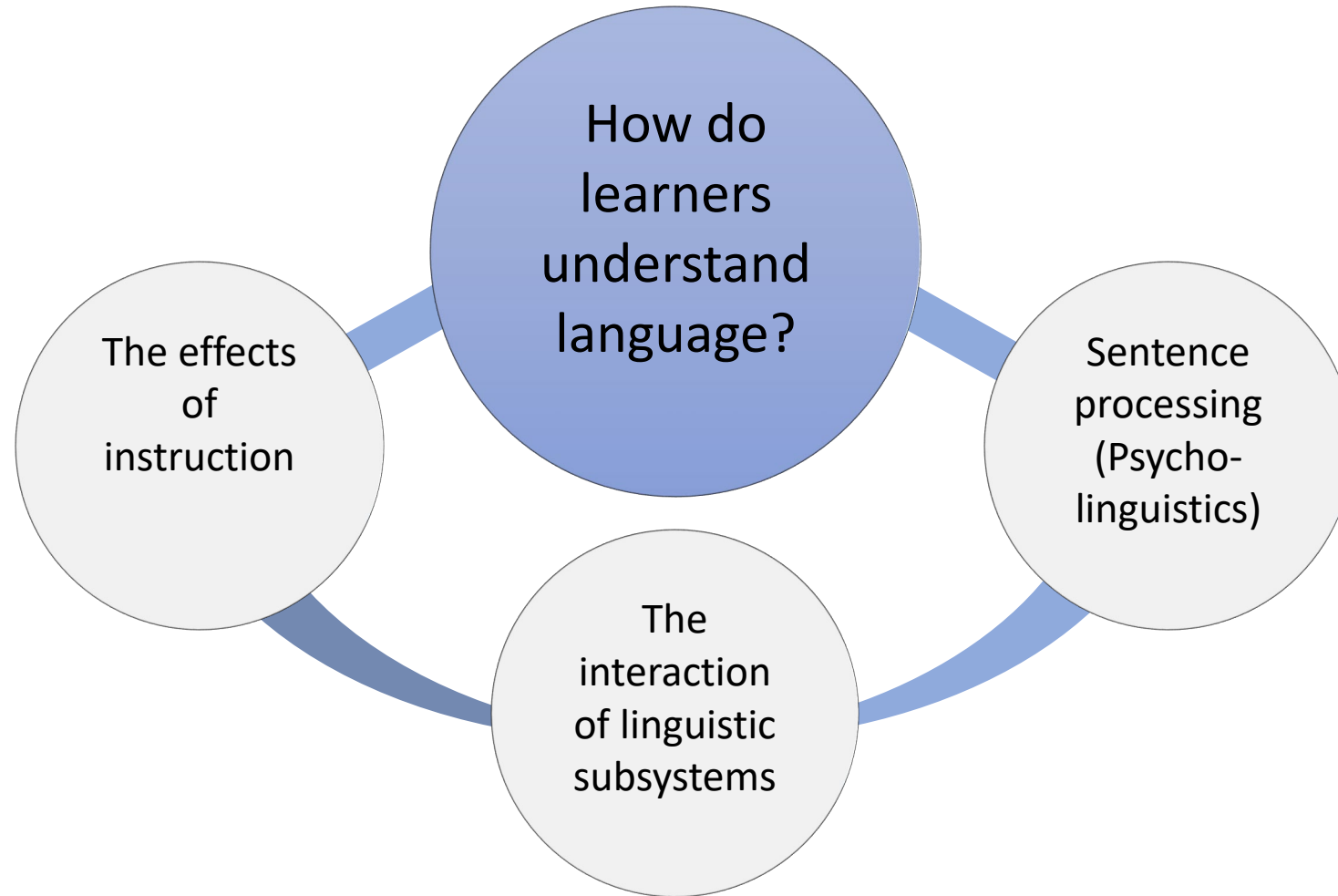
Mind and Memory in Germanic Studies
University of Wisconsin, Madison
February 26, 2022
Nick Henry, Ph.D.



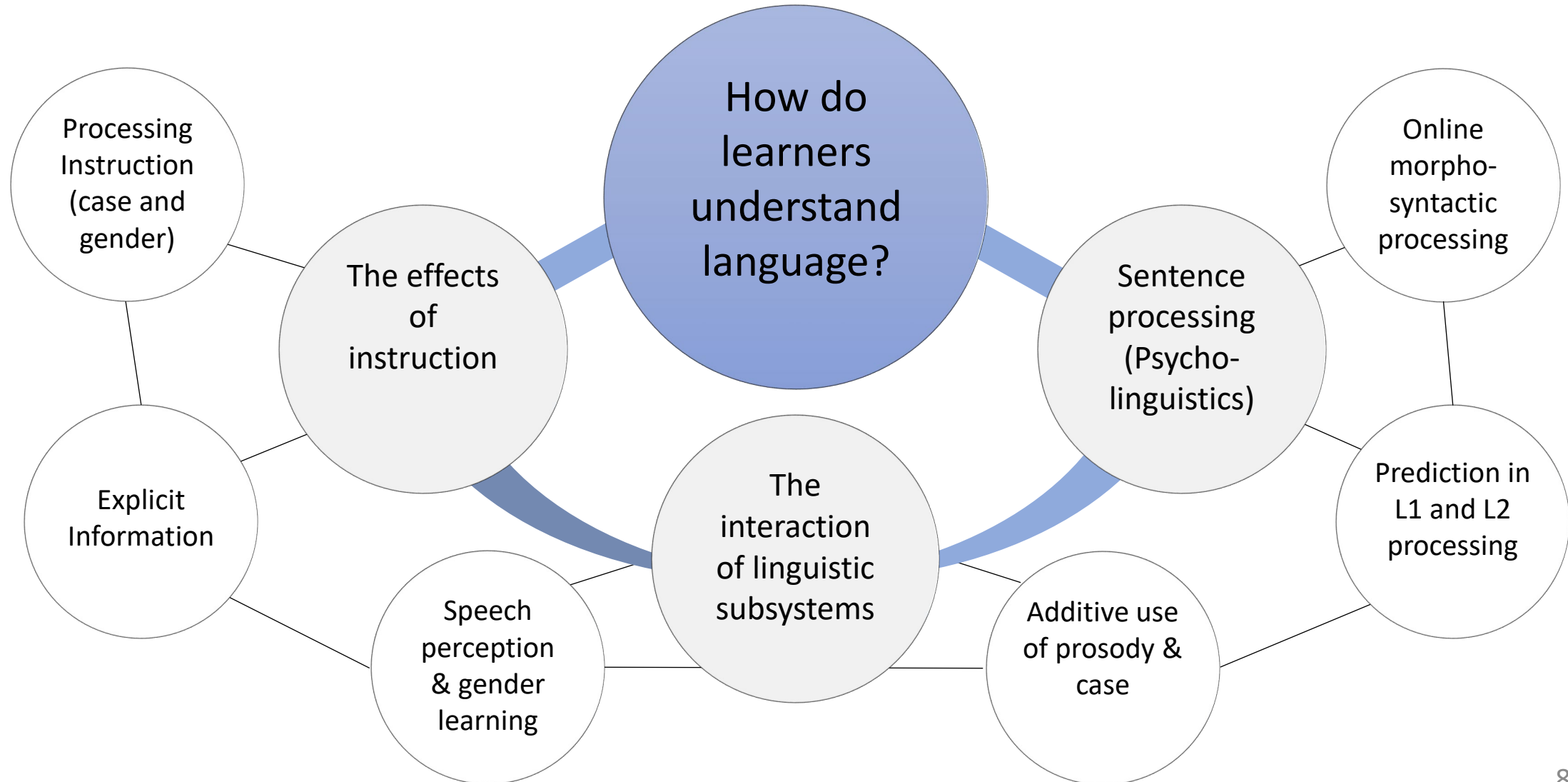
The SLAB Lab at UT

How do
learners
understand
language?

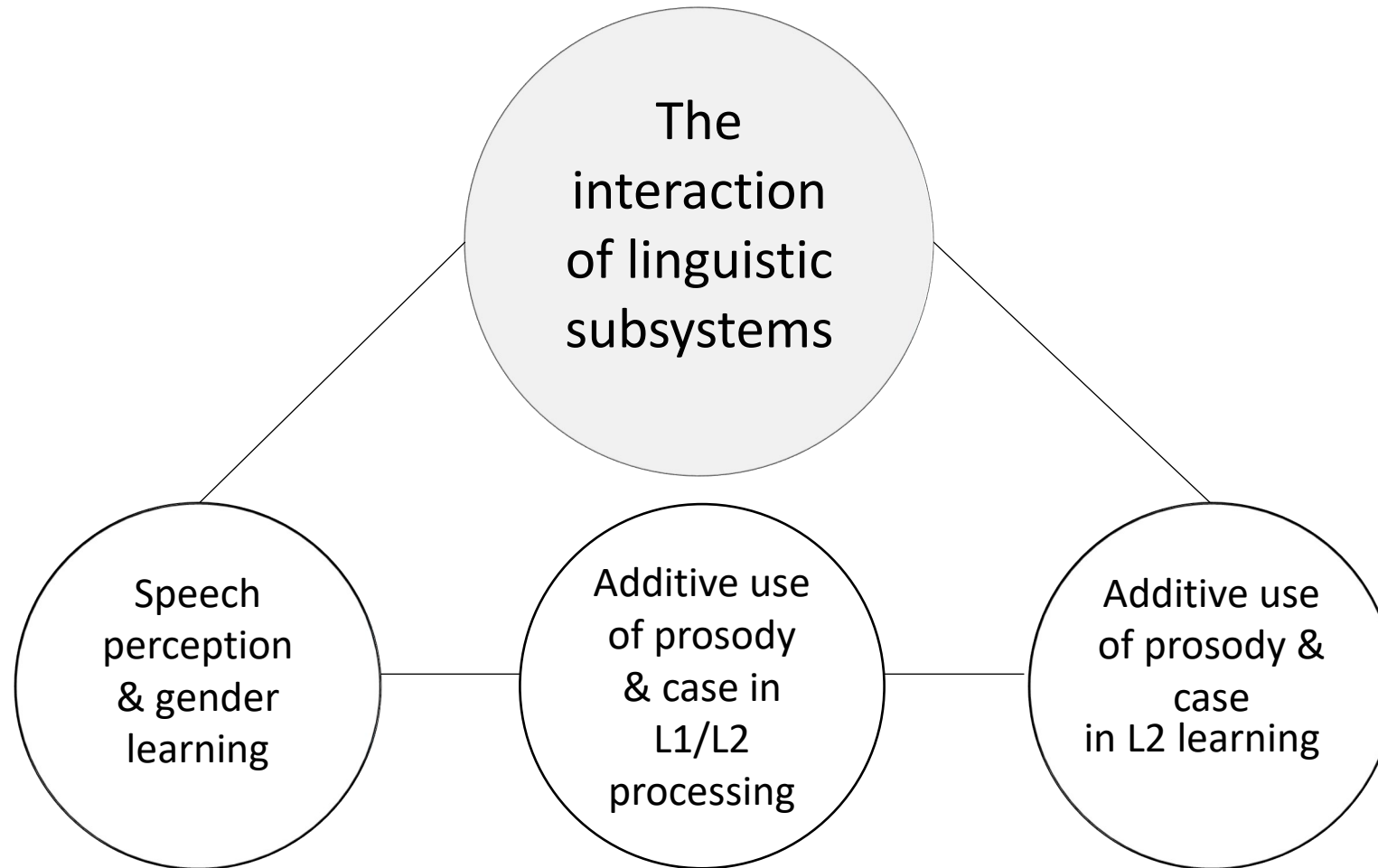
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The focus of today's talk



Input Processing in L2 research

- As a subfield of L2 acquisition, research on input processing asks how learners comprehend individual elements of a sentence and what parts of a sentence learners use to make meaning (in real time).
- Consider this example:

John devoured the whole cake yesterday at his party.

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[+past] [+past]

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- Consider this example:

John devoured the whole cake yesterday at his party.
[+anim] [+past] [-anim] [+past]
[+pre] [+post]

Processing in acquisition

- From a psycholinguistic perspective, the language system must contain a complex and detailed system of linguistic cues along with their meanings and information about how to process these cues in context.
- In order to acquire a language, learners must be able to:
 1. Perceive and identify relevant (morphological) cues in the speech stream.
 2. Link those cues to their associated meanings.
- Phonology is implicated in both of these processes.

A note on theory:

- “It does not matter how you see grammatical functors as operating in acquisition or processing” or what theory / framework you work from. “In all cases, the functors have to be perceived as cues before they can partake in acquisition.” (Ellis, 2006)

The “Detectability Problem”

A role for phonology in detection and initial identification of L2 cues

The “Detectability Problem”

- The “detectability problem” relates to learners’ ability to use bottom-up information to perceive cues and identify them as relevant for a given task.

- Consider the sentence: “Every/last Sunday they talk-∅/ed to John”



- “Fluent language processors can perceive [grammatical] elements in continuous speech because their language knowledge provides top-down support. But this is exactly the knowledge that learners lack.” (Ellis, 2006)

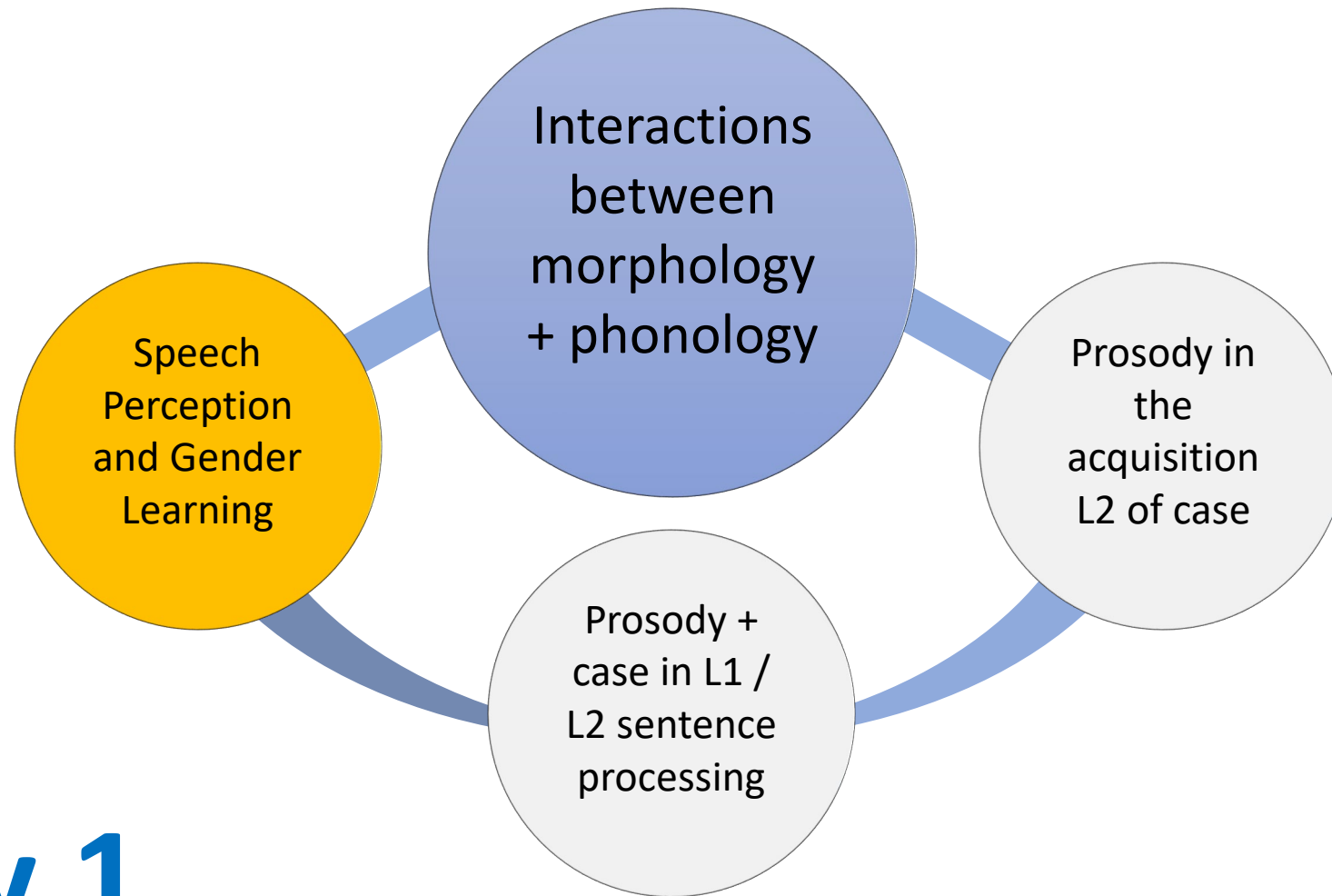
Saliency in SLA

- Saliency describes a characteristic or set of characteristics that influence how easy it is for learners to perceive, attend to, or process a linguistic form.
- Saliency is influenced by:
 - physical characteristics of the input
 - properties of the learner's grammar
 - linguistic properties of the input
 - acquisitional processes and processing factors
 - context of the input
 - learner experiences
 - instruction

Physical Characteristics of the Input

Perceptual Salience

- Length and Syllabicity
 - Goldschneider & DeKeyser (2001)
 - Field (2008)
 - Behney, Spinner, Gass, Valmori (2017)
 - Simoens, Housen, & De Cuypere (2017)
 - DeKeyser, Alfi-Shabtay, Ravid & Shi (2017)
- Goldschneider & DeKeyser (2001) tested the degree to which perceptual salience could account for acquisition orders for L1 English that are widely reported in the literature (e.g., -ing > 3rd person -s).
 - PS = a combined score of: the number of phones, 1/0 syllabicity, a sonority score
 - Findings: perceptual salience explained about 40% of the variance in acquisition order.
- But these studies all view perceptual salience as static / inherent to functors. They do not consider how L1 background and knowledge of L2 phonology affects salience.



Study 1

Phonological awareness, salience, and the acquisition of grammatical gender in German

Motivation

- Research on salience has concentrated on physical characteristics of the input, but it has discounted the role of learners' phonological knowledge.
- The present study investigates how the interaction between the physical properties of the input and learners' ability to perceive the input accurately affects the processing and acquisition of grammatical gender in German.

Background – Grammatical Gender in German

- The distinction between masculine and feminine gender marking on demonstratives and adjective endings rests on the distinction between two central vowels: [ə] and [e].
 - Demonstratives: (m) dies**er**, (f) diese**e**, (n) diese**s**
 - Adjective Endings: (m) schön**er**, (f) schön**e**, (n) schön**es**
- Gender markings on dieser, diese, and dieses have facially similar salience along several dimensions:
 - All three are syllabic, phonemic, and appear as unstressed affixes.
 - But English does not differentiate [ə] and [e].
 - From the perspective of the L1 English learner of L2 German, the masculine and feminine are not perceptually distinct, which could lead to *inconsistent input*.
- Compare this to the gender-marked pronouns, er, sie, and es:
 - All three are syllabic, monomorphemic, and should be perceptually distinct.

Research Question

Is the acquisition of dieser, diese, and dieses delayed compared to er, sie, and es?

Methodology

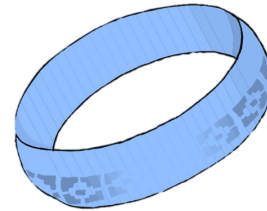
- Participants
 - 12 L1 English participants with no knowledge of German and minimal knowledge in another L2.
 - Two groups: Pronoun Group & DiesX Group
 - Only difference was the audio heard during training
- Grammatical Gender Training
 - Based on principles of Processing Instruction using a reduced set of German forms
 - Familiarization phase followed by 4 trainings
 - Focused on 24 clothing words and their genders (8x m/f/n)
 - Must show 100% accuracy before moving to the next training unit

Training

Pronoun Group



Anzug



Armband



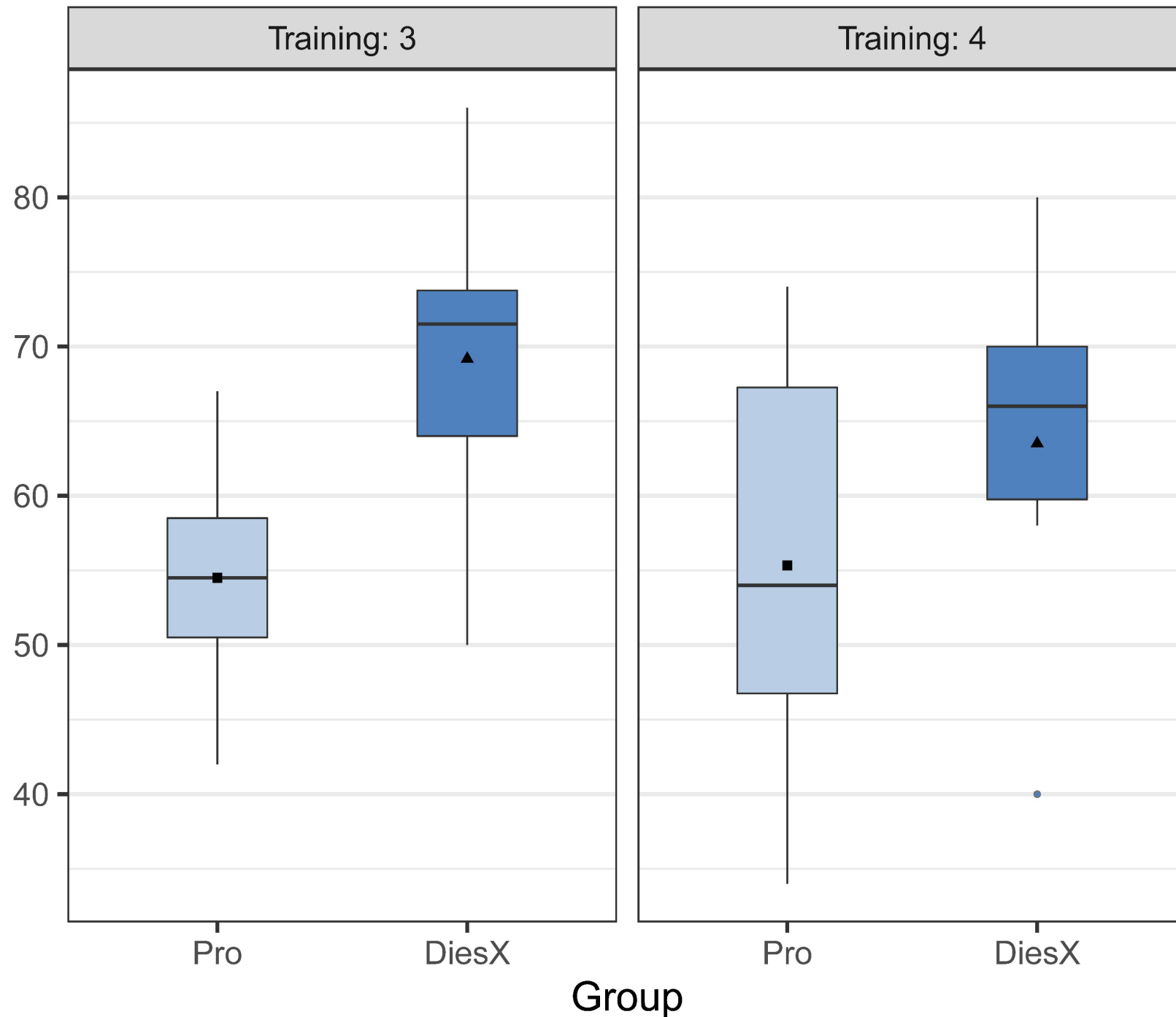
Handtasche

DiesX Group



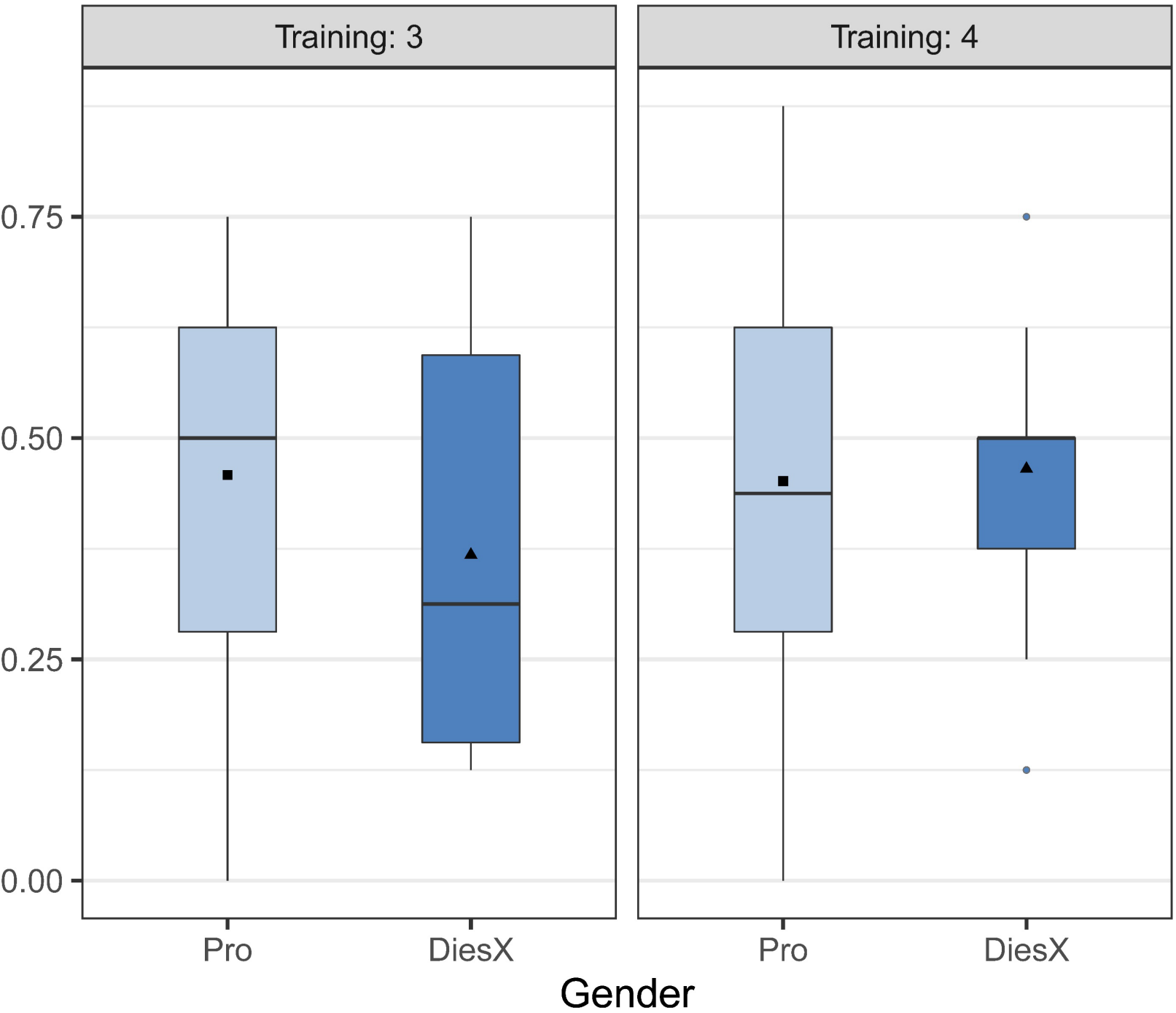
Assessment Measures

- Trials to 100% accuracy
 - Total number of trials seen in 3rd and 4th Training Units
 - i.e., Total number of correct and incorrect responses, with repeats
- Accuracy
 - Percent correct on first 24 trials in 3rd and 4th Training Units
 - No repeated items



**Trials to 100%
accuracy
(Trainings 3 & 4)**

Accuracy on first 24 items (Trainings 3 & 4)



Summary

- The Pronoun group is overall more accurate than the DiesX group and requires fewer trials to complete training with 100% accuracy.
- The data is far from conclusive because of overall small participant numbers, but the data trend towards confirmation of the research question.

Discussion

- While perceptual salience is important because it influences attention and the ability to attend to certain forms (Gass, Spinner & Behney, 2017), it is equally important that learners be able to *distinguish* a form from other similar forms.
- Research should consider the degree to which forms are salient and detectable *to the learner*, not *in the abstract*.

Linking Form and Meaning

How phonology (prosody) helps learners link morphological forms to meaning

Coalitions as Prototypes

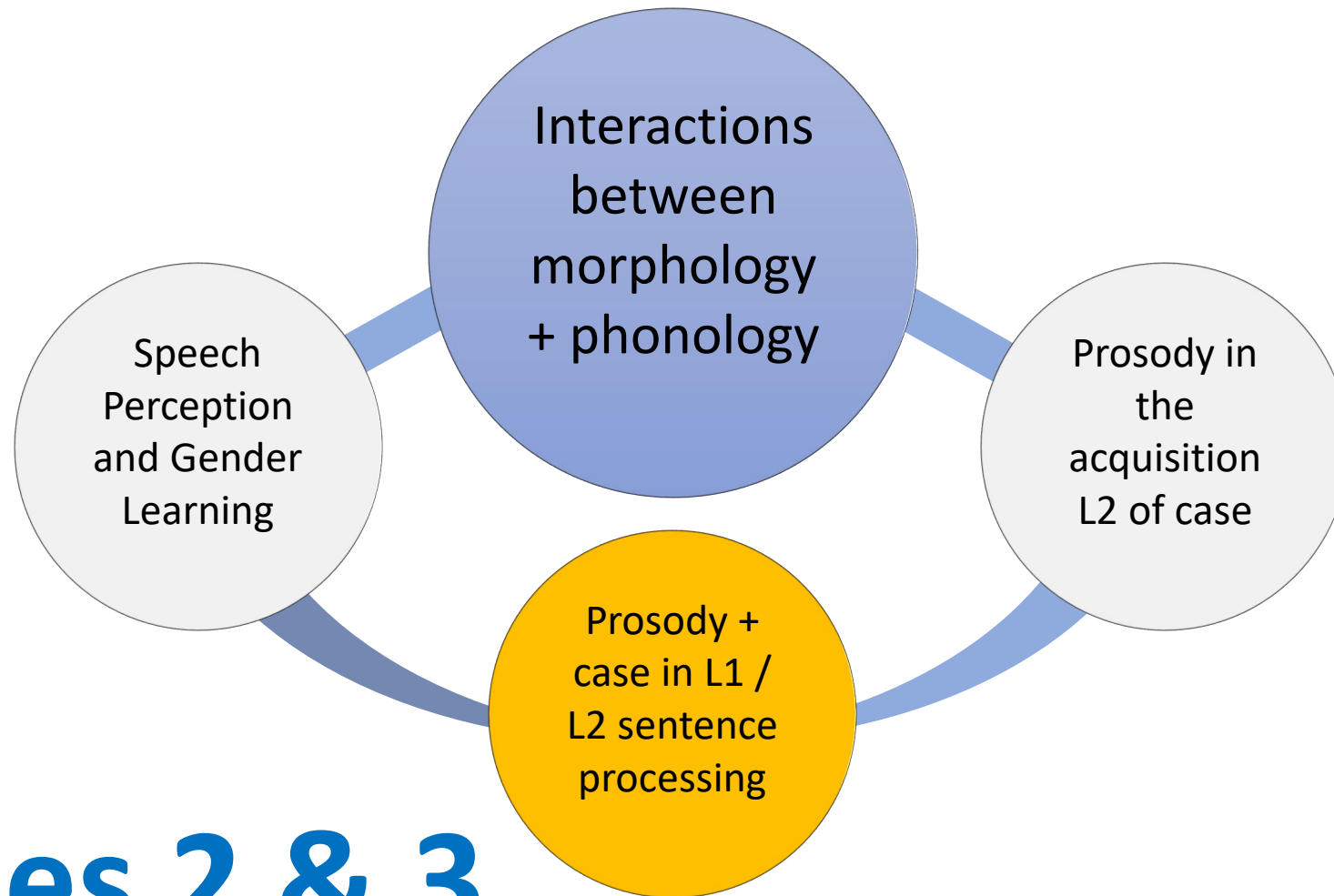
- The coalitions as prototypes approach (Bates & MacWhinney, 1989) describes a sort of 'bootstrapping' whereby learners can use one cue to process another cue that commonly co-occurs with it and link it to its meaning.

John ate the whole cake yesterday at his party.
[+anim] [-anim]
[+pre] [+post]

- As support for this approach: Grünloh et al., (2011) demonstrated that German children were better able to identify thematic roles earlier if prosodic cues were available, but they had difficulty interpreting sentences based on case cues alone.

Coalitions & Additivity

- Research suggests that *cue coalitions*, i.e., the joint presence of multiple cues pointing towards the same structural analysis of a sentence facilitates sentence processing (e.g., Hale, 2001; Levy, 2008).
- That is, language users could gain an advantage by processing prosodic cues and morphological cues ***additively***.



Studies 2 & 3

Additive processing of case and prosody in L1 and L2 German

Henry, Hopp, & Jackson, 2017

- Focus on the first research question:
 - Does the comprehension system use multiple cues additively in generating predictions, i.e., do additive cues improve processing speed and confidence?
- In order to test this, we focused on L1 speakers of German and whether they process case cues (morphology) and prosodic cues (phonology) additively during sentence processing.
 - Specifically, we used eye-tracking to test how they use case and / or prosody to predict upcoming nouns in a sentence.
 - Note: I'm only going to present one experiment from this study (Experiment 3, 16 L1 German speakers)

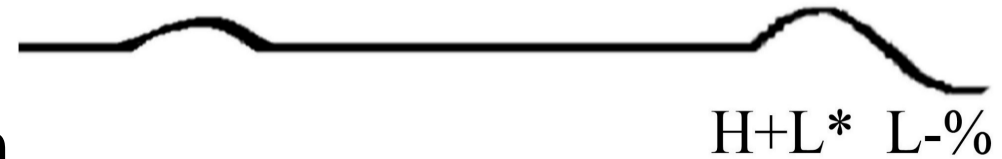
Case and Word Order in German

Subject First Sentences (SVO)

Der Wolf tötet gleich den Hirsch.

The wolf_{NOM} kills soon the deer_{ACC}.

“The wolf will soon kill the deer.”

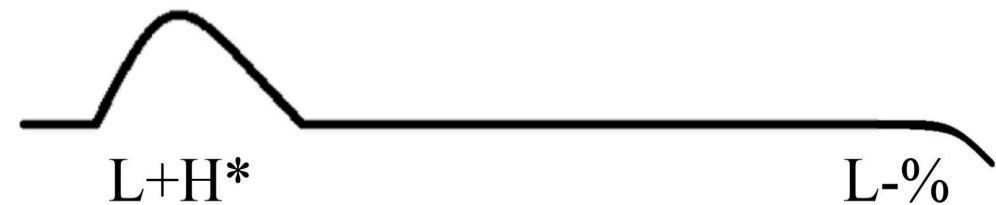


Object First Sentences (OVS)

Den Wolf tötet gleich der Jäger.

The wolf_{ACC} kills soon the hunter_{ACC}.

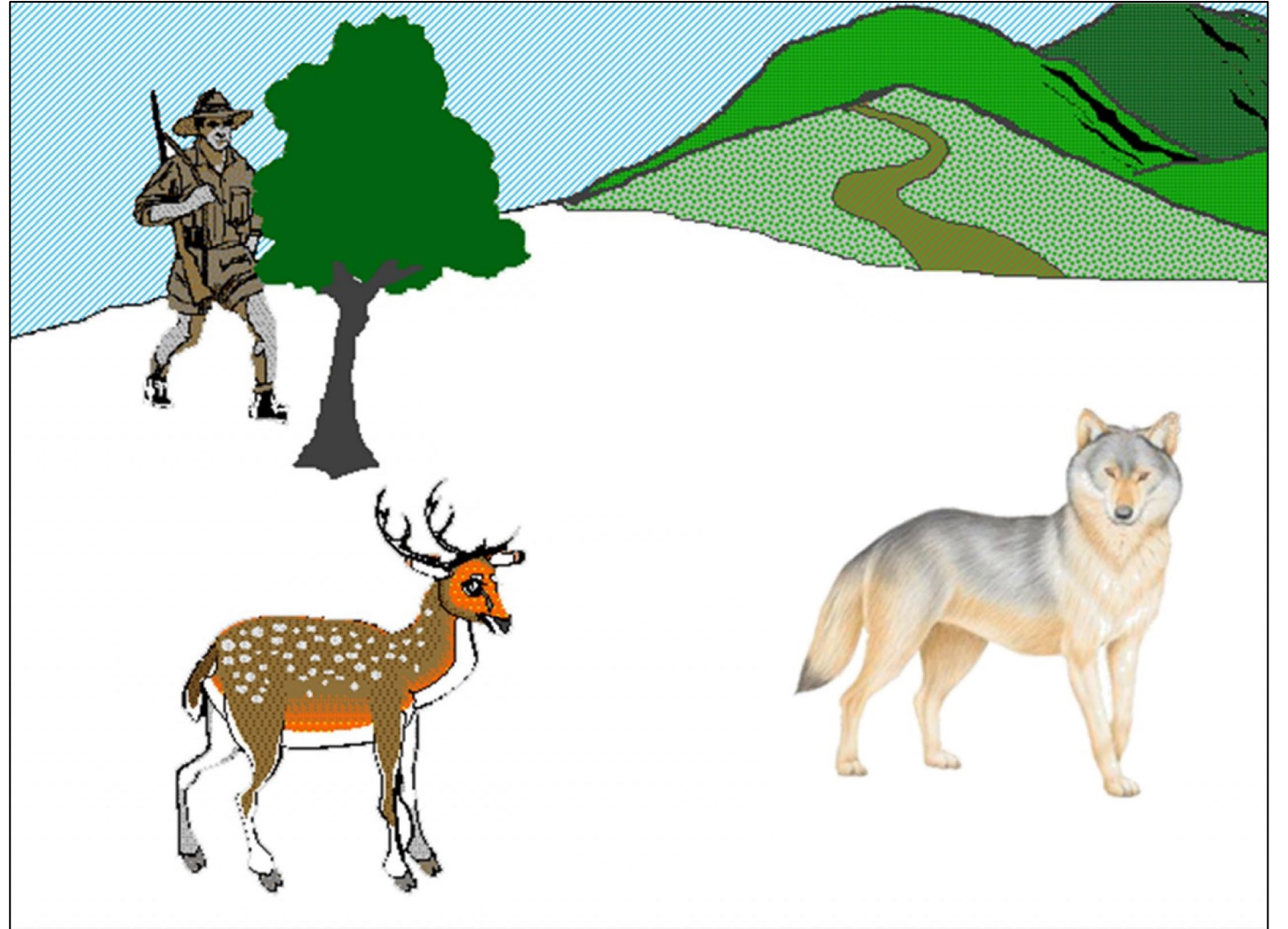
“The hunter will soon kill the wolf.”

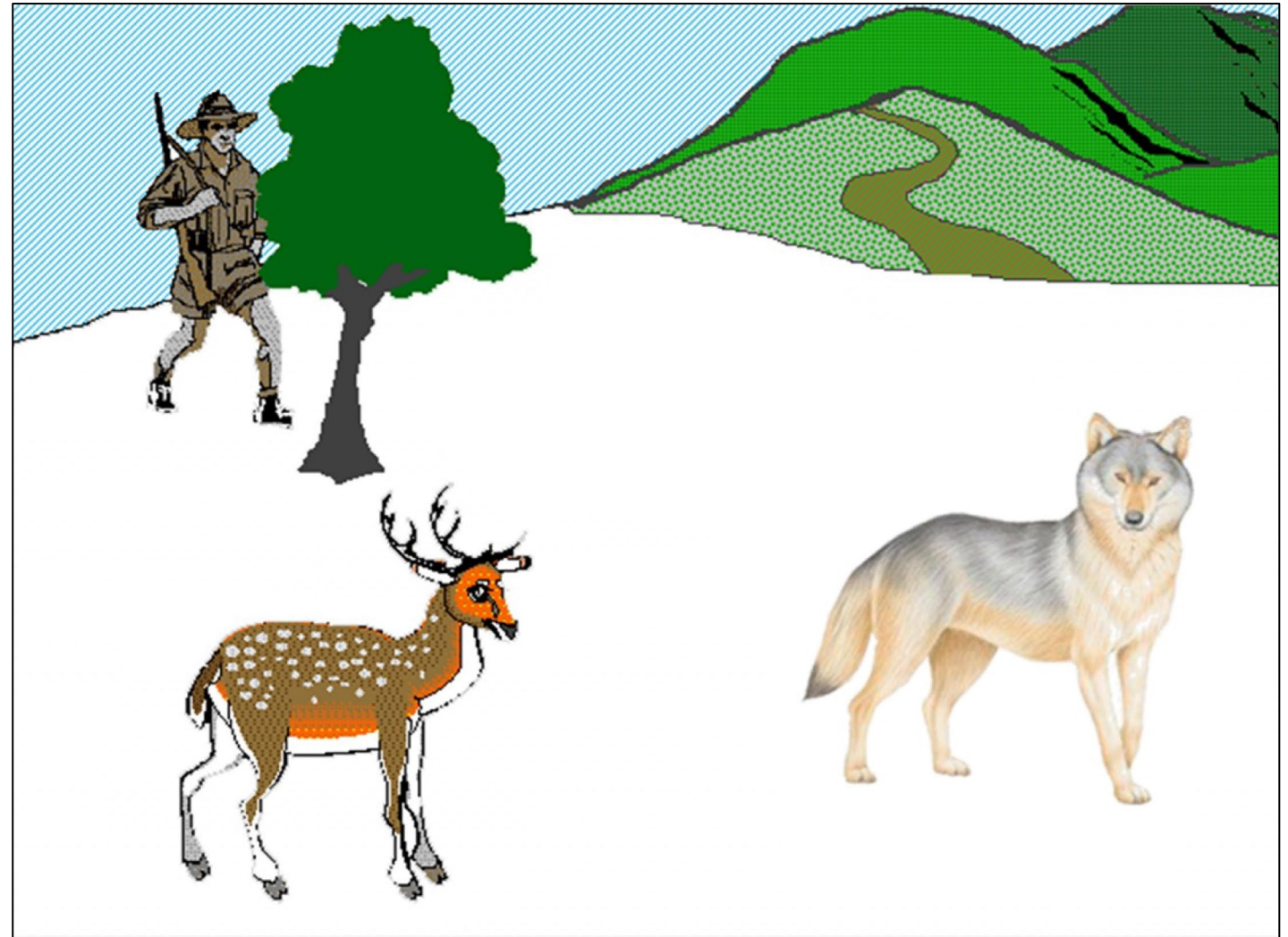


Eye – Tracking Experiment

Visual World Paradigm
(VWP)

32 SVO / OVS sentences
with visual world scenes



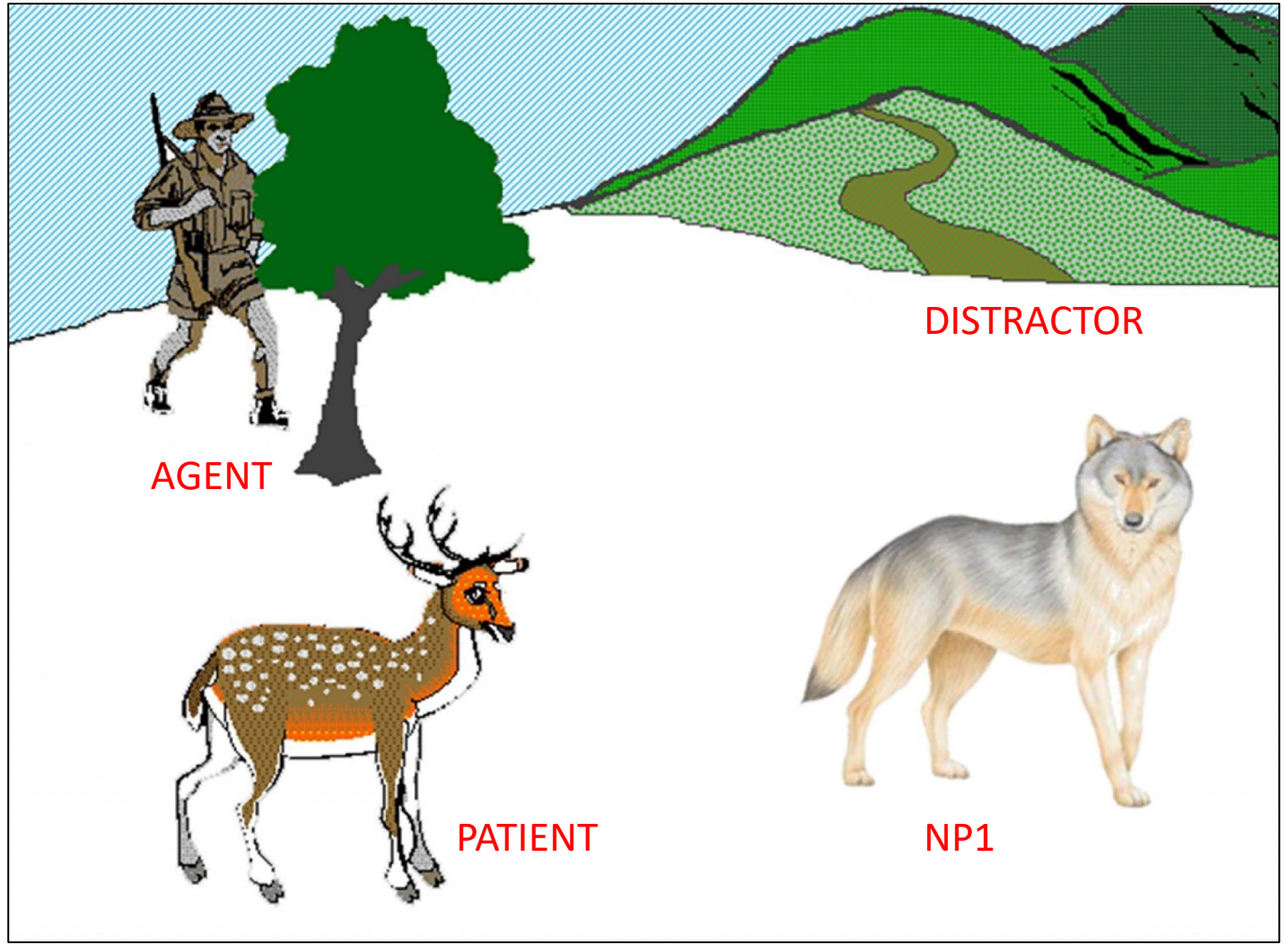


Subject First

Der Wolf tötet gleich den Hirsch.
The wolf_{NOM} kills soon the deer_{ACC}.
“The wolf will soon kill the deer.”

Object First

Den Wolf tötet gleich der Jäger.
The wolf_{ACC} kills soon the hunter_{ACC}.
“The hunter will soon kill the wolf.”

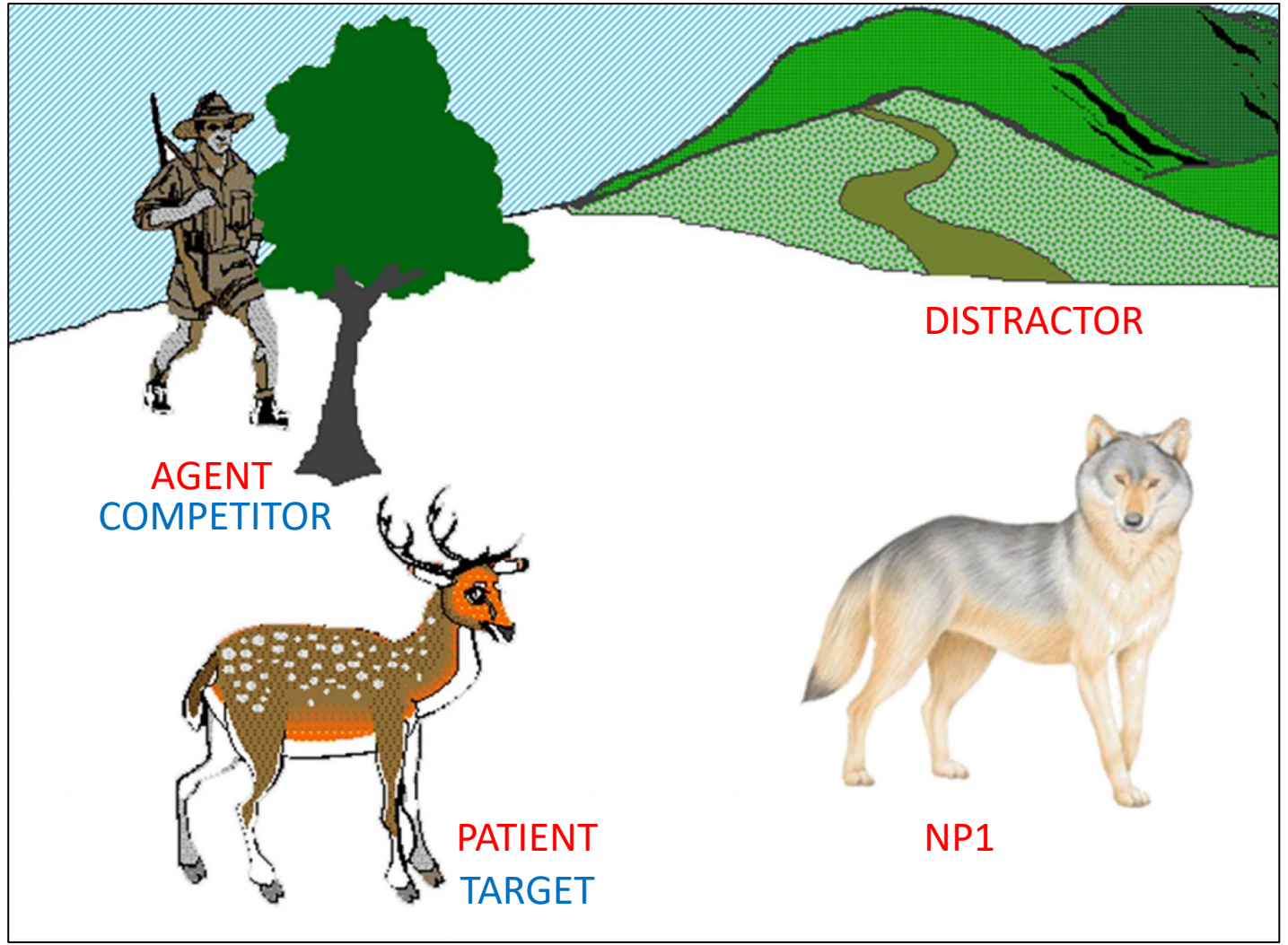


Subject First

Der Wolf tötet gleich den Hirsch.
The wolf_{NOM} kills soon the deer_{ACC}.
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Object First

Den Wolf tötet gleich der Jäger.
The wolf_{ACC} kills soon the hunter_{ACC}.
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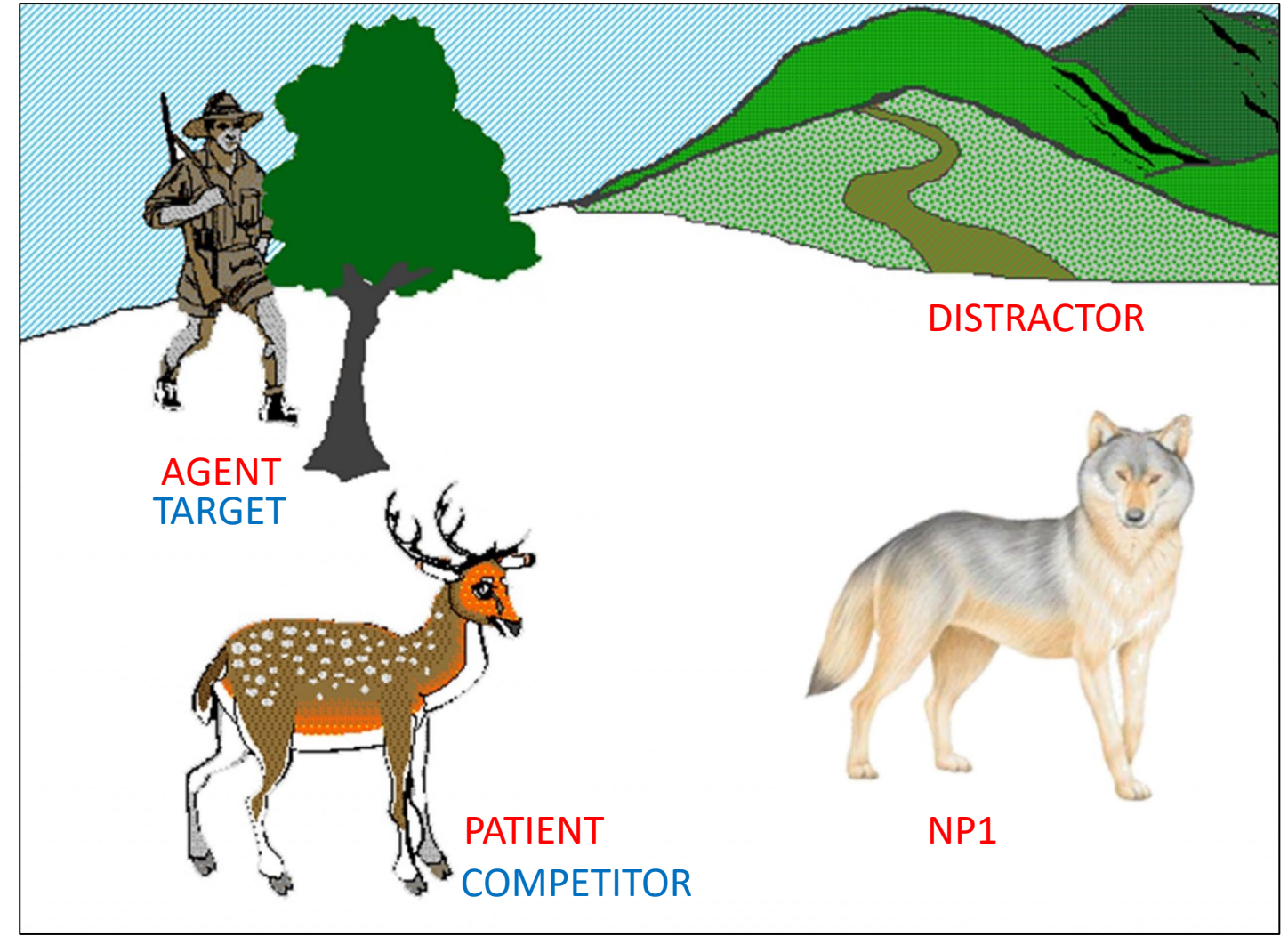


Subject First

Der Wolf tötet gleich den Hirsch.
The wolf_{NOM} kills soon the deer_{ACC}.
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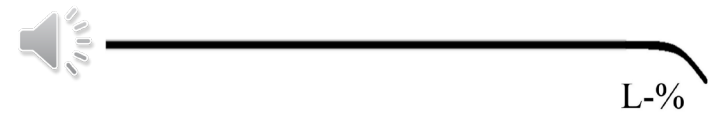
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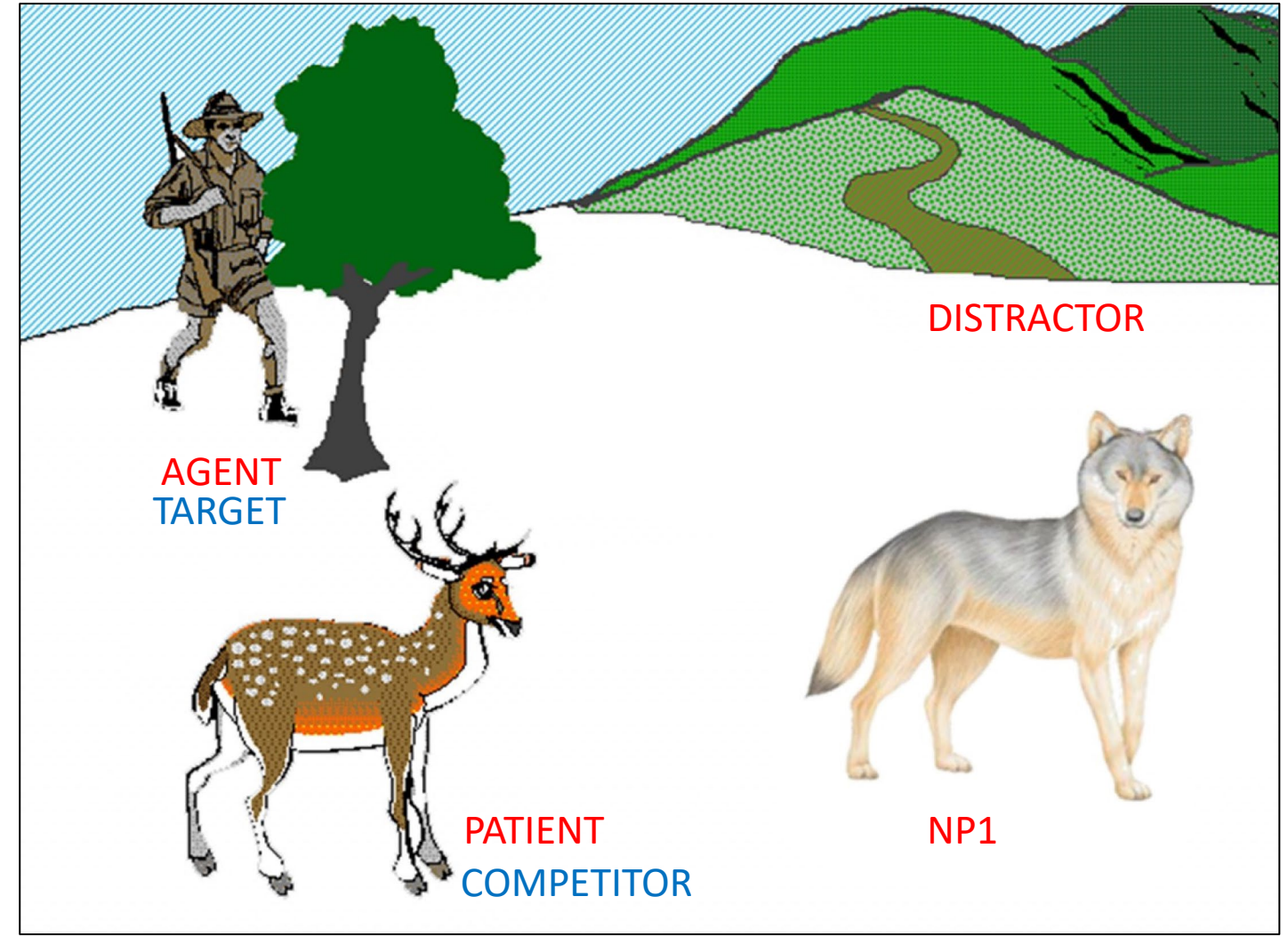
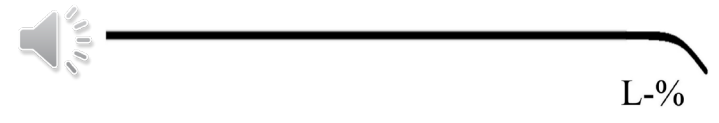
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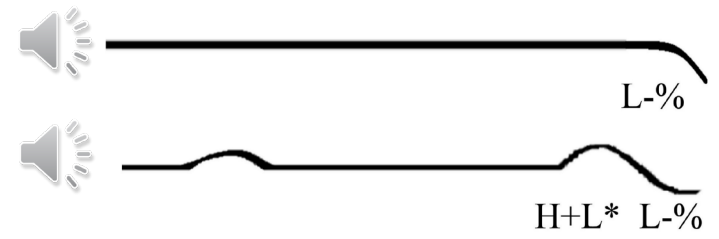
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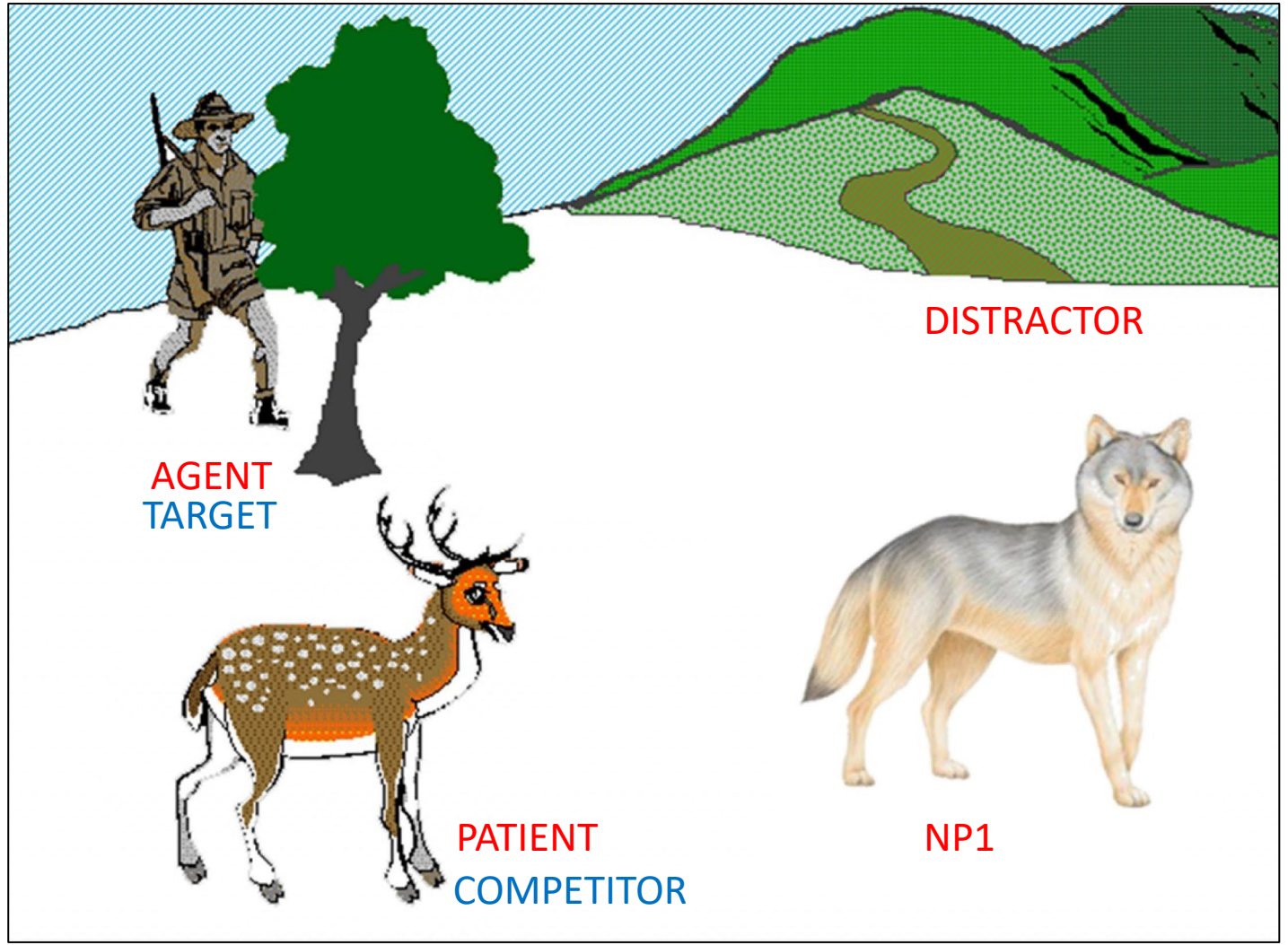
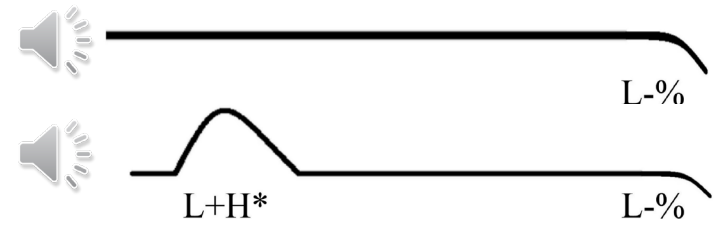
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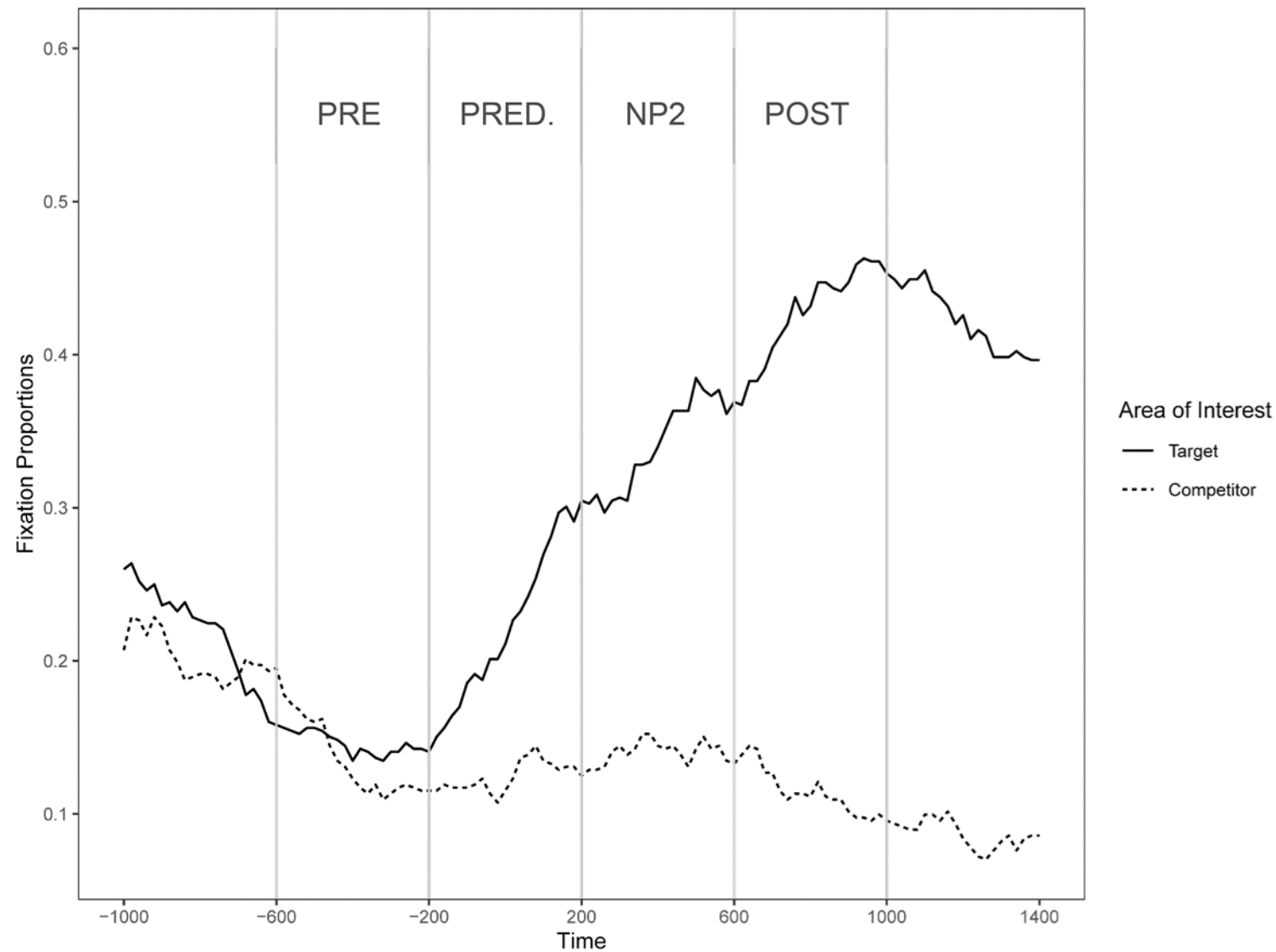


Object First

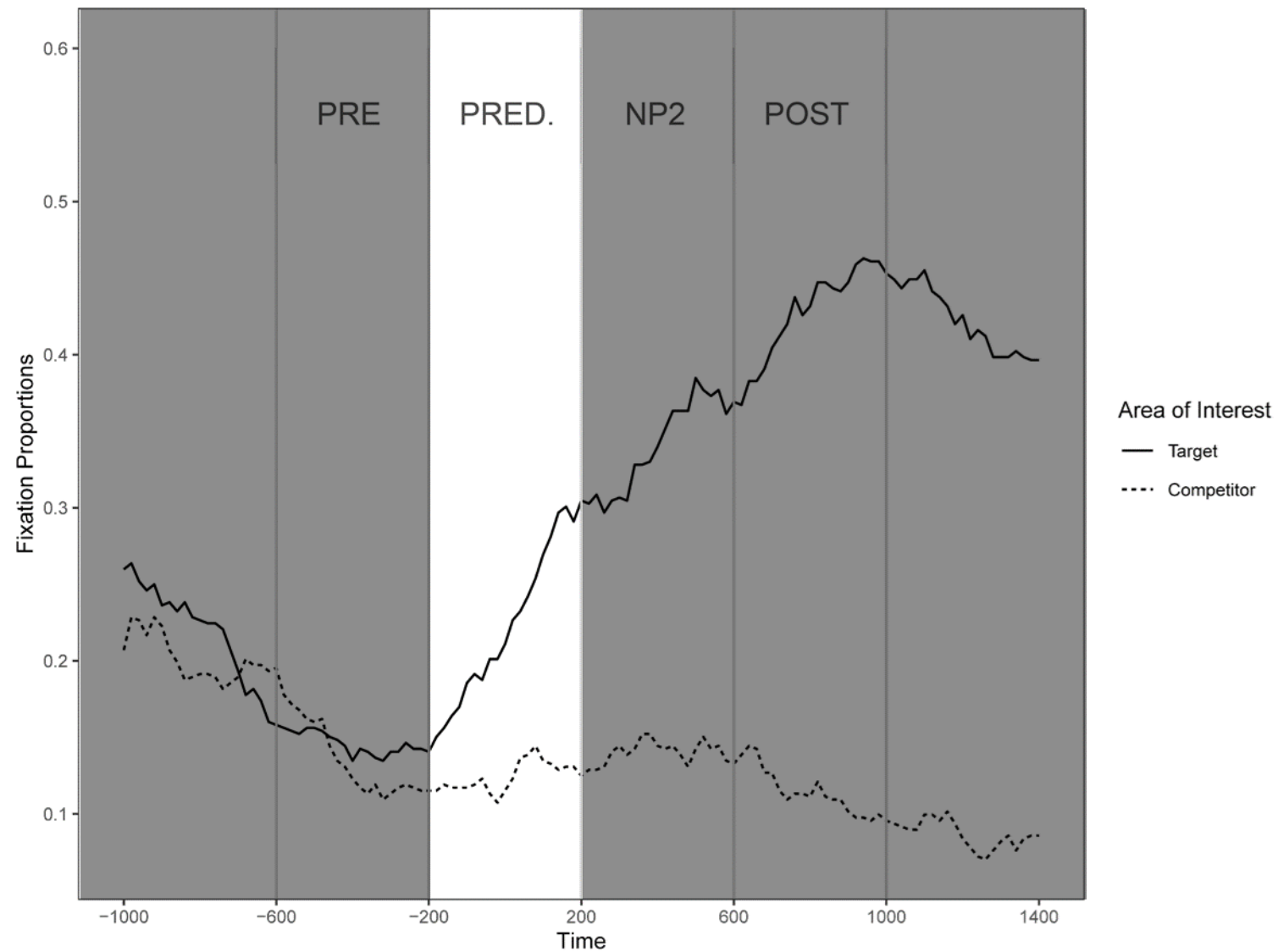
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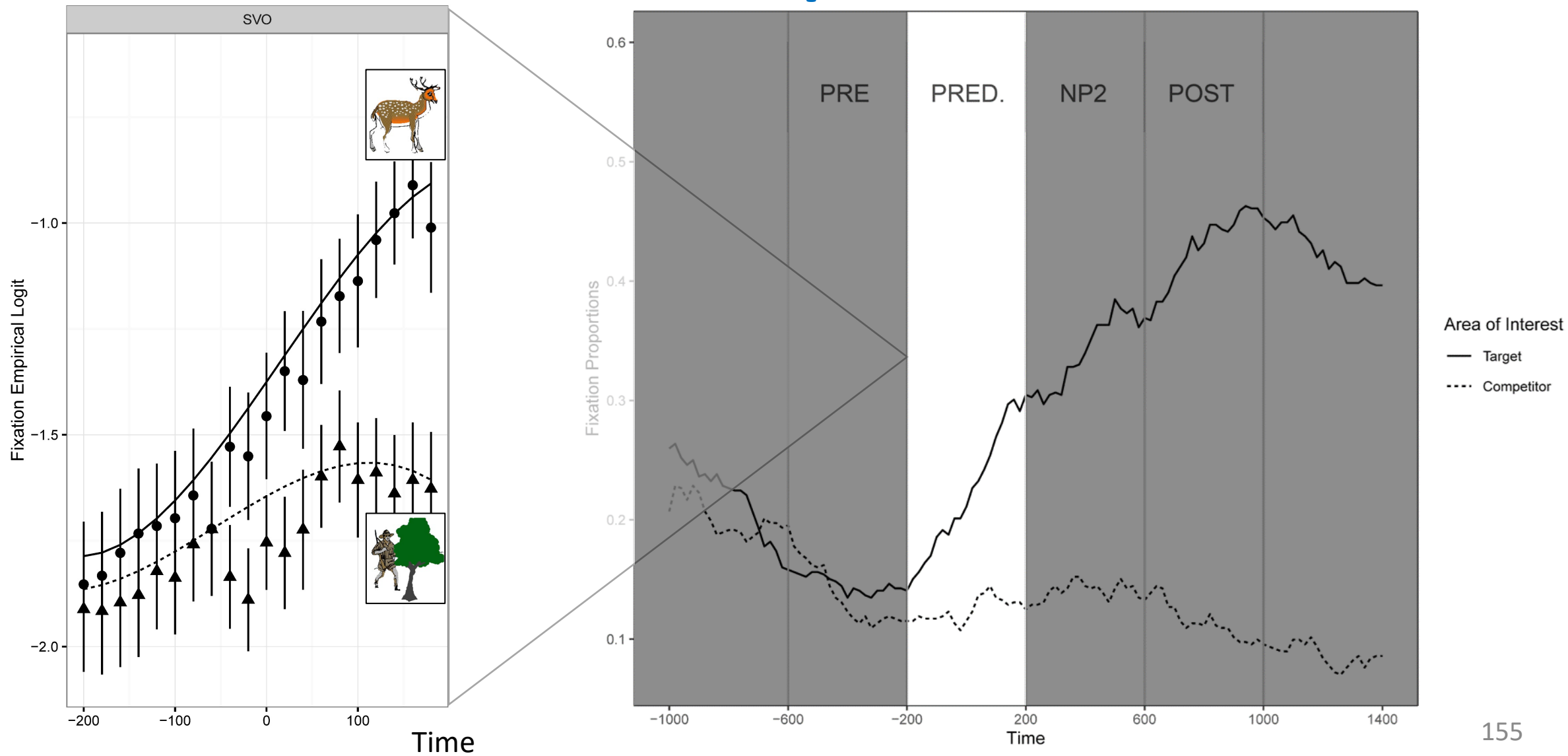
Results, Experiment 3



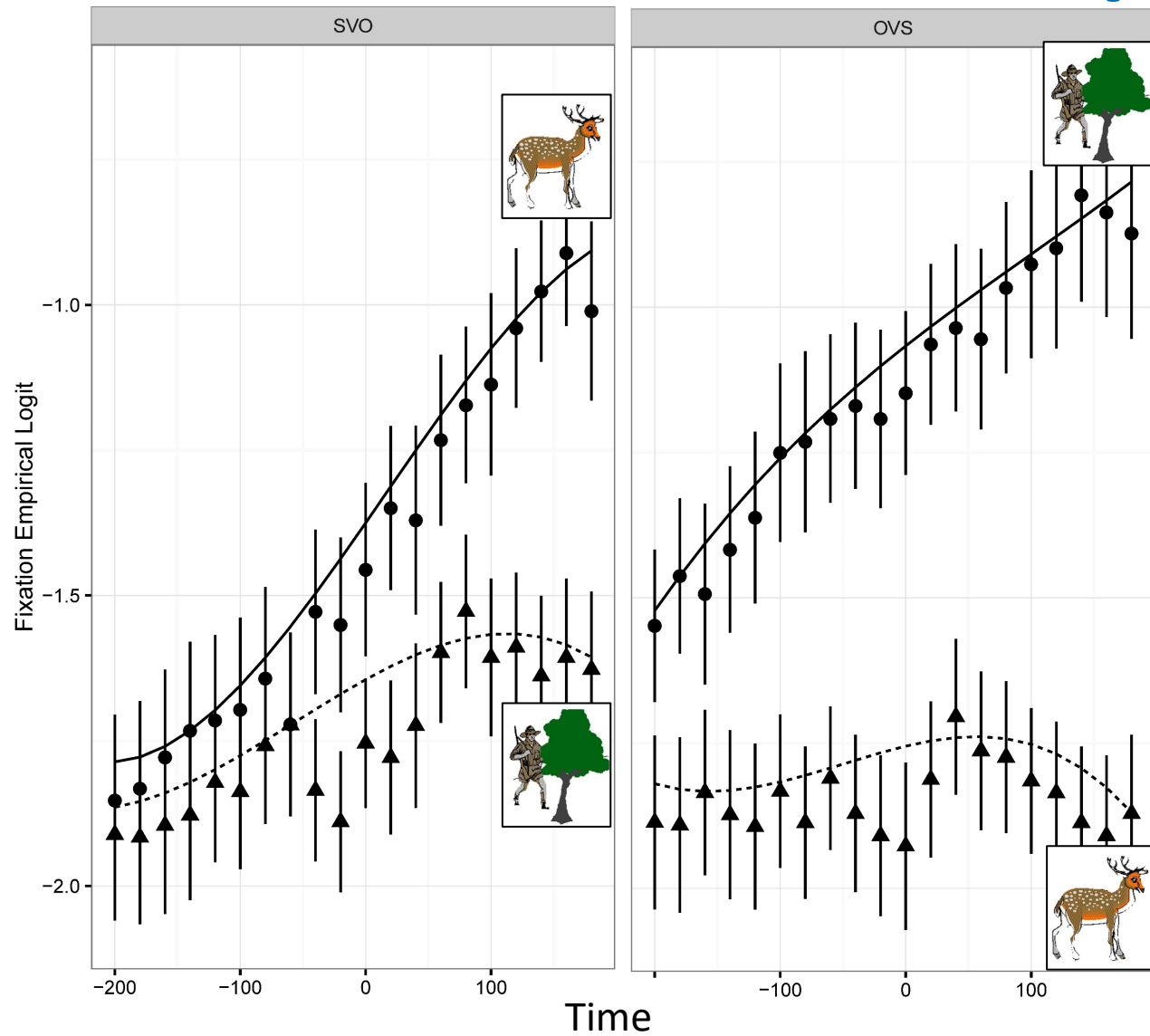
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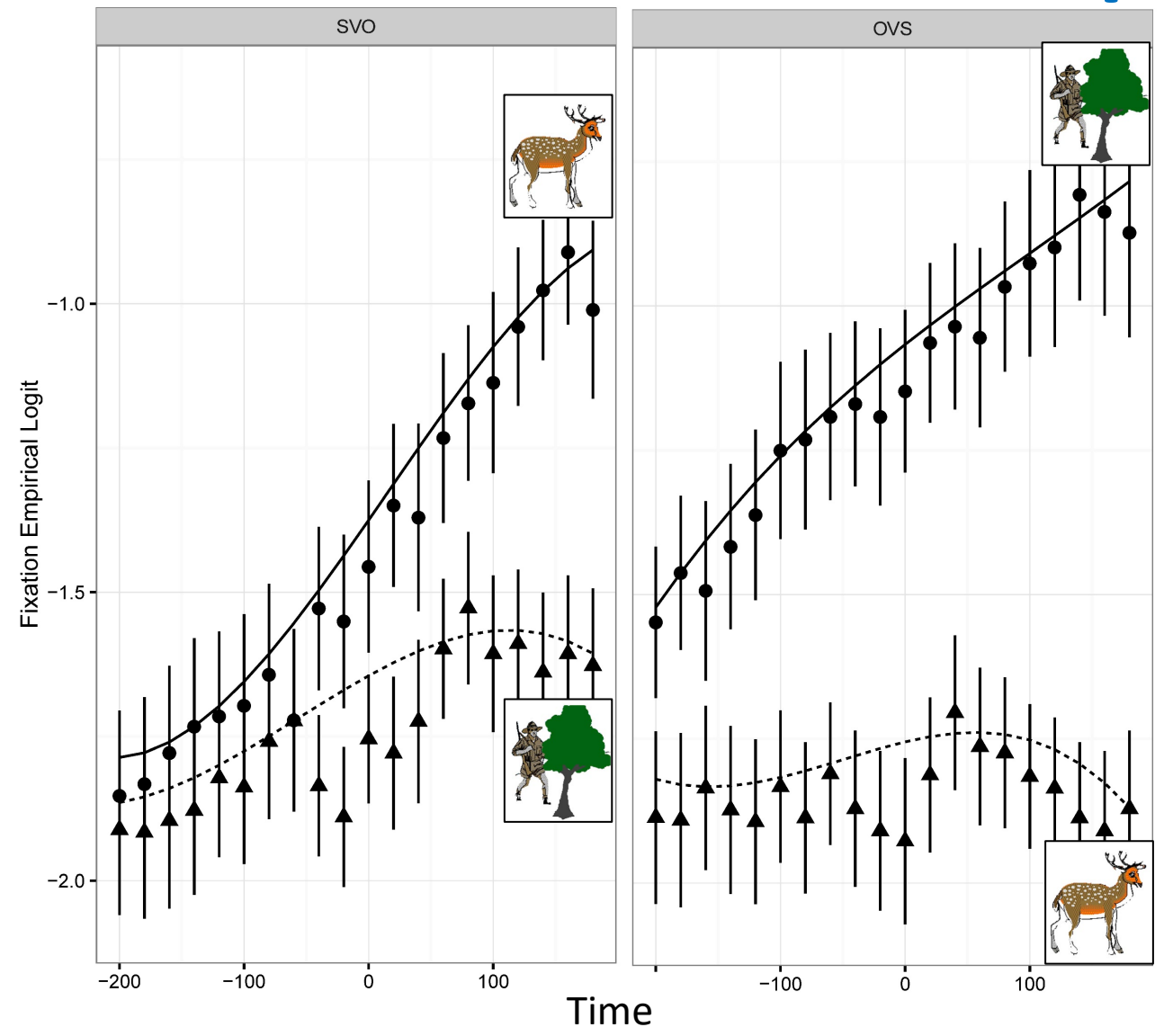
Results, Experiment 3



Results, Experiment 3

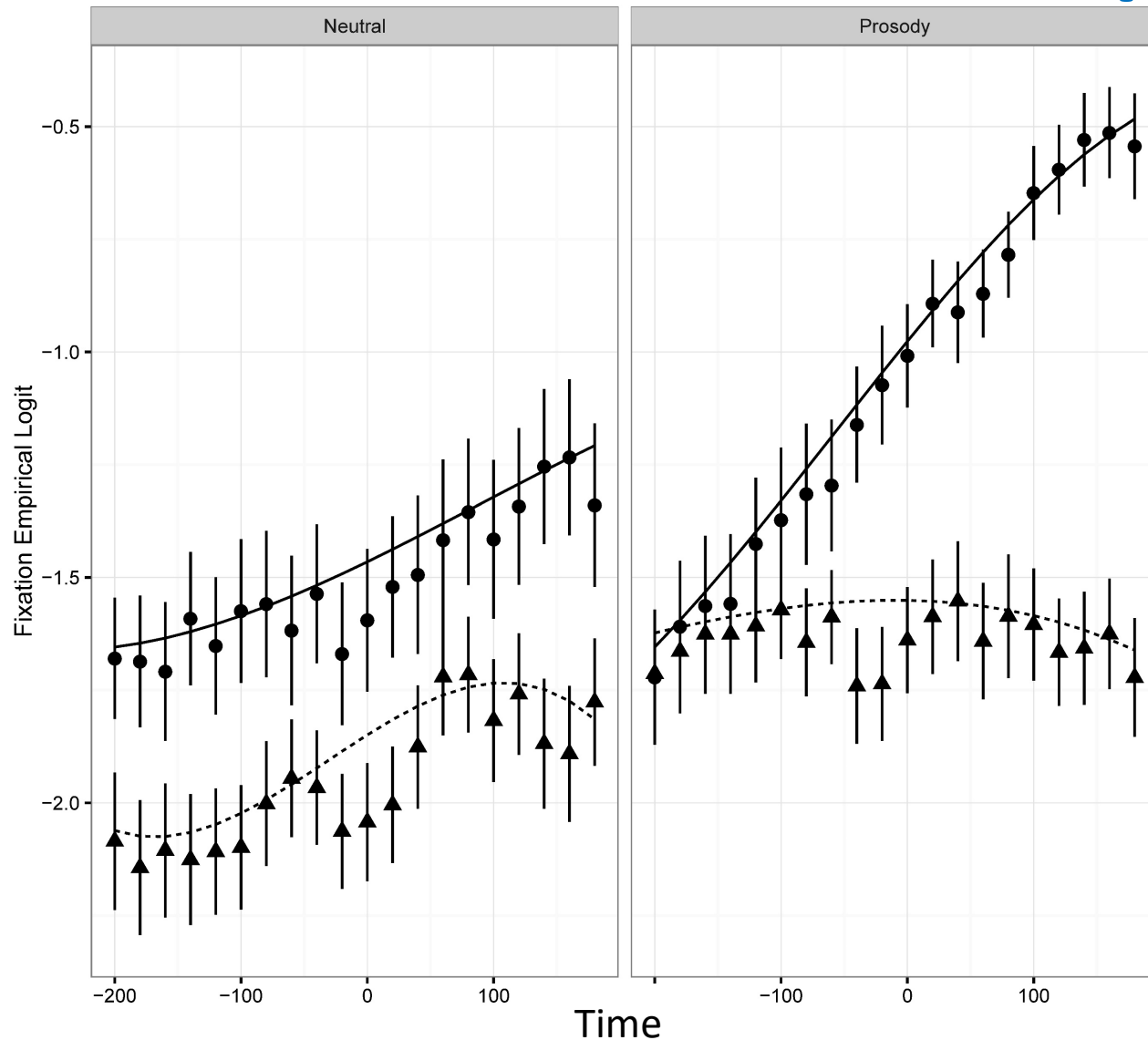


Results, Experiment 3



- Results by Word Order show prediction in both SVO and OVS sentences.

Results, Experiment 3



- Results by Word Order show prediction in both SVO and OVS sentences.
- Results by prosody indicate that it boosted prediction (i.e., provided an *additive* effect).

Henry, Jackson & Hopp, 2020

- Adult second language (L2) learners often show a reduced ability to predict input based on morphosyntactic information (e.g., Hopp, 2015).
- Reading research has found that L2 learners of German struggle to use case information online and often process OVS sentences incorrectly (Hopp, 2006, 2010; Jackson, 2008).
- L2 prediction research echoes this finding:
 - Hopp (2015) found that learners only predicted upcoming input based on word order and lexical-semantic information, not case.
 - High proficiency learners were quicker to integrate case information after hearing the whole sentence.

Research Questions

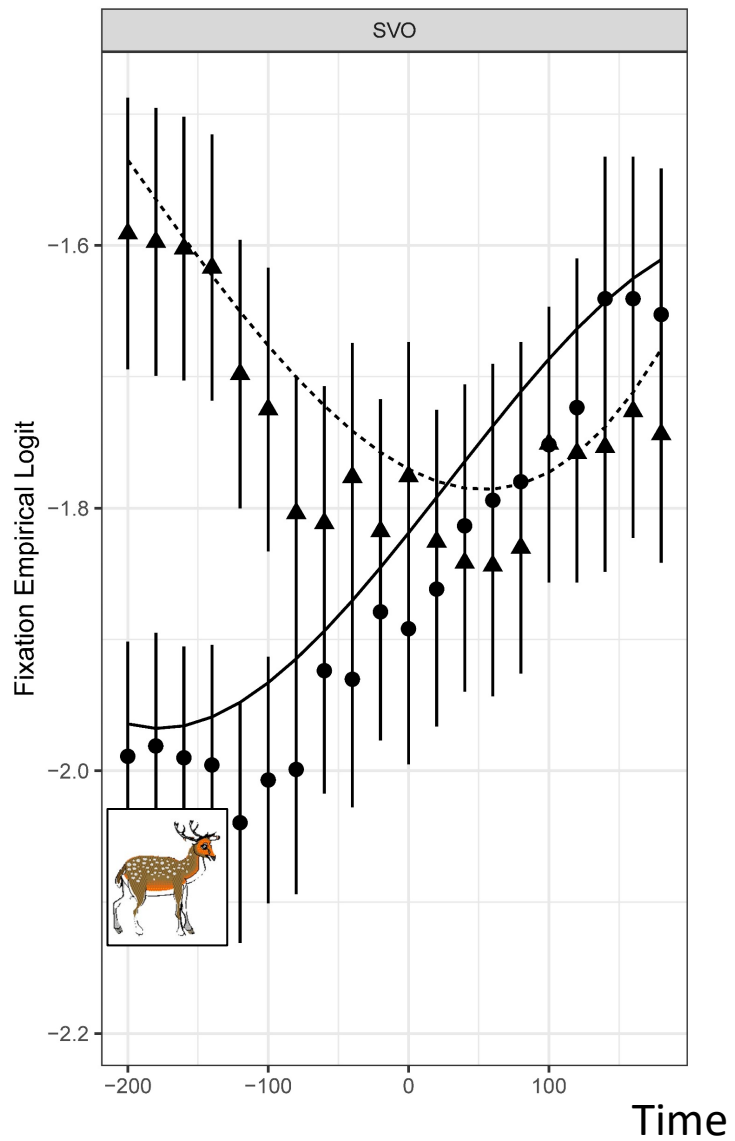
- Does the provision of prosodic cues impact prediction via case marking, as measured by prediction speed and accuracy?
- Does L2 proficiency modulate prediction speed and accuracy?

Methodology

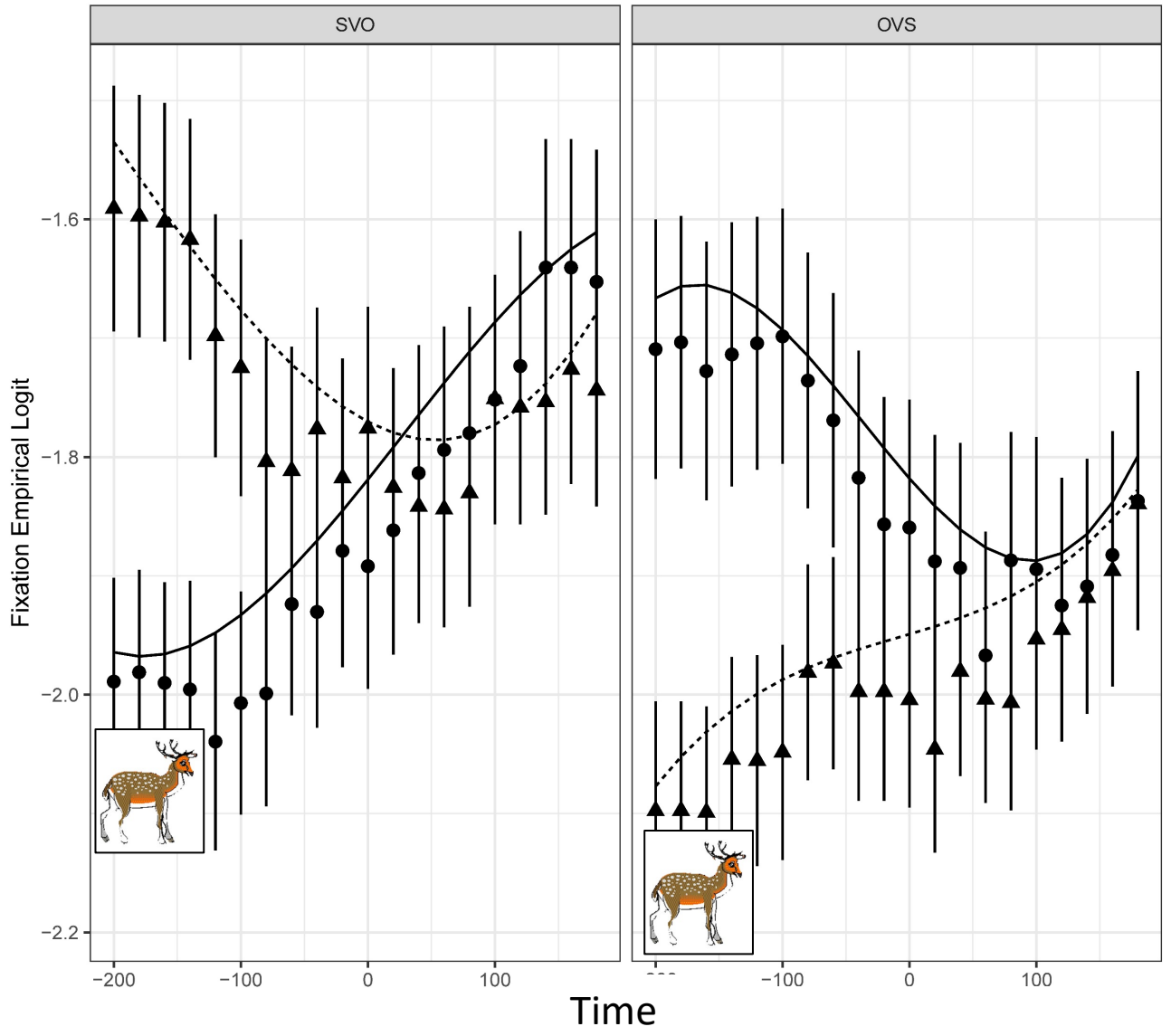
- **Participants**
 - 37 L2 German speakers studying or working in Germany
 - Proficiency measured by self ratings (SR) and Goethe placement test.
 - Analyses used a composite proficiency score.
- **Procedure**
 - LBQ and Proficiency tests
 - Eye-Tracking Experiment

Biographical Data	Average (SD)	Range
Years of German Study	5.25 (3.05)	0-12
SR Speaking (1-10)	6.31 (1.6)	3-9
SR Reading (1-10)	6.59 (1.59)	3-9
SR Listening (1-10)	6.89 (1.6)	3-9
SR Grammar (1-10)	6.44 (1.56)	3-9.5
SR Vocabulary (1-10)	6.21 (1.58)	3-9
SR Overall (1-10)	6.75 (1.45)	3-10
Goethe Score (0-30)	18.46 (4.24)	11-29
Composite Proficiency (0-30)	18.82 (4.01)	11.2-26.5

Results – Prediction Window

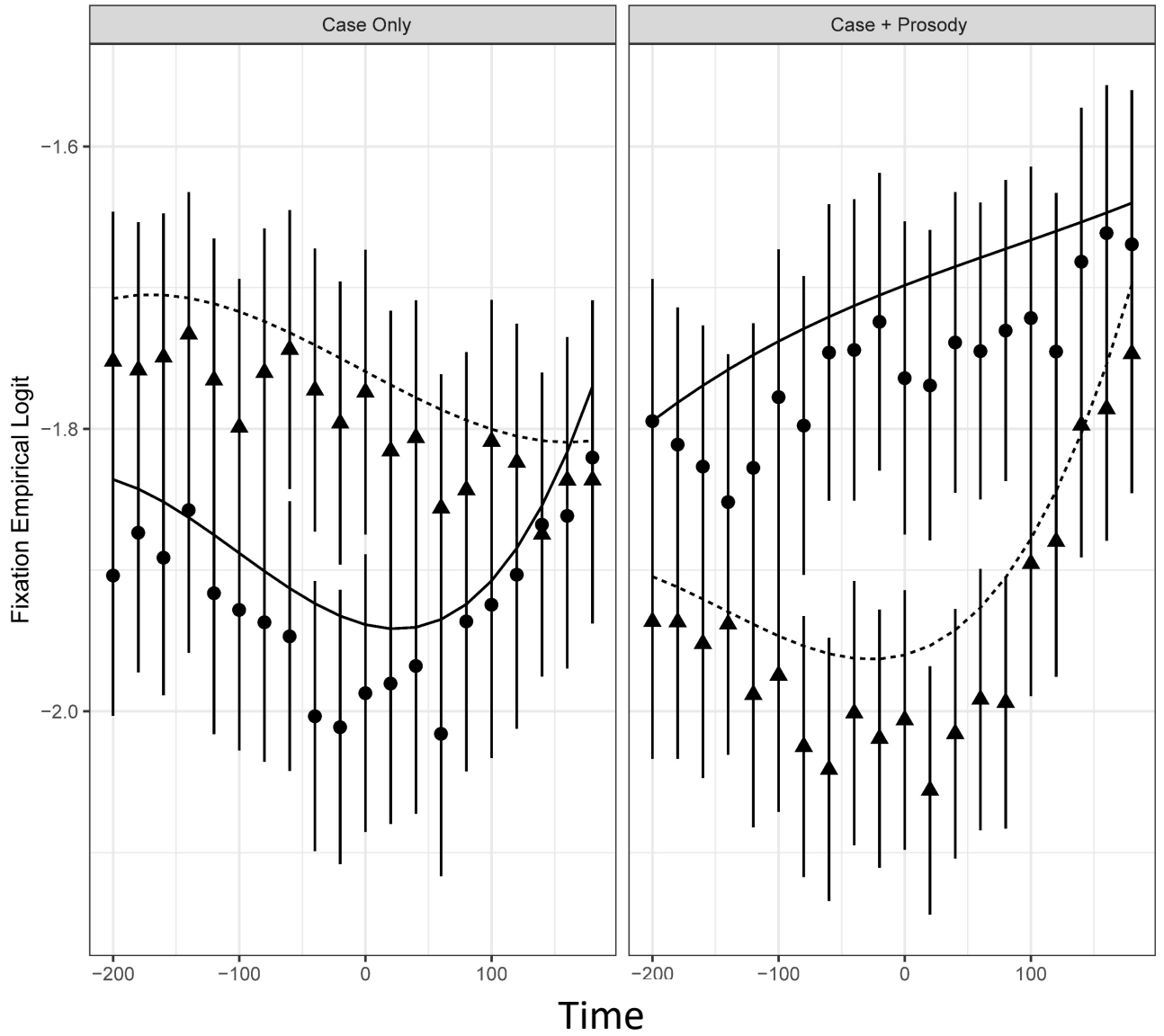


Results – Prediction Window



- Results by Word Order indicate successful prediction *only* in the SVO sentences.

Results – Prediction Window



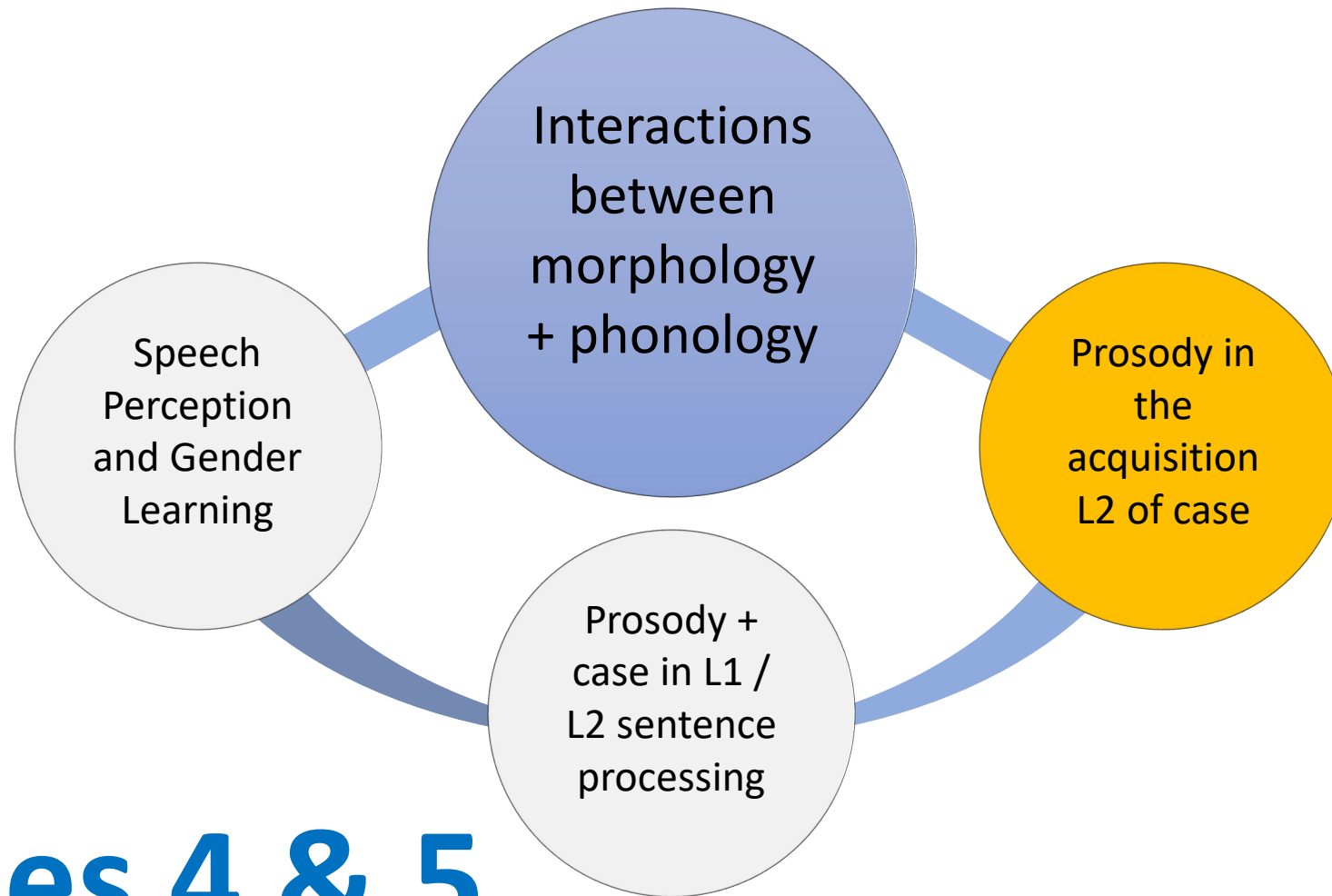
- Results by Word Order indicate successful prediction *only* in the SVO sentences.
- Results by prosody indicate that prosody boosted the success of prediction regardless of word order.
- Results also indicate that higher proficiency led to more successful prediction.

Discussion

- While L2 learners formed predictions based on word order and lexical-semantics (Hopp, 2015), prosody facilitated prediction by attenuating the subject-first bias.
- That is, prosody can support the use of morphological information during L2 sentence processing.
- In L2, like in L1 processing, the ability to exploit correspondences between different cue types and to process them additively is a key feature of the processor.

What about learning?

- BUT: The finding that prosody supports the processing of morphology does not necessarily suggest that prosody helps learners make the *initial* form-meaning connections between case and grammatical / thematic roles.
- Further research is needed to explore the relationship between processing and learning, focusing on how cue coalitions promote the discovery and subsequent use of different types of linguistic information.



Studies 4 & 5

Using prosody to enhance the efficacy of morphological training (Processing Instruction)

Input Processing and Instruction

- PI trainings use *Structured Input* activities, which manipulate the presence / absence of cues from the input to promote processing of a target form.
- PI is therefore a good instrument by which to test whether the presence / absence of a particular cue influences learning.

Input Processing and Instruction

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Der Hund beißt den Mann.
The dog bites the man.

The dog bites the man.

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Der Hund beißt den Mann.
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Input Processing and Instruction

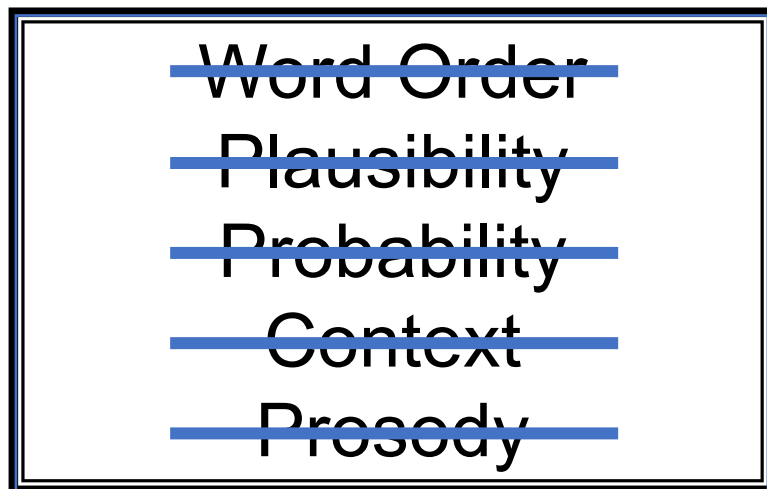
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Word Order
Plausibility
Probability
Context
Prosody

Der Hund beißt den Mann.
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Input Processing and Instruction

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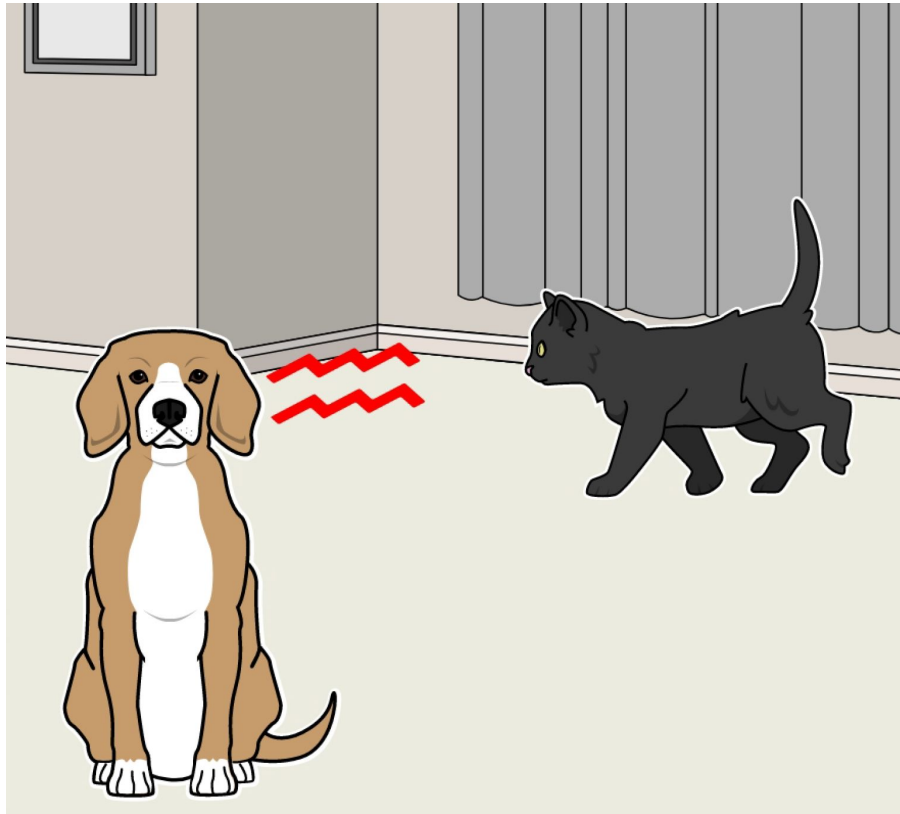
Der Hund beißt den Mann.
The ^{NOM} dog bites the ^{ACC} man.
The dog bites the man.

Den Hund hört die Katze.

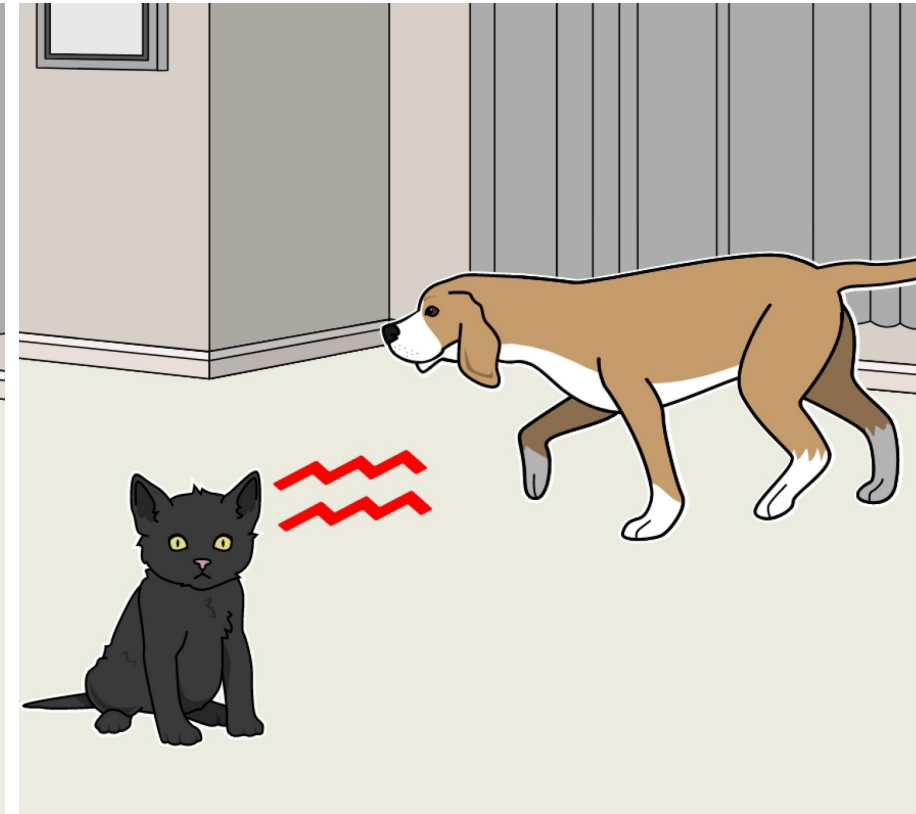
The dog hears the cat.

“The cat hears the dog”

A



B

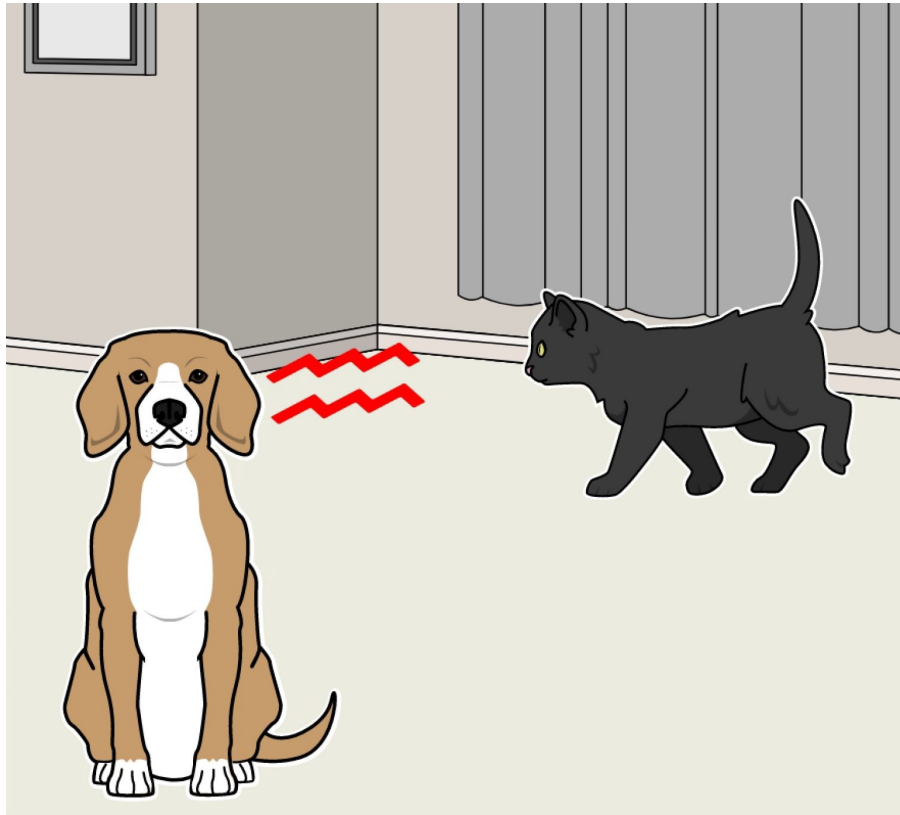


Den_{ACC} Hund hört die_{NOM} Katze.

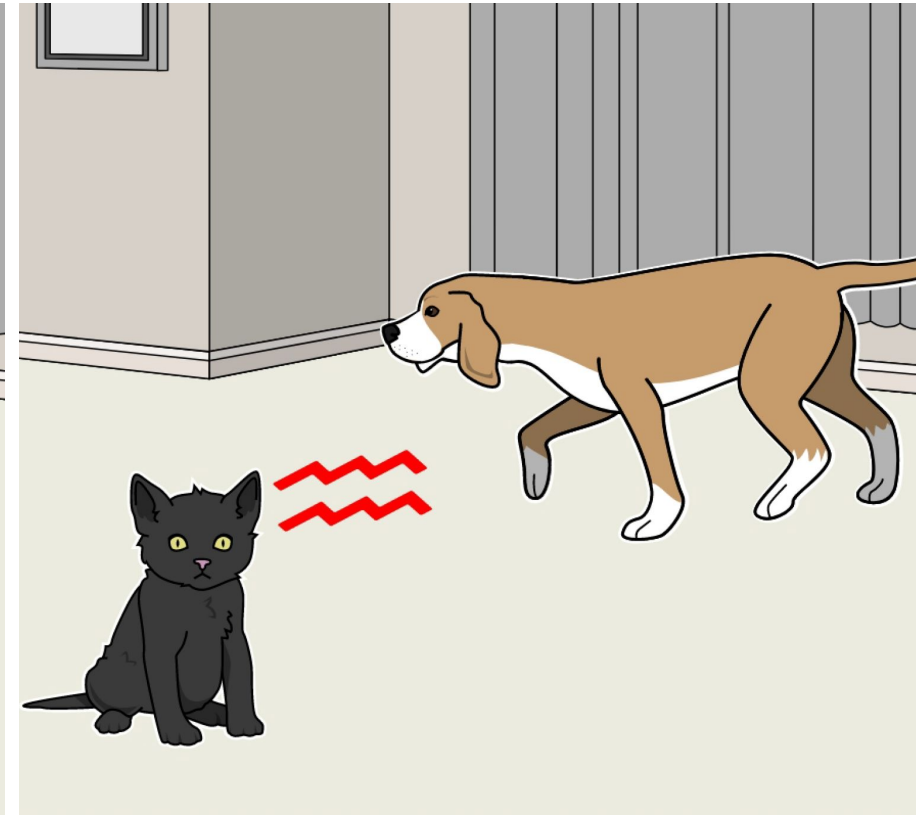
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A



B

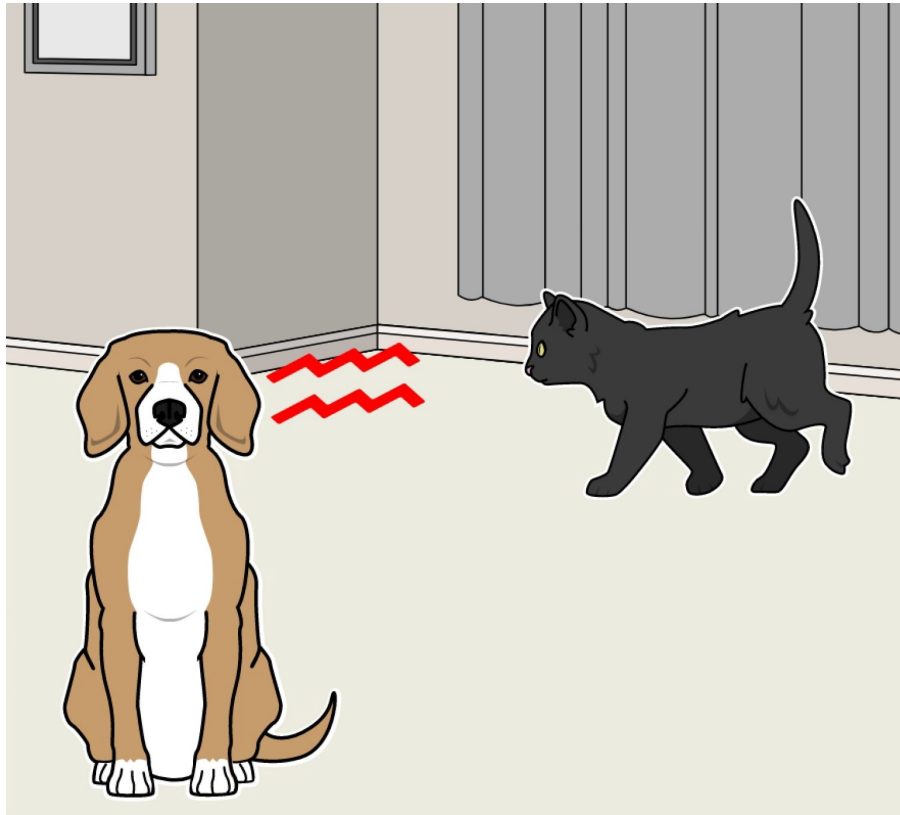


Den_{ACC} Hund hört die_{NOM} Katze.

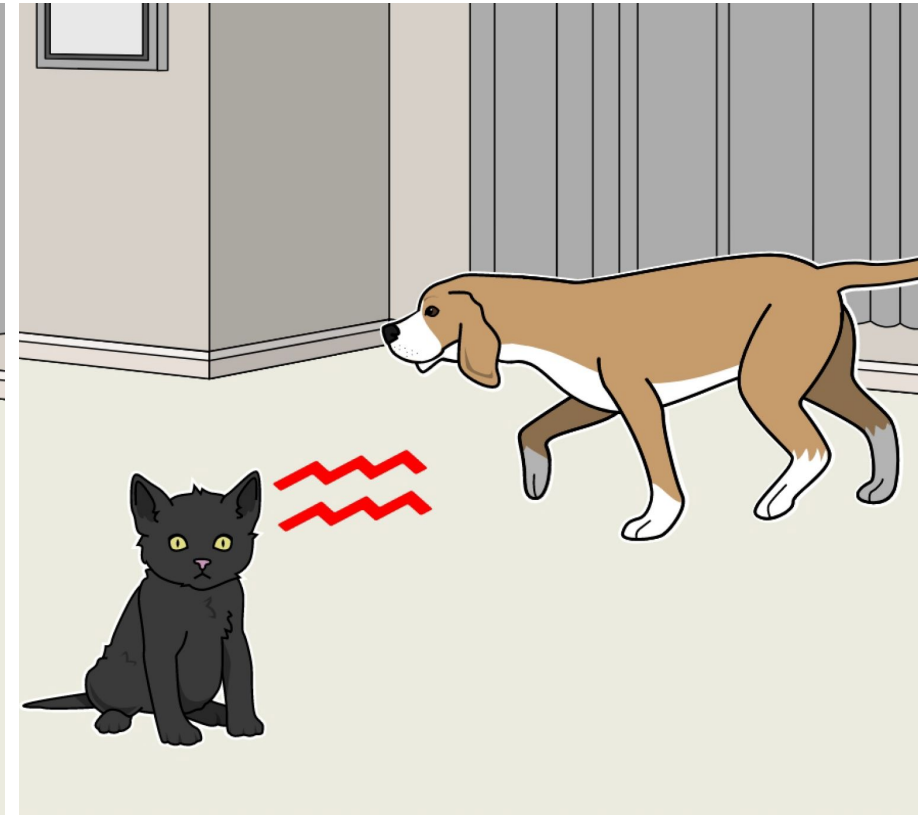
The dog hears the cat.

"The cat hears the dog"

A



B



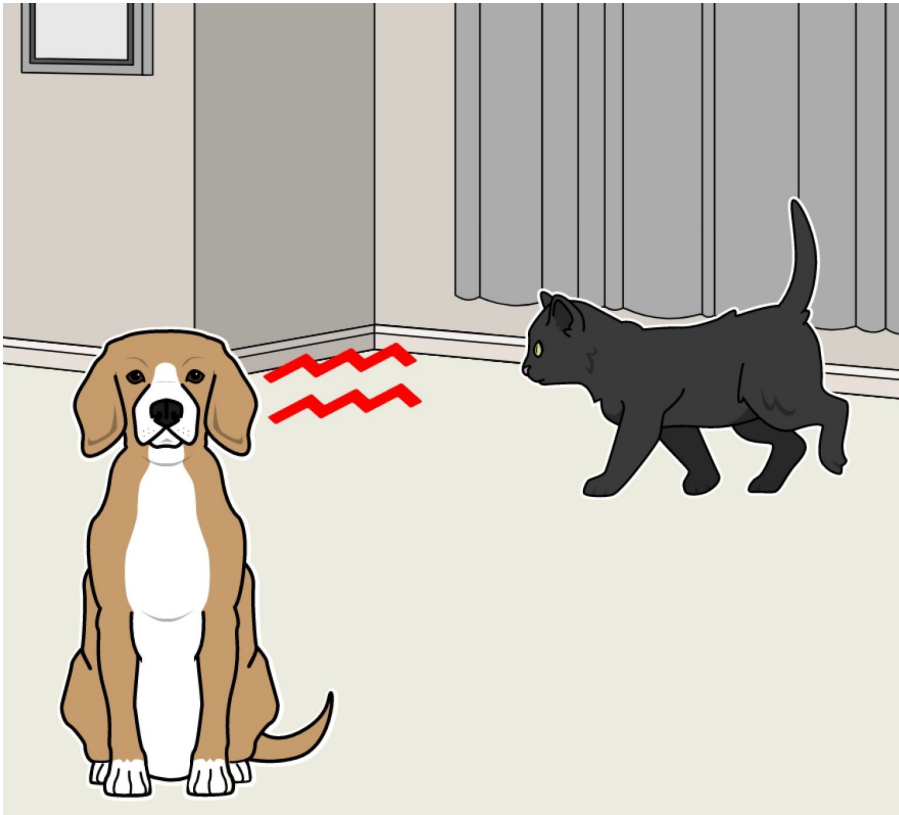
Correct! Good Job!

Den_{ACC} Hund hört die_{NOM} Katze.

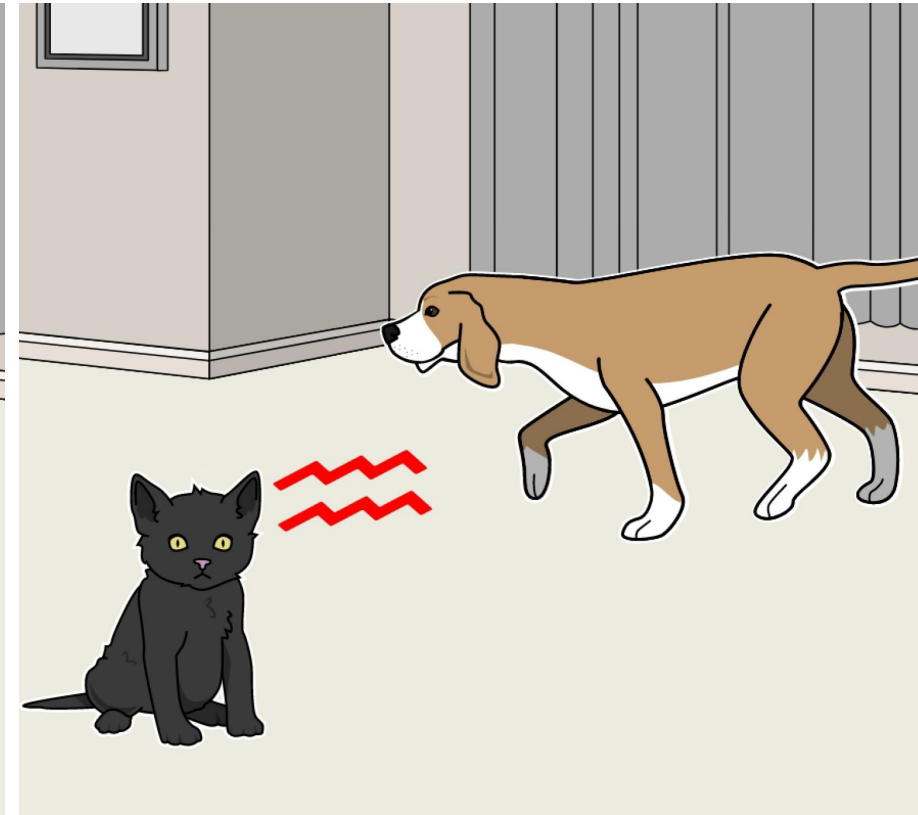
The dog hears the cat.

"The cat hears the dog"

A



B



Incorrect.

Henry, Jackson, & DiMidio (2017)

- During Processing Instruction, prosodic cues are typically “removed” from the input.
- Previous research suggests that L1 children use prosody alongside case and have difficulty using case cues alone (Grünloh et al., 2011).
- Do L2 learners also use prosody to support the development of form-meaning connections for German case cues?

The Primary Research Question

- RQ1: Does Processing Instruction with prosodic cues (+P) lead to more accurate comprehension and production of accusative case markers in German than does PI without prosodic cues (-P)?

Explicit Information (EI) in PI

- While EI is not necessary (VanPatten & Oikennon, 1996), it may be beneficial for some forms (McManus & Marsden, 2017).
 - EI is particularly beneficial in PI trainings targeting the accusative case in German (Culman et al., 2009; Henry et al., 2009).
 - This may mask the effects of prosody.
- RQ2: Does the presence of explicit information (+EI / -EI) in Processing Instruction modulate the effect of prosody with respect to the comprehension and production of accusative case markers in German?

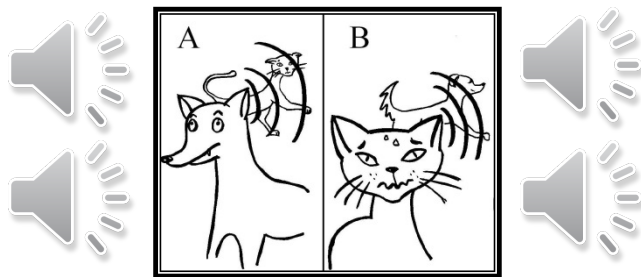
Participants

- 3rd Semester German learners
 - L1 English
 - No advanced knowledge of another L2
 - No established knowledge of case-markers and OVS sentence structure (determined by pretest)
- 8 intact classes randomly divided into 4 treatment groups:
 - Processing Instruction with EI, without Prosody (+EI-P) = 22
 - Processing Instruction with EI, with Prosody (+EI+P) = 17
 - Processing Instruction without EI or Prosody (-EI-P) = 20
 - Processing Instruction without EI, but with Prosody (-EI+P) = 21

Training - 4 Groups

Standard PI (+EI)

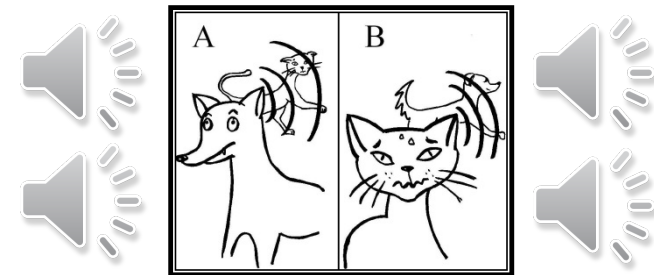
1. Explicit Information Plus
2. Referential Activity
 - a. 50 sentences (38 OVS, 12 SVO) with simple corrective feedback
+Prosody | -Prosody



3. Affective Activity
 - a. Input, no right/wrong

Without EI

1. Referential Activity
 - a. 50 sentences (38 OVS, 12 SVO) with simple corrective feedback
+Prosody | -Prosody

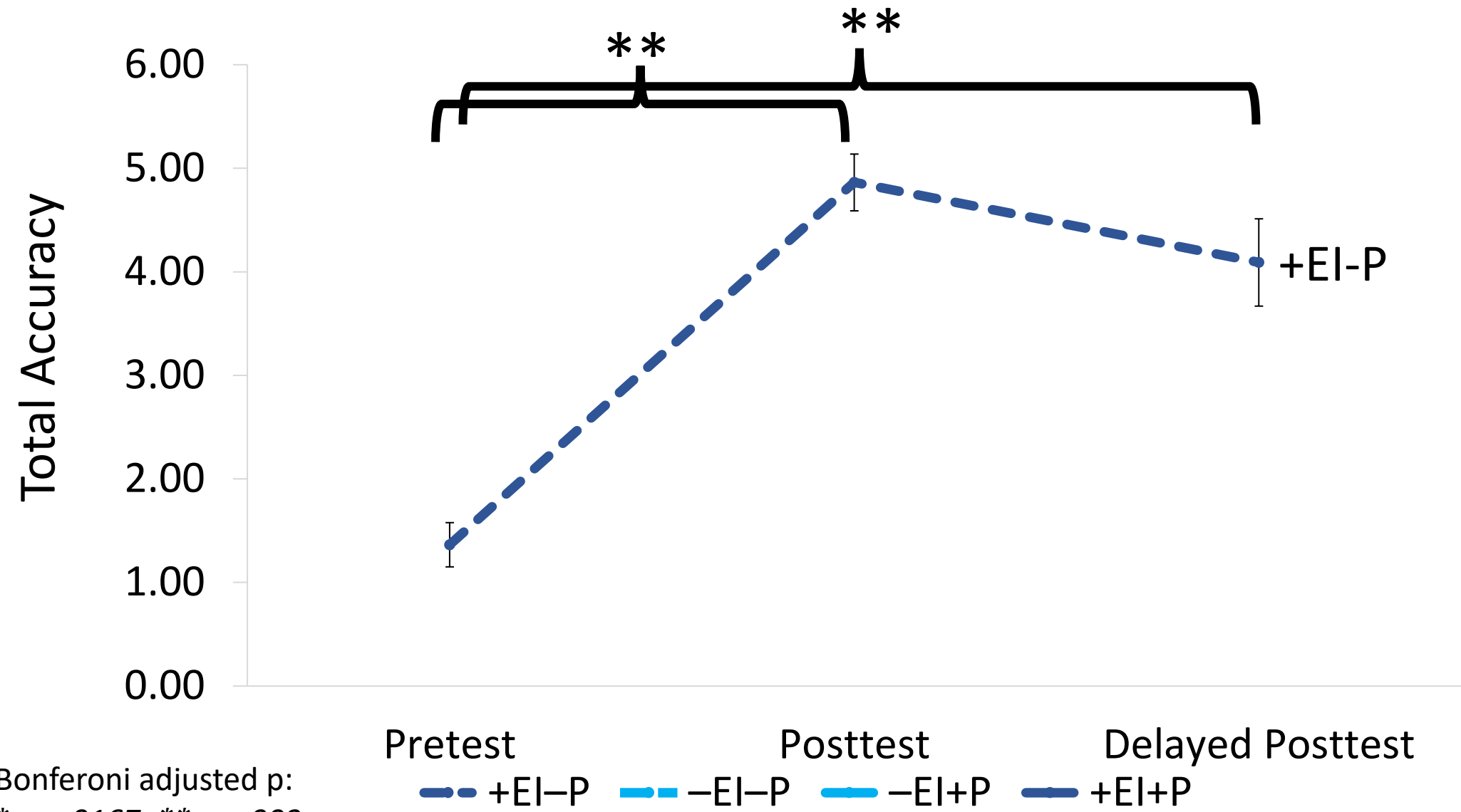


3. Affective Activity
 - a. Input, no right/wrong

Offline Assessment Measures

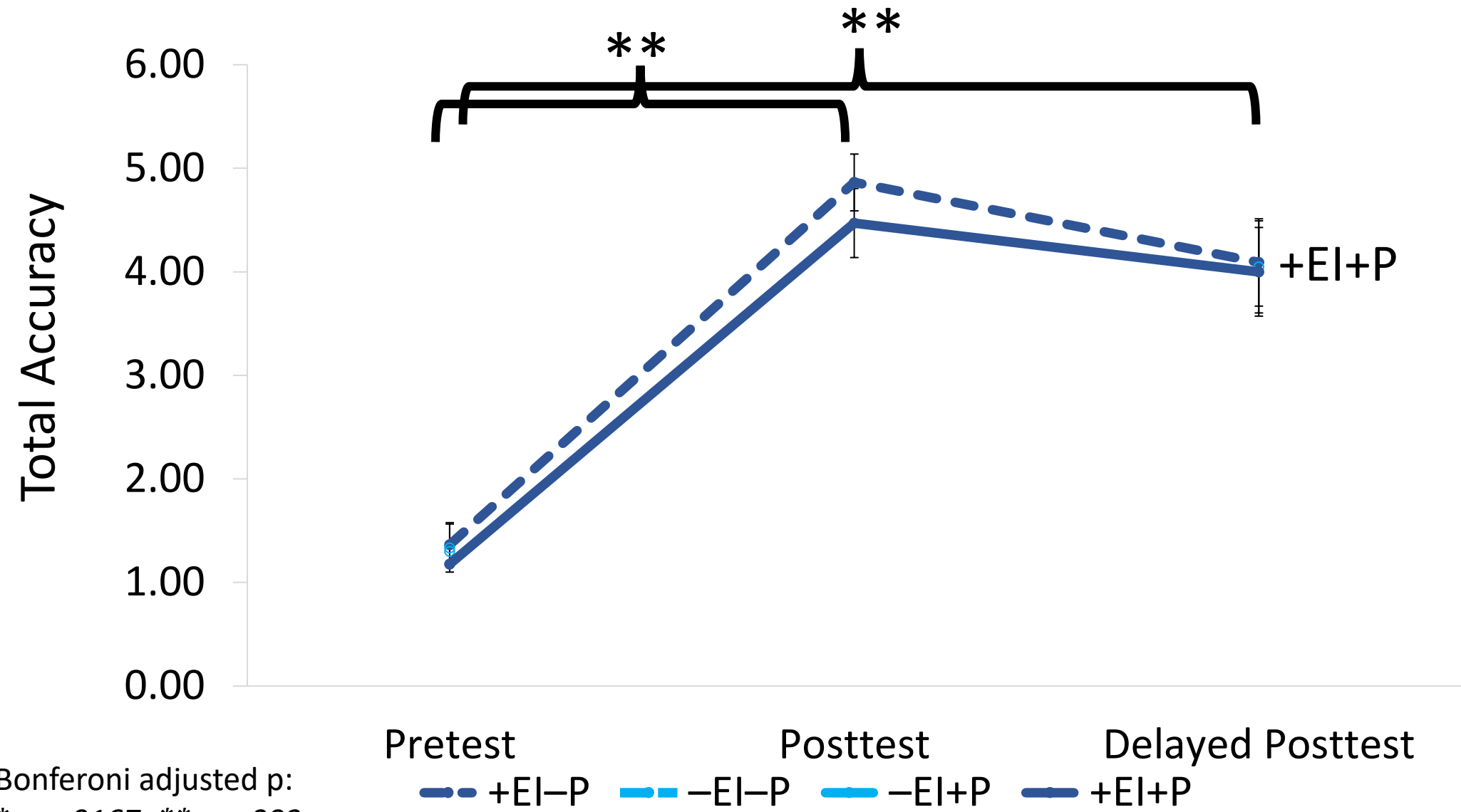
- The sentence interpretation and picture story-telling tasks.
 - Sentence Interpretation (SVO / OVS Accuracy)
 - Picture Story-telling Task (*der* and *den* % correct)
- These tests were administered as a pretest, a posttest, and a 4-week delayed posttest.

Interpretation: Accuracy on OVS Items



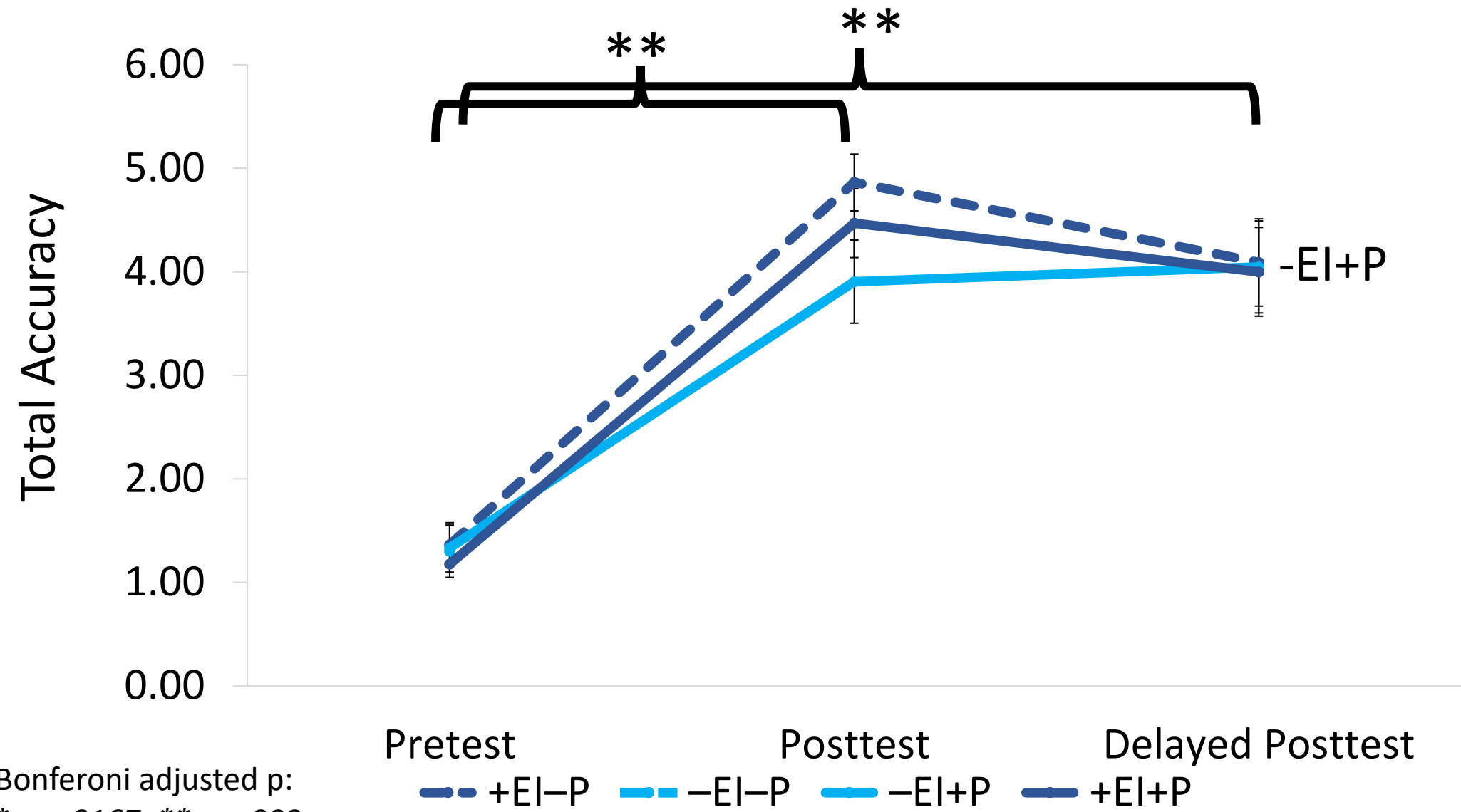
Bonferoni adjusted p:
* $p < .0167$, ** $p < .003$

Interpretation: Accuracy on OVS Items



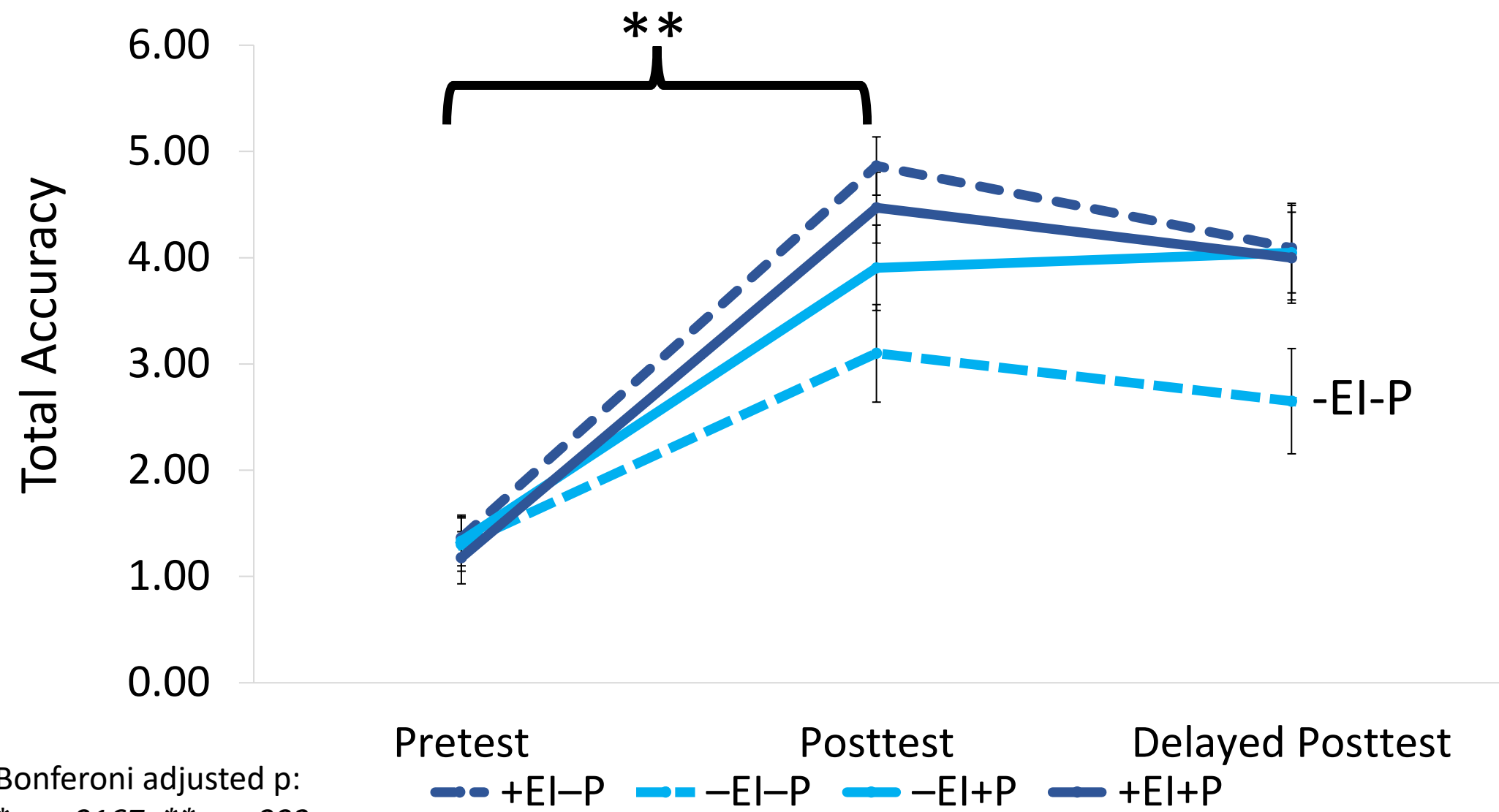
Bonferroni adjusted p:
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Interpretation: Accuracy on OVS Items



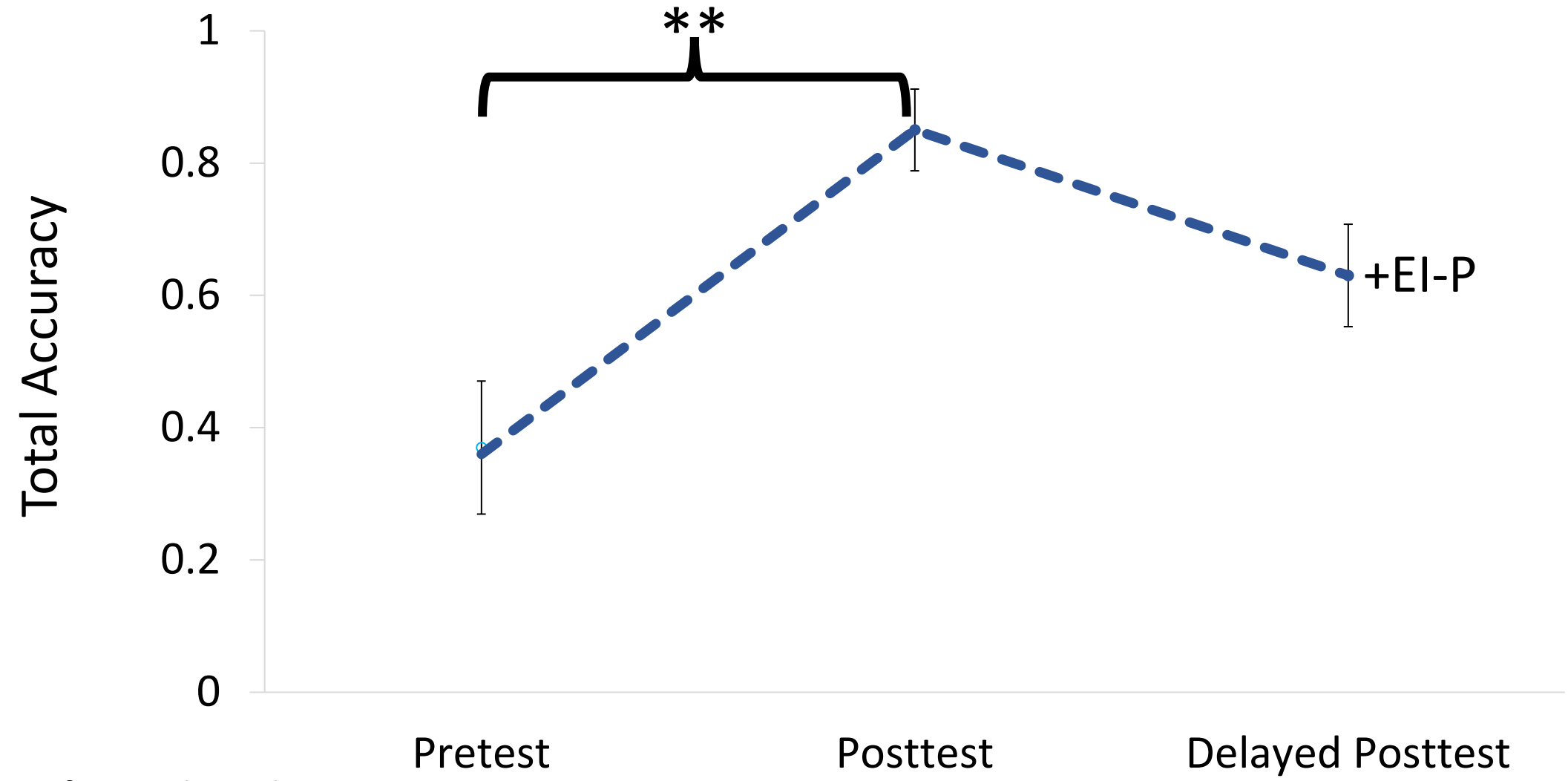
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Interpretation: Accuracy on OVS Items



Bonferoni adjusted p:
* $p < .0167$, ** $p < .003$

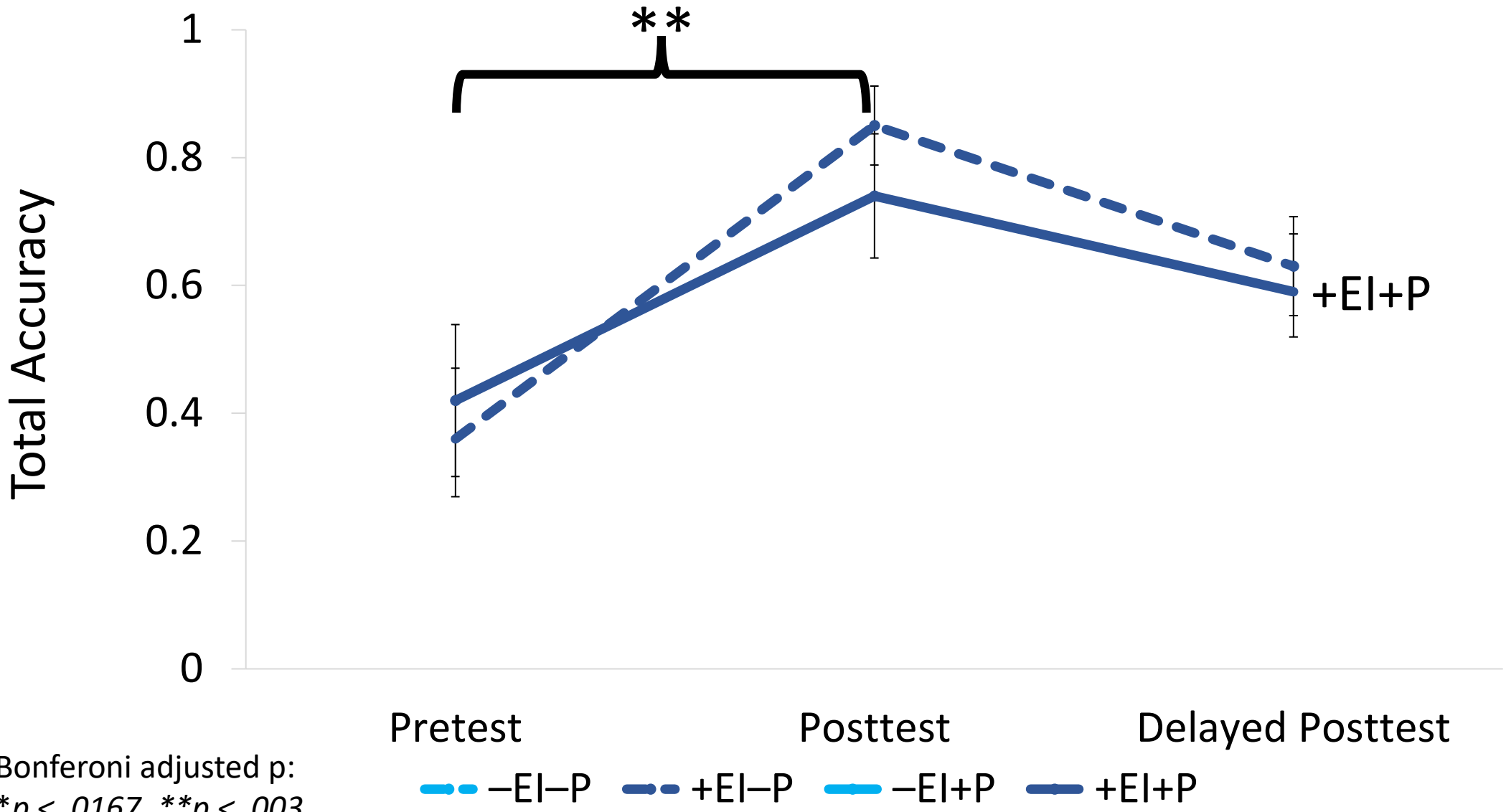
Production: Accuracy on *den*



Bonferroni adjusted p:
* $p < .0167$, ** $p < .003$

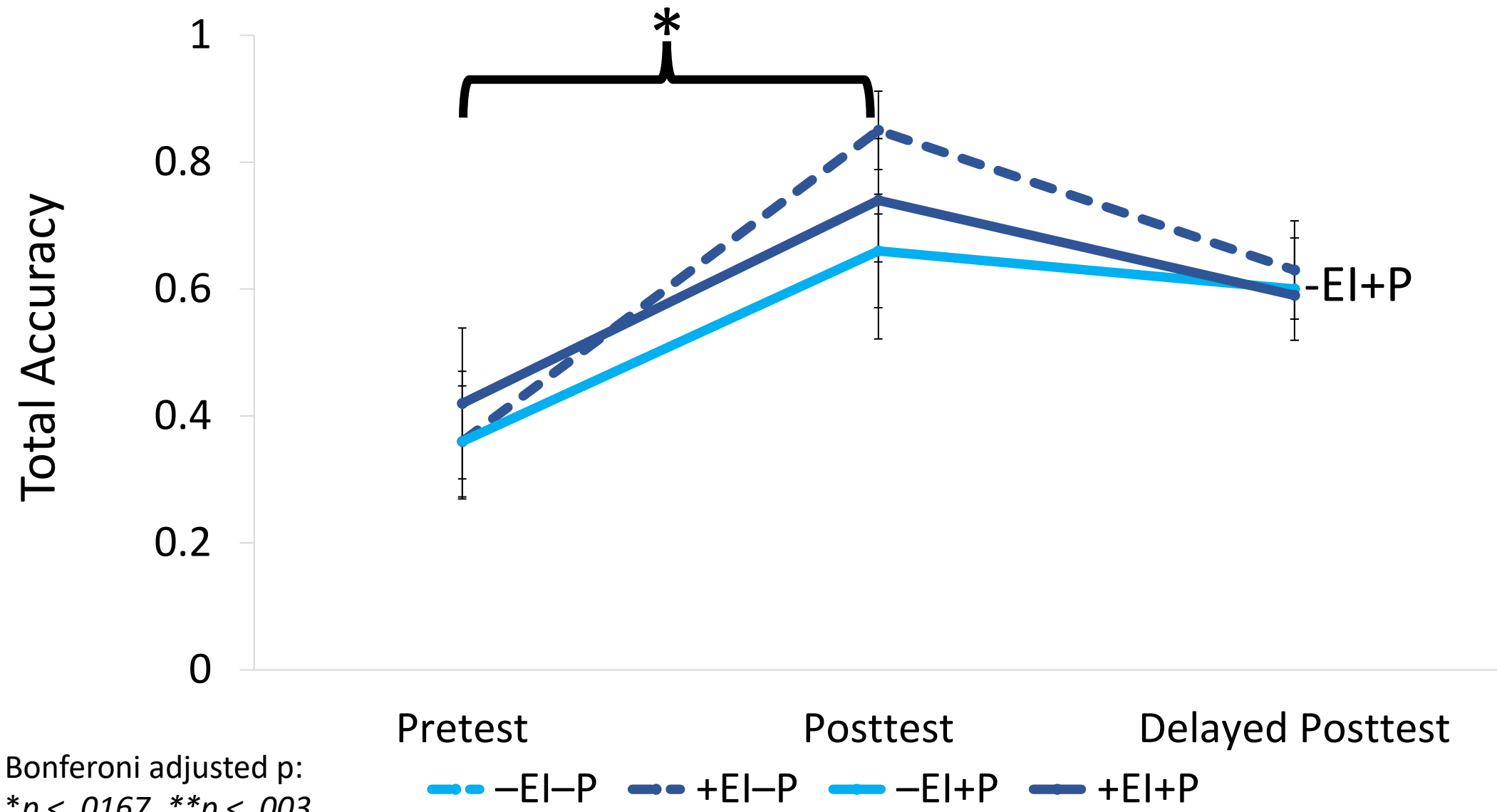
—EI—P +EI—P —EI+P +EI+P

Production: Accuracy on *den*



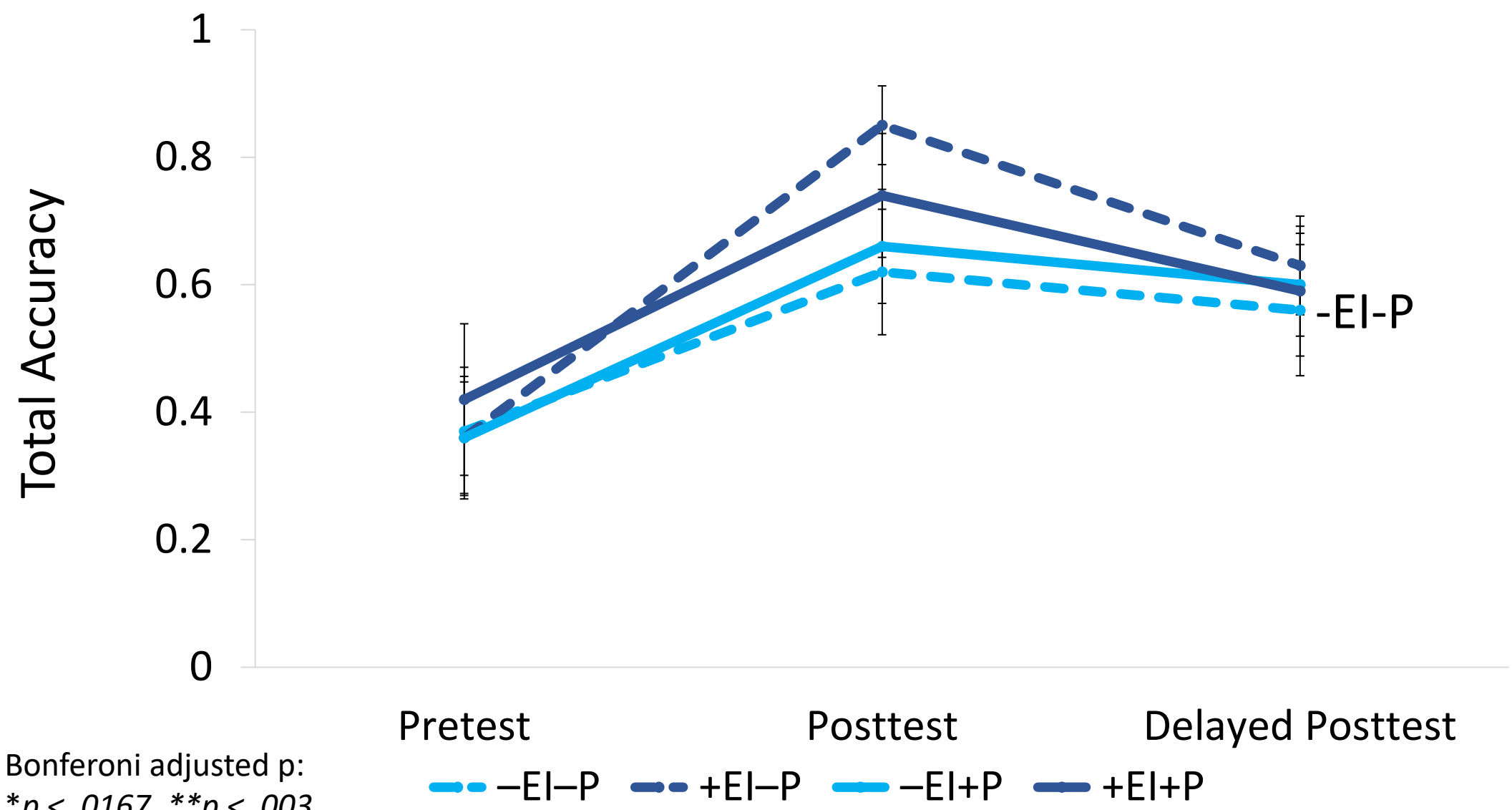
Bonferoni adjusted p:
* $p < .0167$, ** $p < .003$

Production: Accuracy on *den*



Bonferroni adjusted p:
* $p < .0167$, ** $p < .003$

Production: Accuracy on *den*



Bonferoni adjusted p:
* $p < .0167$, ** $p < .003$

The Role of Prosody

- When EI is included in the training, the addition of prosody to the PI training had no impact on the interpretation or production of accusative case markers.
- BUT, when EI is absent from the training, prosody has a significant positive impact on interpretation and production.
 - Prosody facilitated processing of object-first word order, and participants maintained gains over time;
 - Like EI, the inclusion of prosodic cues enabled learners to process the target input more purposefully, resulting in better intake for the developing system (i.e., stronger form-meaning connections).


The Role of Prosody

- There was transfer from the auditory to the written modality, suggesting that learners used prosody to isolate the meaning and communicative purpose of the target form and create more robust form-meaning connections.

Henry (in press)


- If prosody helps learners link form and meaning during training (Henry et al., 2017), and if prosody helps learners use case information during sentence processing (Henry et al., 2020), does **training** with prosodic cues also help learners use case online?
- This study focuses on two groups of learners who received comparable PI and PI+P treatments.

Assessment Measures

- Offline (Written Pre & Posttest) 
 - Sentence Interpretation (SVO / OVS Accuracy)
 - Picture Story-telling Task (*der* and *den* % correct)
- Online: Self-Paced Reading (Pre & Posttest)
 - Reading Times on each segment

Both the PI and the PI+P groups performed similarly on the pretest / posttest tasks when compared to learners in Study 4 (Henry, Jackson, & DiMidio, 2017)

Assessment Measures

- Offline (Written Pre & Posttest) 
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Online Measure: Self-Paced Reading

“The grandmother surprises the grandfather during the party”

+

Online Measure: Self-Paced Reading

“The grandmother surprises the grandfather during the party”

Den Opa -----

Online Measure: Self-Paced Reading

“The grandmother surprises the grandfather during the party”

----- überrascht -----

Online Measure: Self-Paced Reading

“The grandmother surprises the grandfather during the party”

----- die Oma -----

Online Measure: Self-Paced Reading

“The grandmother surprises the grandfather during the party”

----- während -----

Online Measure: Self-Paced Reading

“The grandmother surprises the grandfather during the party”

----- der Party.

Online Measure: Self-Paced Reading

“The grandmother surprises the grandfather during the party”

Did the grandmother surprise the grandfather?

Self-Paced Reading Task

- The underlying logic of the SPR task is that an increase in reading times (RTs) shows an increase in processing difficulty.
- If we see that RTs on SVO and OVS sentences are different, this provides evidence that the learners used case markers to understand the sentences like native speakers do (Hemforth, Konieczny, & Strube, 1993; Schlesewsky et al., 2000).

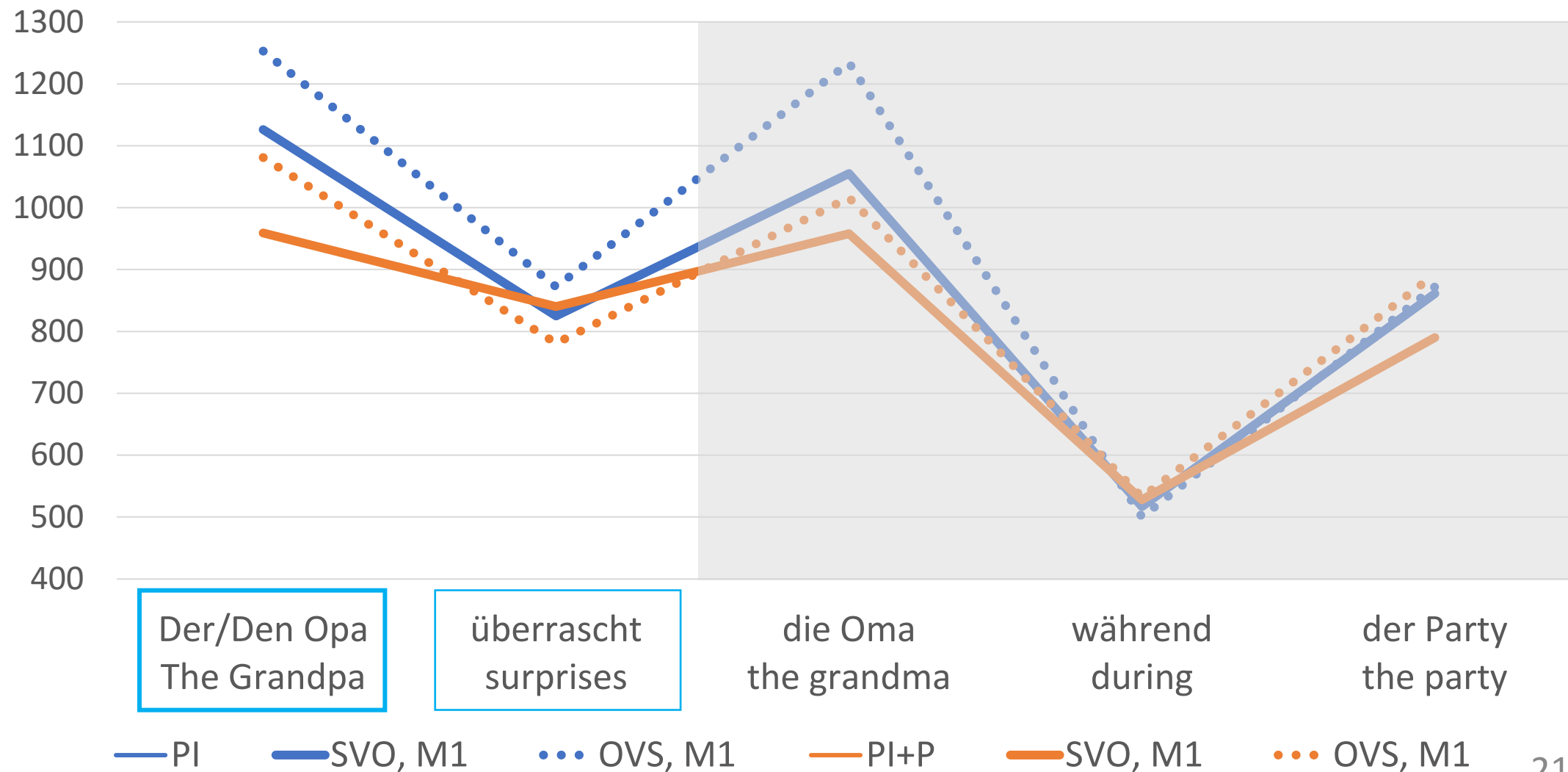
Self-Paced Reading Task

- Participants read segmented sentences in 4 conditions, manipulated for word order and placement of the masculine noun.

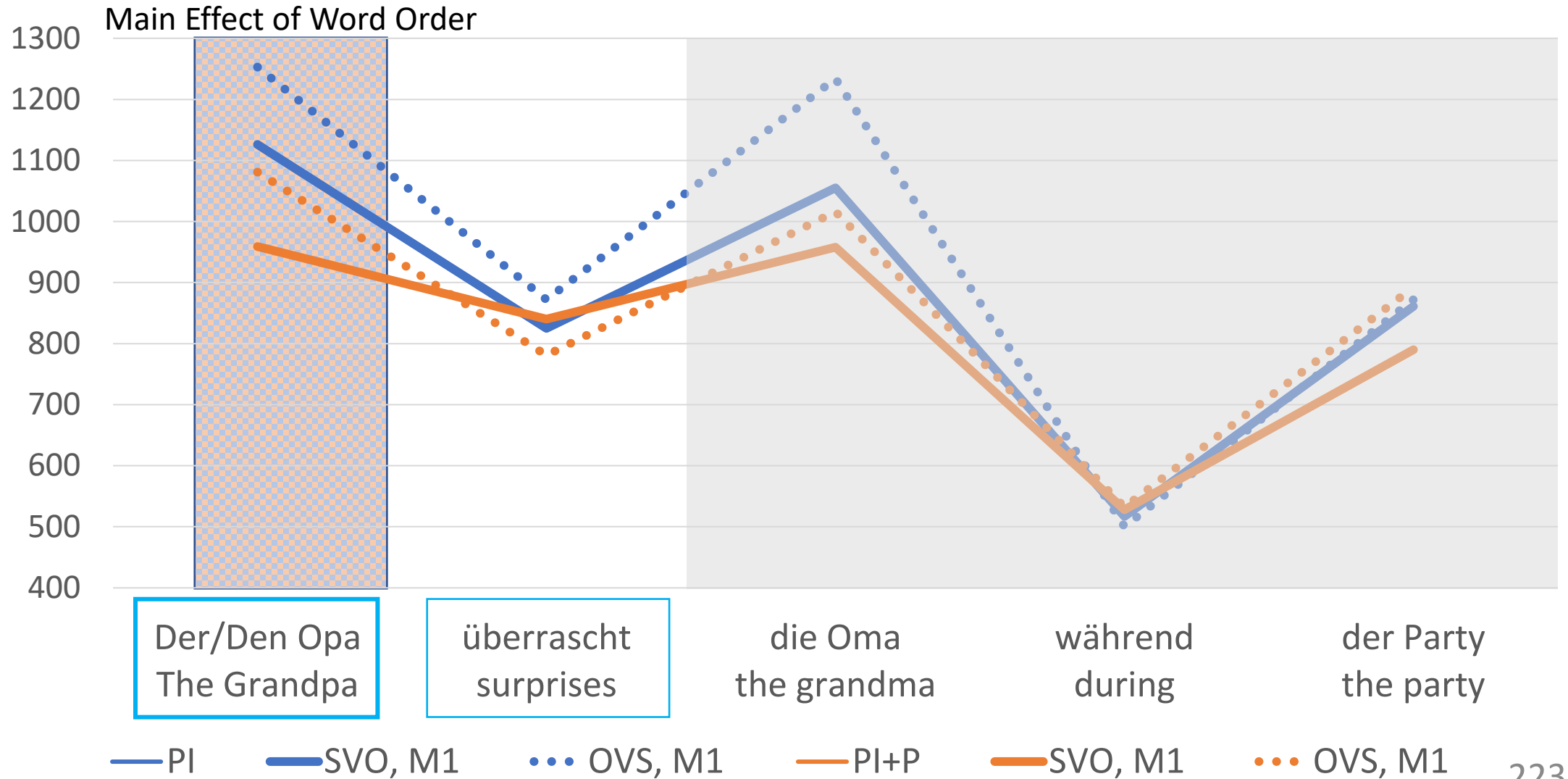
- M1st [a. **Der Opa** / überrascht / die Oma / während / der Party. (SVO)
b. **Den Opa** / überrascht / die Oma / während / der Party. (OVS)
- M2nd [c. Die Oma / überrascht / **den Opa** / während / der Party. (SVO)
d. Die Oma / überrascht / **der Opa** / während / der Party. (OVS)

“The (**grandfather/ grandmother**) surprises the (**grandmother/ grandfather**) during the party.”

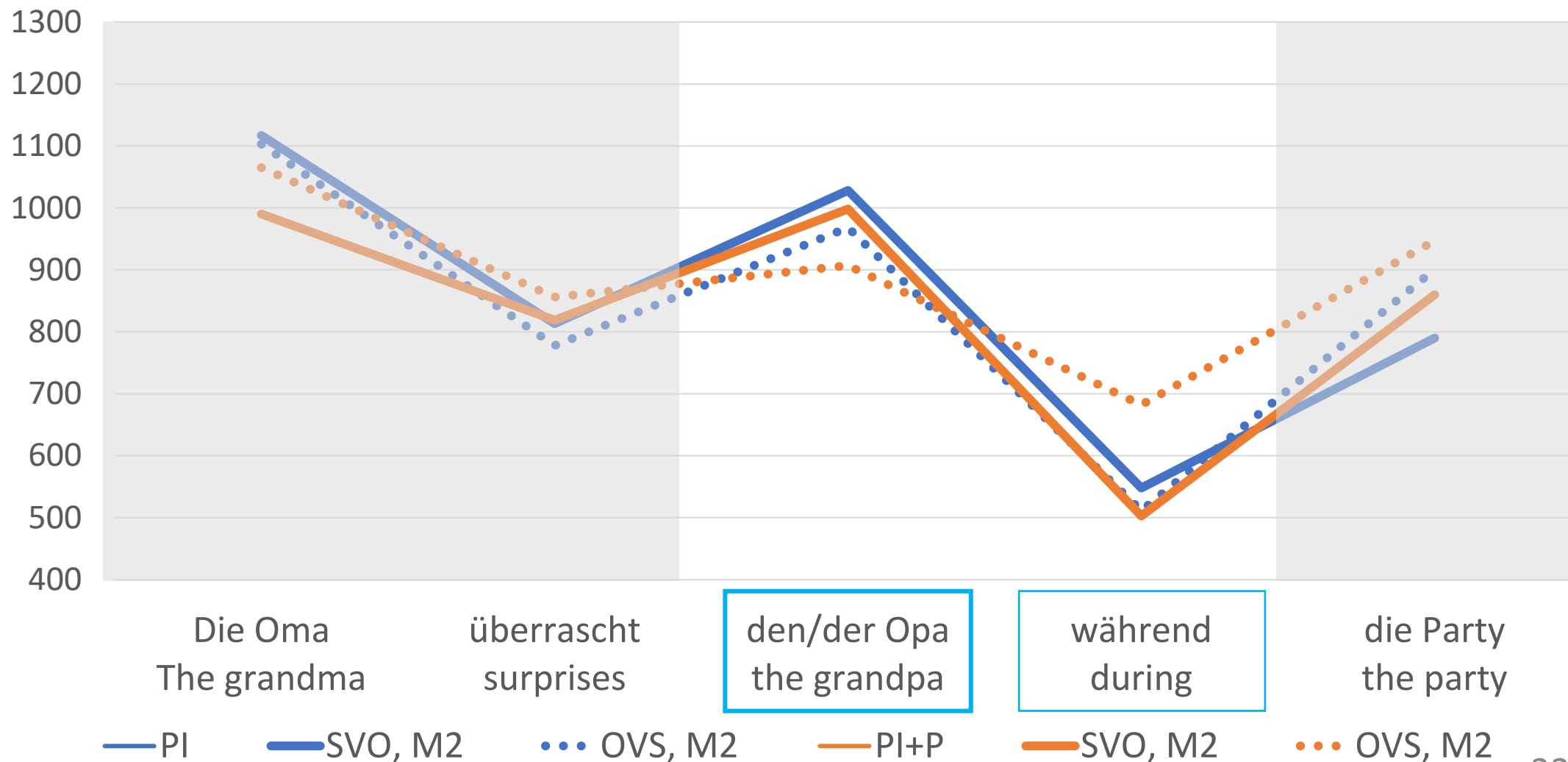
SPR Posttest: Masculine First Items



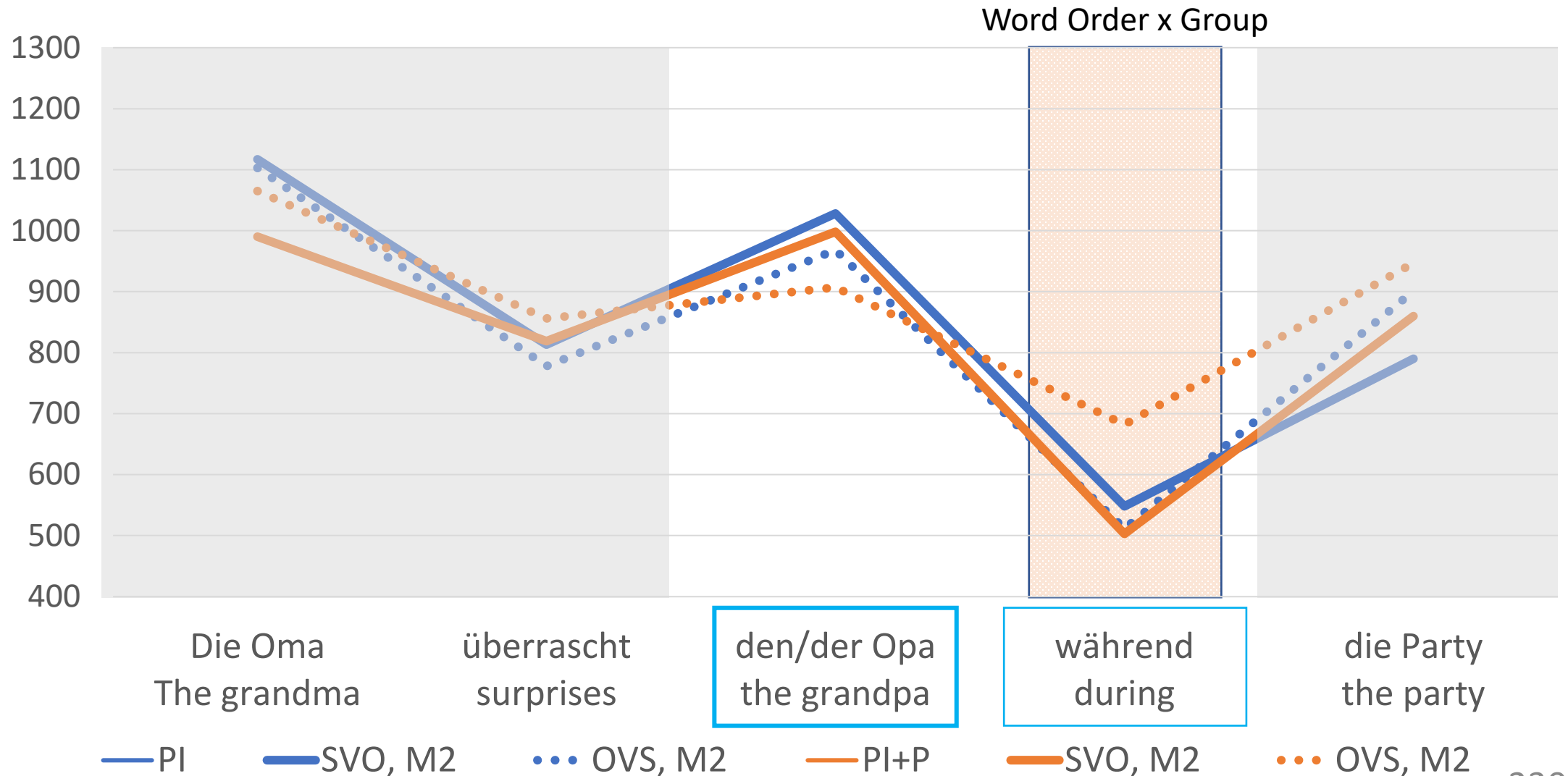
SPR Posttest: Masculine First Items



SPR Posttest: Masculine Second Items



SPR Posttest: Masculine Second Items



Discussion

- After training, participants were better able to identify, extract, and integrate case cues, representing a movement towards the native-like processing pattern. In Masculine-Second sentences, only the PI+P group also had elevated reading times on OVS sentences (though this effect was delayed until the spillover region).
- This pattern indicates that, although the PI+P group may have processed case markers less automatically when found in NP2, they were sensitive to case marking in all conditions and processed these forms quickly.
- These results support emerging evidence that prosodic information supports syntactic processing (Henry et al., 2020), and helps learners identify important cues to word order, create form-meaning mappings, and use those forms online.

Conclusions

- Although L2 research has often treated the development of morphology and phonology separate, it is clear that phonology can affect the acquisition and use of morphology in several key ways:
 - First, by influencing what can or cannot be detected in the input.
 - Second by helping learners to identify the linguistic meanings for morphological forms.
 - Third by supporting processing of morphological forms.
- Phonological factors in input processing need to be investigated more seriously and incorporated into models of input processing.

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- Jack DiMidio

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