Does production of verbal inflection precede comprehension? Evidence from eyetracking

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March 4th 2009

Previous findings – Production

Brown (1973) – English

- production of 3rd person singular /-s/
- spontaneous speech
- 90 % correct use in obligatory contexts: 2;2 to 3;10

Rice & Wexler (2002) – English

- production of 3rd person singular /-s/
- elicited production
- 90% correct use in obligatory contexts: 4 years

Previous studies – Comprehension

Johnson, de Villiers & Seymour (2005) - English

- Comprehension of verbal affixes
- number-contrast: 3rd pers. singular vs. 3rd person plural
- picture-choice comprehension task

  The duck swims on the pond. (sg) vs. *The ducks swim on the pond.* (pl)
- 3 – 4 year-olds: no sensitivity
- 5 – 6 year-olds: correct comprehension

→verbal affix /-s/ does not seem to be a transparent marker of number for younger English-speaking children

Previous studies – Comprehension

Perez-Leroux (2006) - Spanish

- Comprehension of verbal affixes
- number contrast: 3rd pers. singular vs. 3rd pers. plural
- picture-selection comprehension task
- subject-drop sentences

  Nada en el charco. (sg) vs. *Nadan en el charco.* (pl)

  ‚(The duck) swims on the pond.' vs. ‚(The ducks) swim on the pond.'
- 3;2 – 4;5 years: chance-level performance
- 4;8 – 6;6 years: sg: chance-level; pl: 67% correct

- →verbal affixes do not seem to be a transparent marker of number for children learning a pro-drop language

Previous studies

Preliminary conclusions:

- Correct production between the age of 2 to 4 years
  (Brown, 1973; Rice & Wexler, 2002)
- Correct comprehension using picture-selection-tasks not before 5 years of age
  (Johnson et al., 2005; Perez-Leroux, 2006)

→ **Production-comprehension-asymmetry** for inflectional affixes in English and Spanish

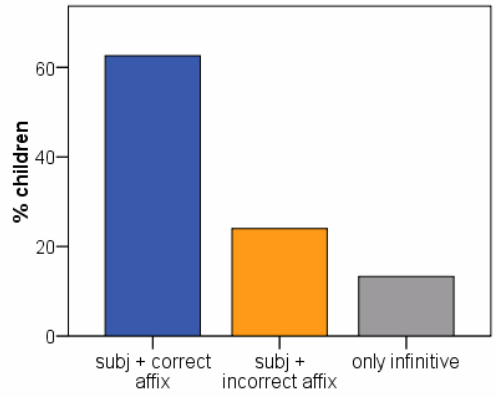
Research questions

- Is there a **production-comprehension asymmetry** for verbal inflections in German?
  - At what age do German children master the **production** of verbal inflections that mark number?
  - At what age do German children show **comprehension** of verbal inflections that mark number?
- Can the employment of a different paradigm (IPLP) reveal earlier comprehension than found for English and Spanish children?

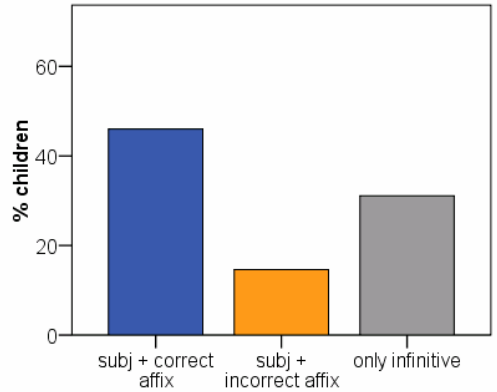
Early production – ELFRA (Grimm & Doil, 2000)

- 150 children acquiring German (mean age: 2;0.15)
  - only children not at risk for SLI (prod. vocab >50 words)
  - mean vocab score: 147 words

- 3rd person **singular**:
  - sg. subject + correct verbal affix (-t): **62,6%**
  - sg. subject + infinitival form (-n): **24%**
  - only infinitival form (-n): **13,3%**



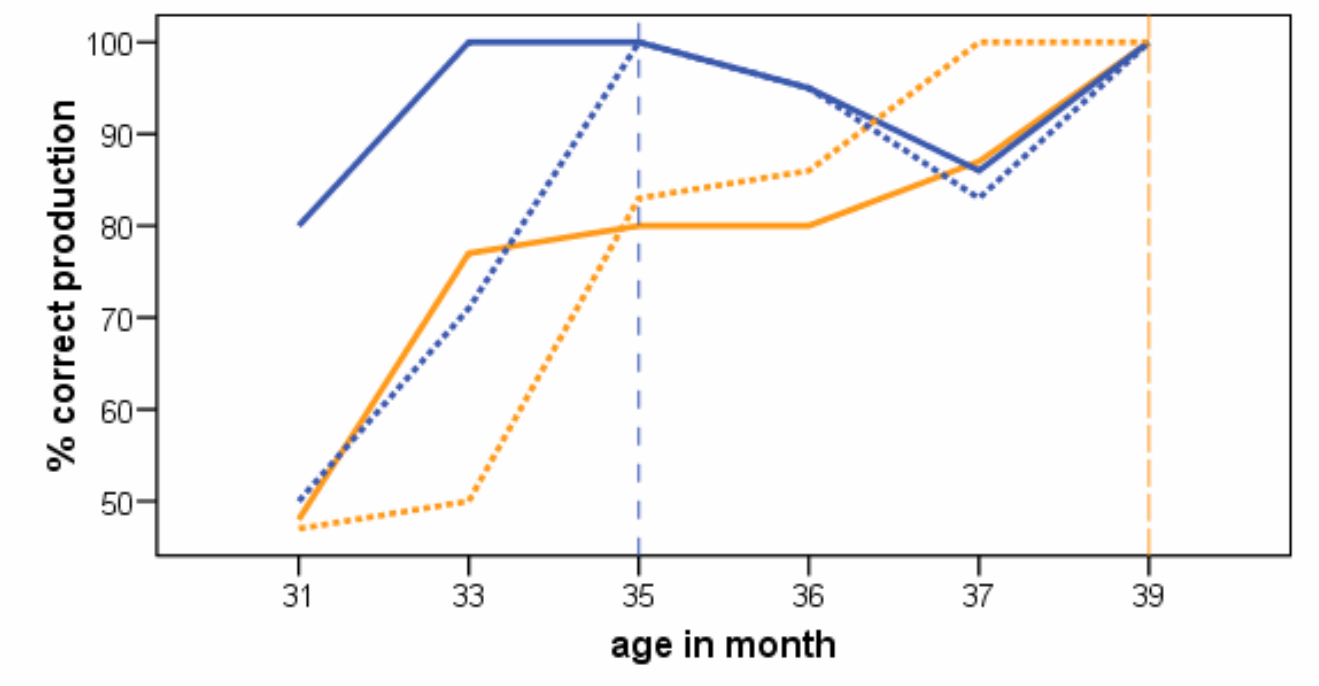
- 3rd person **plural**:
  - pl. subject + correct verbal affix (-n): **46%**
  - pl. subject + 3. pers. singular affix (-t): **14,6%**
  - only infinitival form (-n): **31,1%**



Early production – Clahsen (1986)

- 2 children acquiring German (1;6 – 3;6 years)
- use of verbal inflections in spontaneous speech

- >90 % correct use of 3rd person singular affix (-t): 2;11 years
- >90% correct use of 3rd person plural affix (-n): 3;3 years



	Verb	
	SG	PL
Child 1	____	____
Child 2	.....	.....

Early production – parental questionnaire

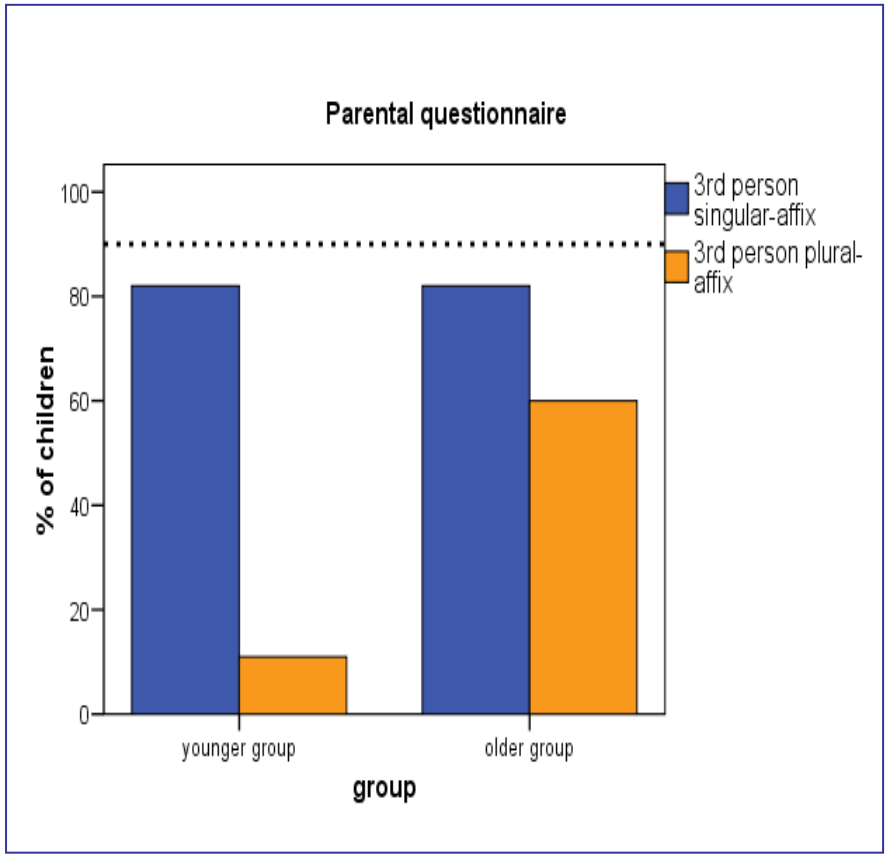
Children in experiment 1 & 2:

Younger group:

- N = 17 (9 male)
- mean age: 2;5 (range: 1;8 – 2;11)
- production of 3rd person singular: **82%**
- production of 3rd person plural: **11%**

Older group:

- N = 45 (25 male)
- mean age: 3;7 (range: 3;0 – 4;2)
- production of 3rd person singular: **82%**
- production of 3rd person plural : **51%**



Early production - Conclusions

→ 2 years: no mastery of 3rd person singular and 3rd person plural

→ 3;7 years: almost productive mastery of 3rd person singular, but no mastery of 3rd person plural affix

→ some children produce 3rd person singular and 3rd person plural correct around the age of 3 years.

→ 3rd person singular > 3rd person plural

→ Even at 3;7 not all German-speaking children produce verbal inflectional affixes up to 90% correct

Present experiments

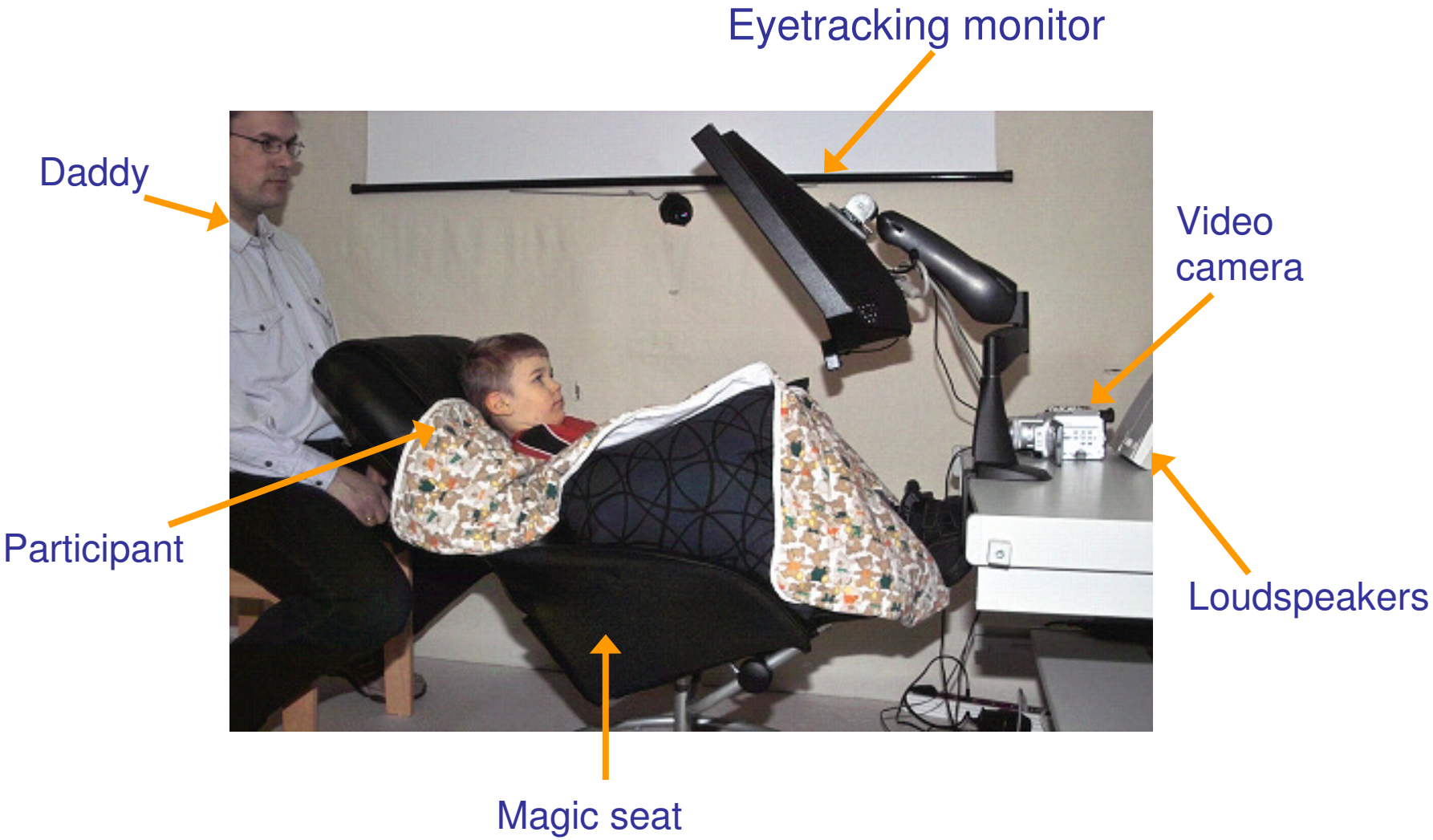
Experiment 1:

- Intermodal Preferential Looking Paradigm (IPLP) using Tobii Eyetracking System
- No explicit task demands
- Participants: children and adults

Experiment 2:

- IPLP using Tobii Eyetracking System
- Additional explicit pointing task
- Participants: children

Tobii (1750) Remote Eyetracker



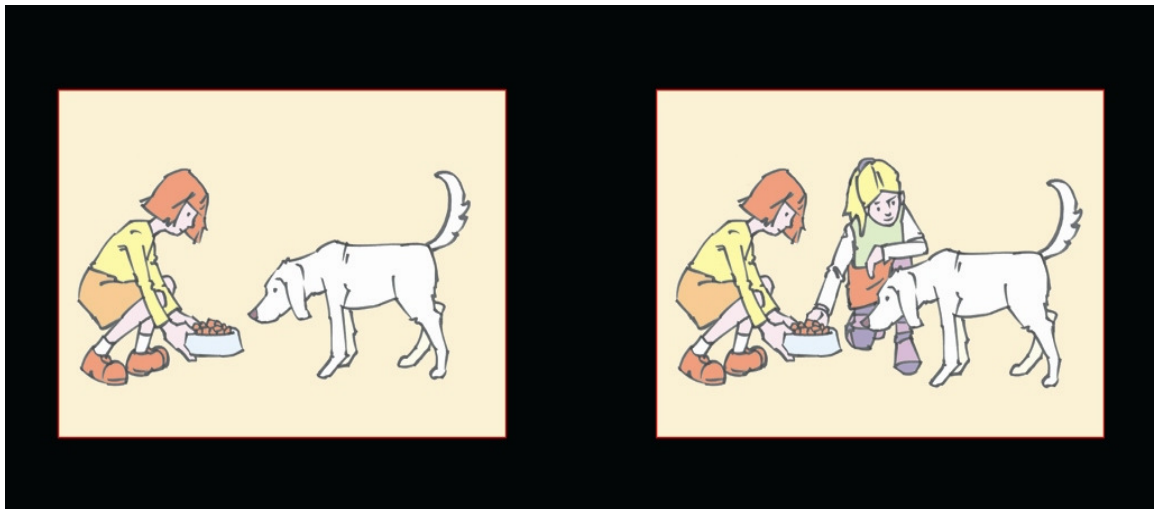
Design

2 verbal conditions:

SG: *Sie fütter-**t** einen Hund.*
‚She is feeding a dog.

PL: *Sie fütter-**n** einen Hund.*
‚They are feeding a dog‘

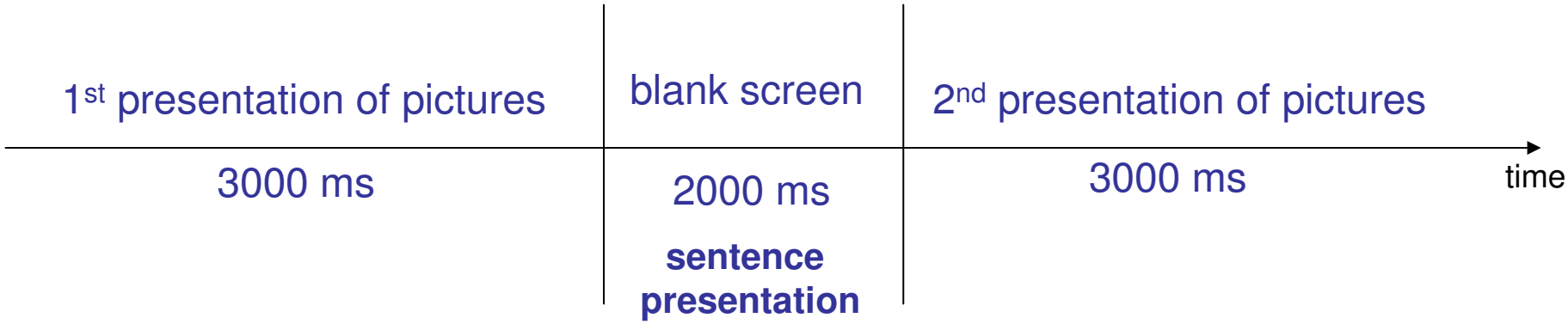
corresponding pictures



subject pronoun: ***sie*** → homophone in German

- 3rd person singular female (‘she‘)
- 3rd person plural (‘they‘)

Procedure and Data Analysis



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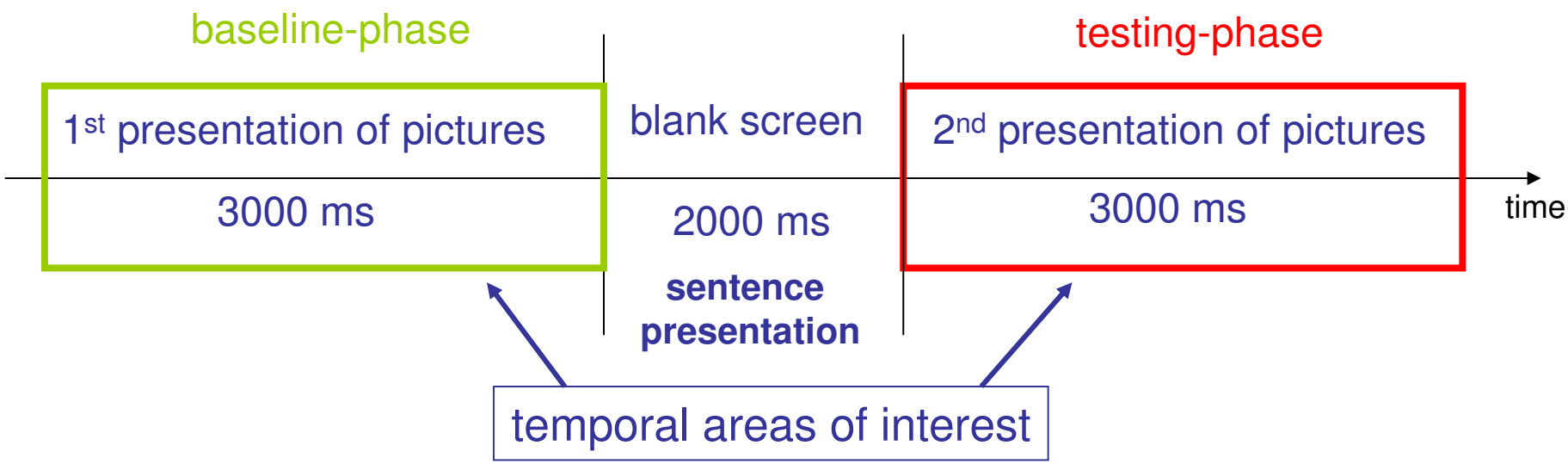

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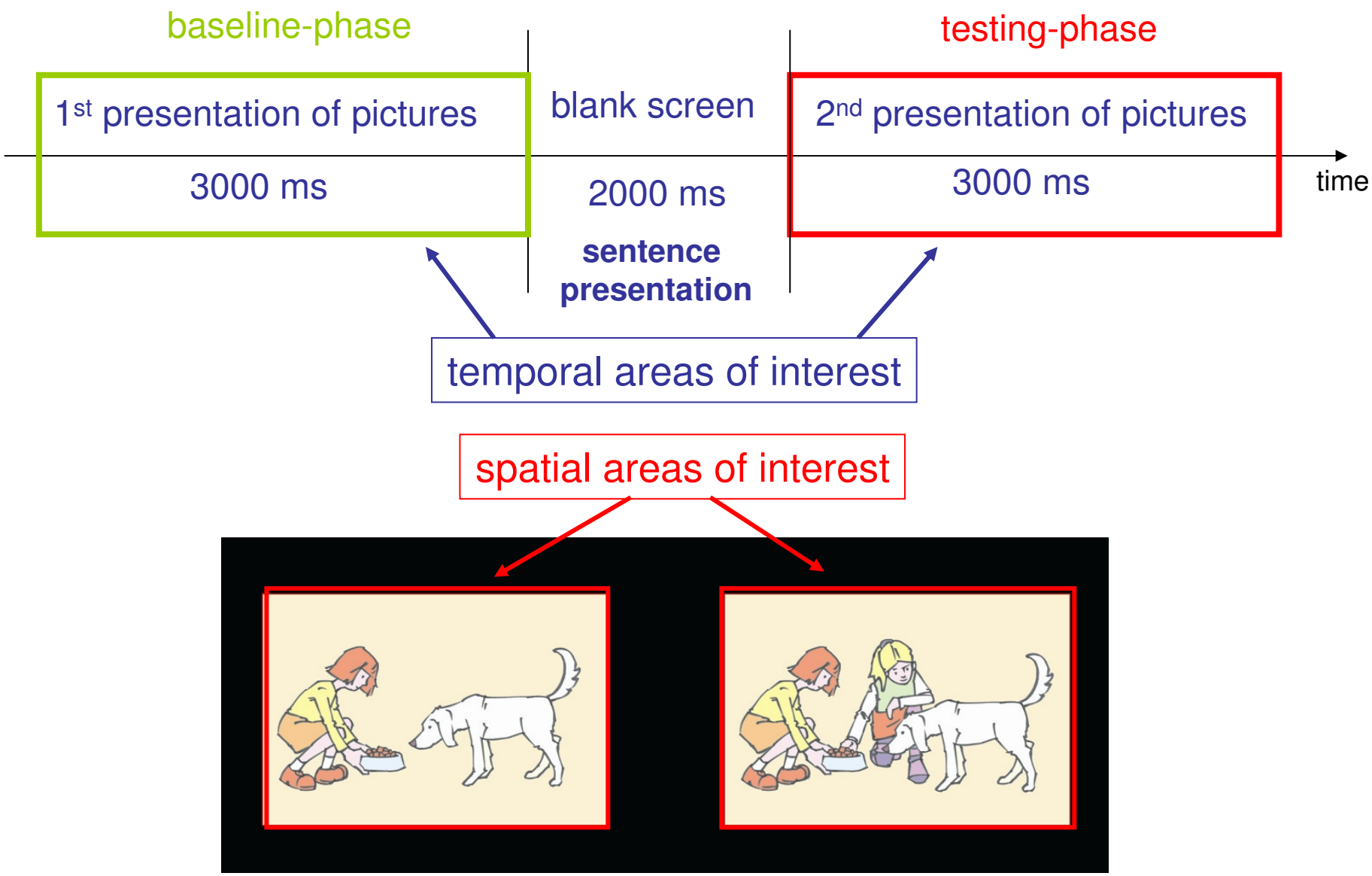


Data Analysis

Eyetracking-Data

- Fixation: min. 100ms, max. radius 30 pixels
- Dependent measure:

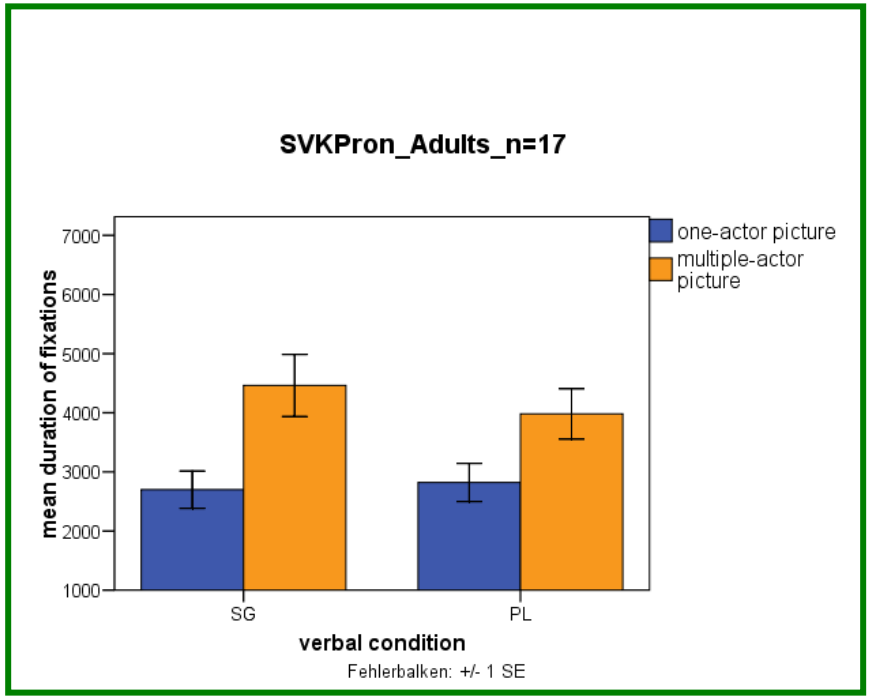
  total amount of fixation time to the corresponding and non-corresponding picture (summed over single fixations and trials)
- Sums of fixation durations are averaged across participants

Experiment 1 – Participants

- **Children**:
  - 50 children tested
    - 7 discarded from analyis because of fuzziness (3), not enough fixations (3), being bilingual (1)
  - 2 age groups:
    - **younger group (2-3; N=17; mean: 2;5; range: 1;8 – 2;11; 9 male)**
    - **older group (3-4; N=27; mean: 3;6; range: 3;0 – 4;2; 16 male)**
- **Adults**:
  - 17 adults tested
  - mean: 26 years (21-42 years), 1 male

Exp. 1: Results – Adults

before sentence presentation

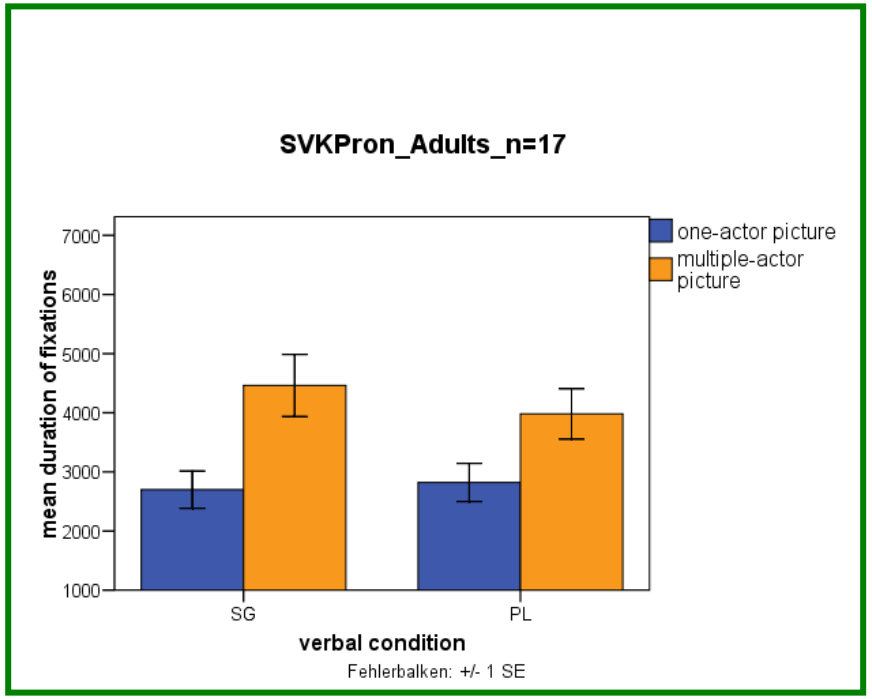


no interaction (verbal condition*picture)
$F_{1,16} < 1$

main effect for picture
$F_{1,16} = 18{,}581$; $p=.001$

Exp. 1: Results – Adults

before sentence presentation



no interaction (verbal condition*picture)
$F_{1,16} < 1$

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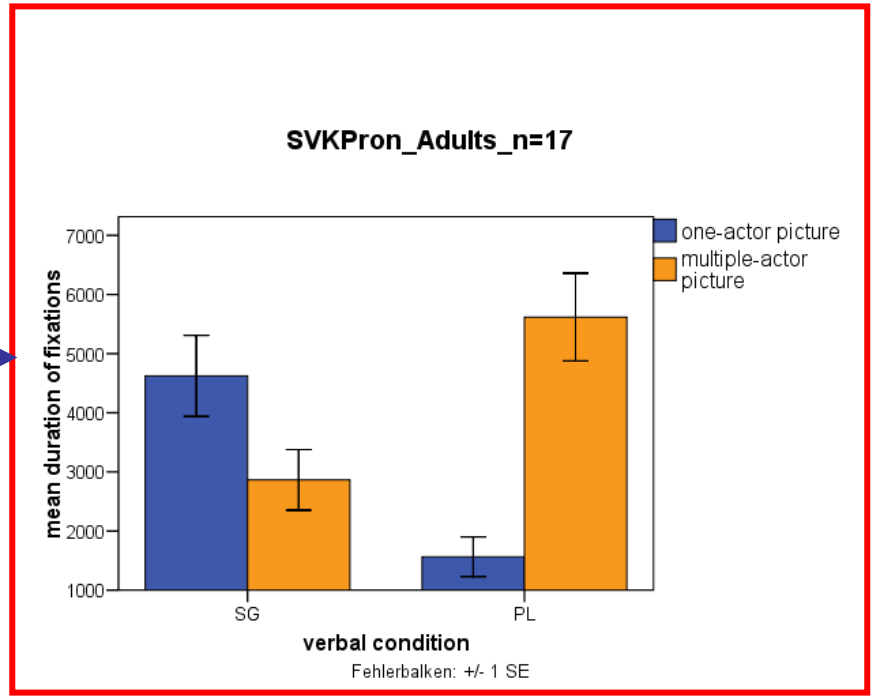
$F_{1,16} = 18{,}581$; p=.001

after sentence presentation

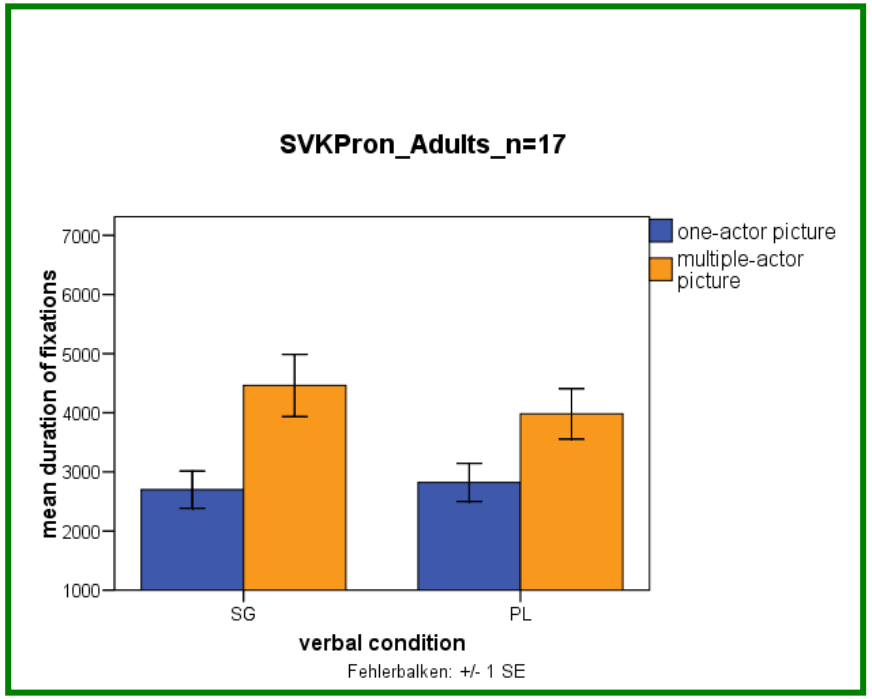


interaction (verbal condition*picture)
$F_{1,16} = 12{,}712$, p=.003

main effect for picture
$F_{1,16} = 8{,}141$; p=.012

Exp. 1: Results – Adults

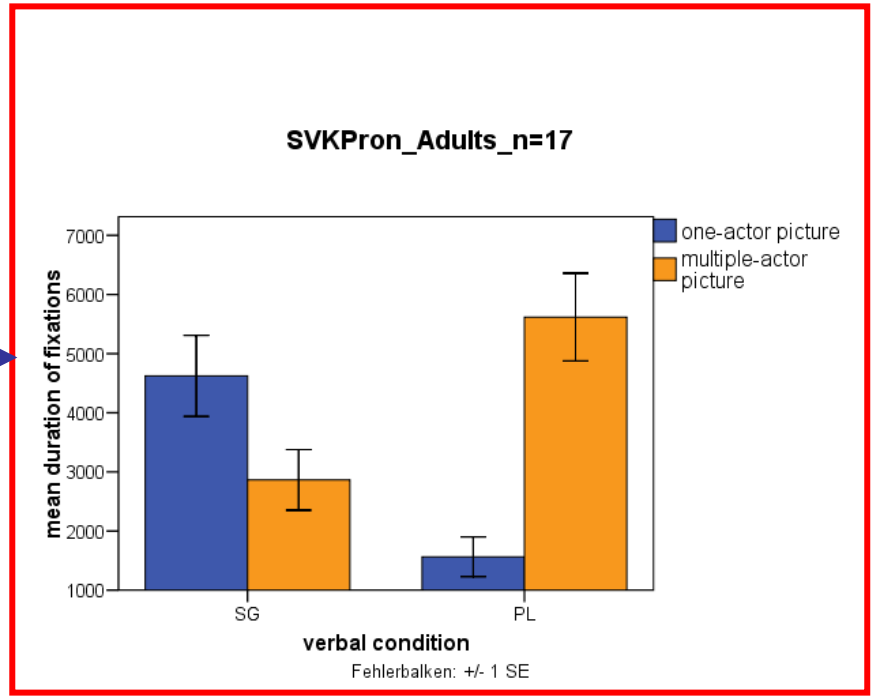
before sentence presentation



no interaction (verbal condition*picture)
$F_{1,16} < 1$

main effect for picture
$F_{1,16} = 18{,}581$; p=.001

after sentence presentation



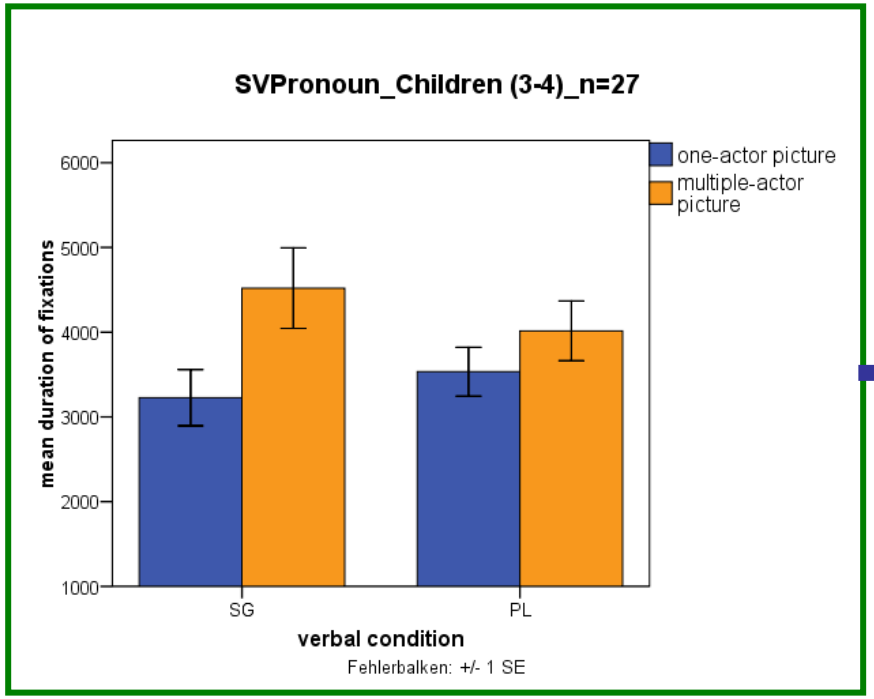
interaction (verbal condition*picture)
$F_{1,16} = 12{,}712$, p=.003

main effect for picture
$F_{1,16} = 8{,}141$; p=.012

→ significant 3-way-interaction (time*verbal condition*picture): $F_{1,16} = 11{,}7$; p=.003

Exp. 1: Results – Children (3-4 years)

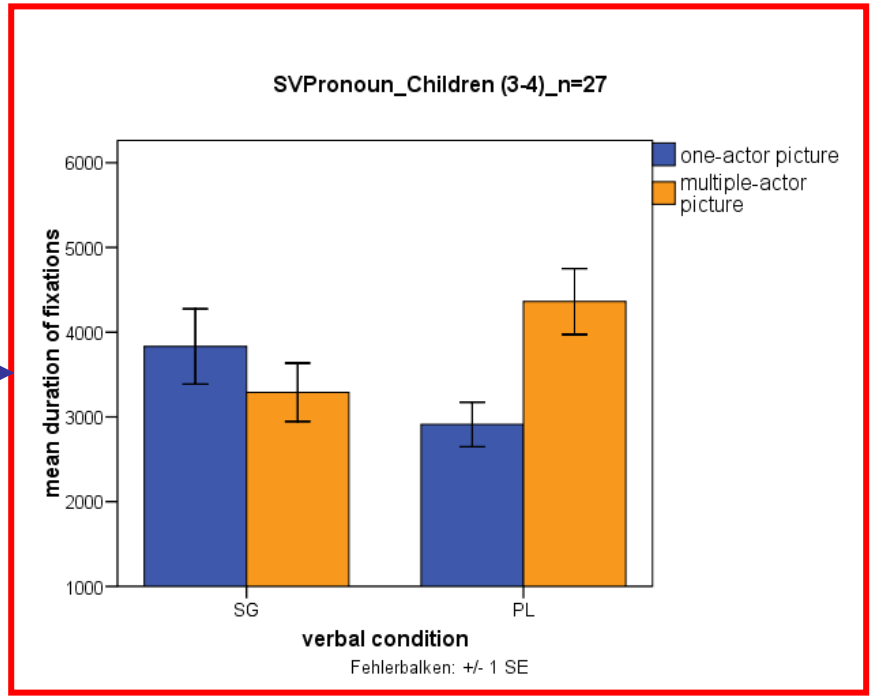
before sentence presentation



no interaction (verbal condition*picture)
$F_{1,26}$ = 1,6; p>.1

main effect for picture
$F_{1,26}$ = 8,616; p=.007

after sentence presentation



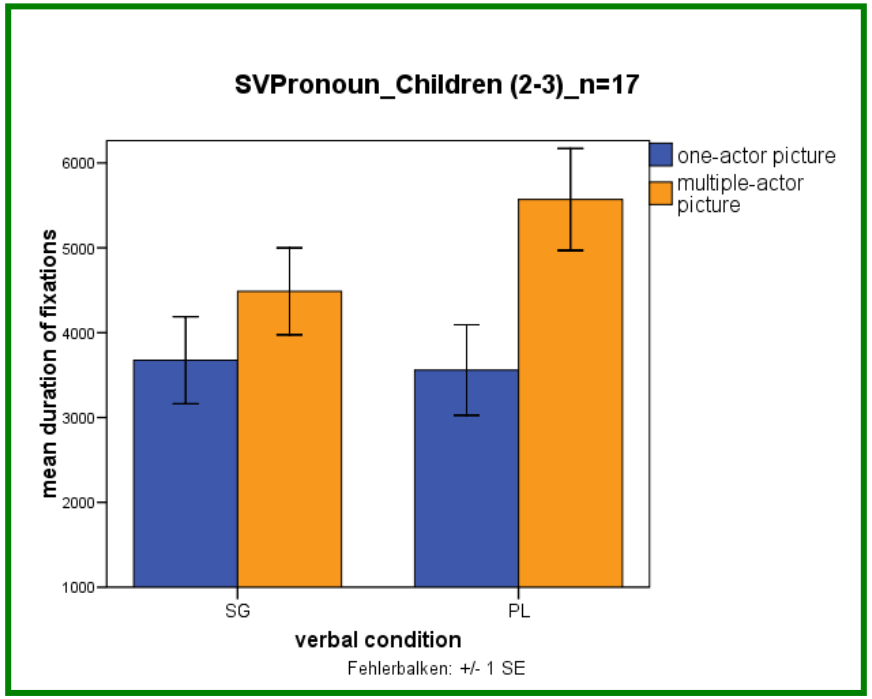
interaction (verbal condition*picture)
$F_{1,26}$ = 10,7, p=.003

no main effects

→ significant 3-way-interaction (time*verbal condition*picture): $F_{1,26}$ = 8,4; p=.008

Exp. 1: Results – Children (2-3 years)

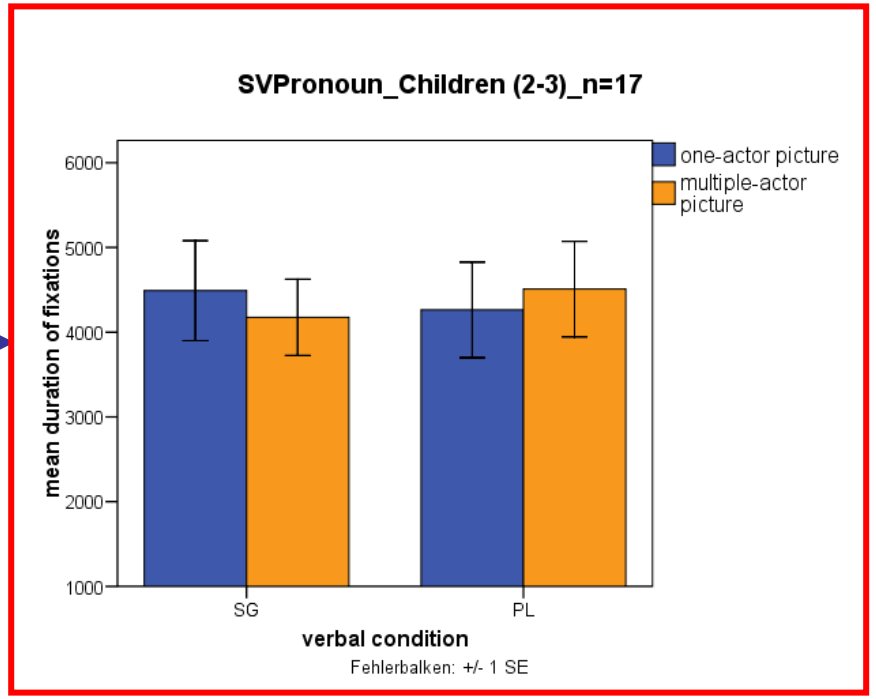
before sentence presentation



no interaction (verbal condition*picture)
$F_{1,16} = 1{,}6$; $p>.1$

main effect for picture
$F_{1,16} = 4{,}623$; $p=.048$

after sentence presentation



no interaction (verbal condition*picture)
$F_{1,16} < 1$

no main effects

→ NO significant 3-way-interaction (time*verbal condition*picture): $F_{1,16} < 1$

Experiment 1 – Discussion

- Interpretation of fixation pattern:
  - Baseline phase: participants show a strong tendency to fixate the multiple-actor picture longer

    = bias for multiple-actor picture

  - testing phase: adults and 3-4 year old children
    - SG-verb: bias gets overriden
    - PL-verb: bias stays the same

  - testing phase: 2-3 year old children
    - no different looking pattern in relation to verbal inflection

→ older children‘s and adults‘ looking behaviour is affected by verbal input, younger children‘s not!

Preliminary Discussion

- Correct understanding of 3rd person singular inflected verbs found in 3-4 year old German children!

- This contrasts with earlier findings for English and Spanish. (Johnson et al., 2005; Perez-Leroux, 2006)

→ Due to low task demands in IPLP-experiments?

→ Due to absence of any instruction in IPLP-experiments?

Experiment 2

- IPLP combined with pointing task
- **explicit instructions**
  - „Show me the picture which fits better to the sentence you hear!“
- **explicit task demands**
  - pointing
- looking and pointing data were obtained in one session

Experiment 2 – Participants

Children:

- n = 18
- mean age: 3;8 (age range: 3;2 – 4;4)
- 9 male, 9 female
- children had not participated in Experiment 1

Experiment 2 – Data Analysis

1. Eyetracking Data

   → same analysis as in Experiment 1

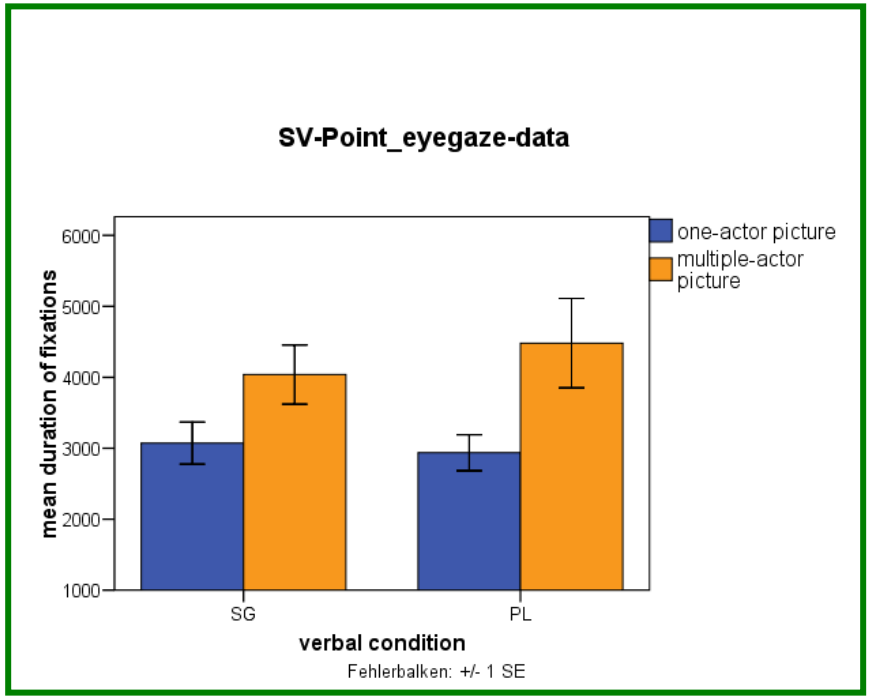
2. Pointing Data

   → coding if children pointed to the corresponding or non-corresponding picture

   maximal timespan in testphase: 15 seconds

Exp. 2: Results – Children (3-4 years)

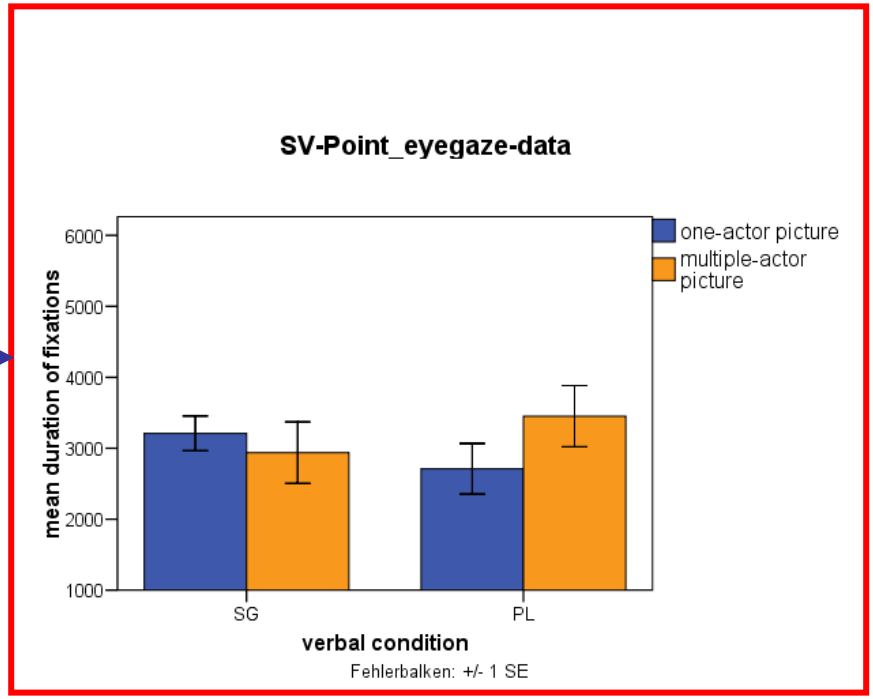
before sentence presentation



no interaction (verbal condition*picture)
$F_{1,17} < 1$

main effect for picture
$F_{1,17} = 8{,}295$; $p=.01$

after sentence presentation



no interaction (verbal condition*picture)
$F_{1,17} = 2{,}643$; $p>1$

no main effect

→ NO significant 3-way-interaction (time*verbal condition*picture): $F_{1,17} < 1$

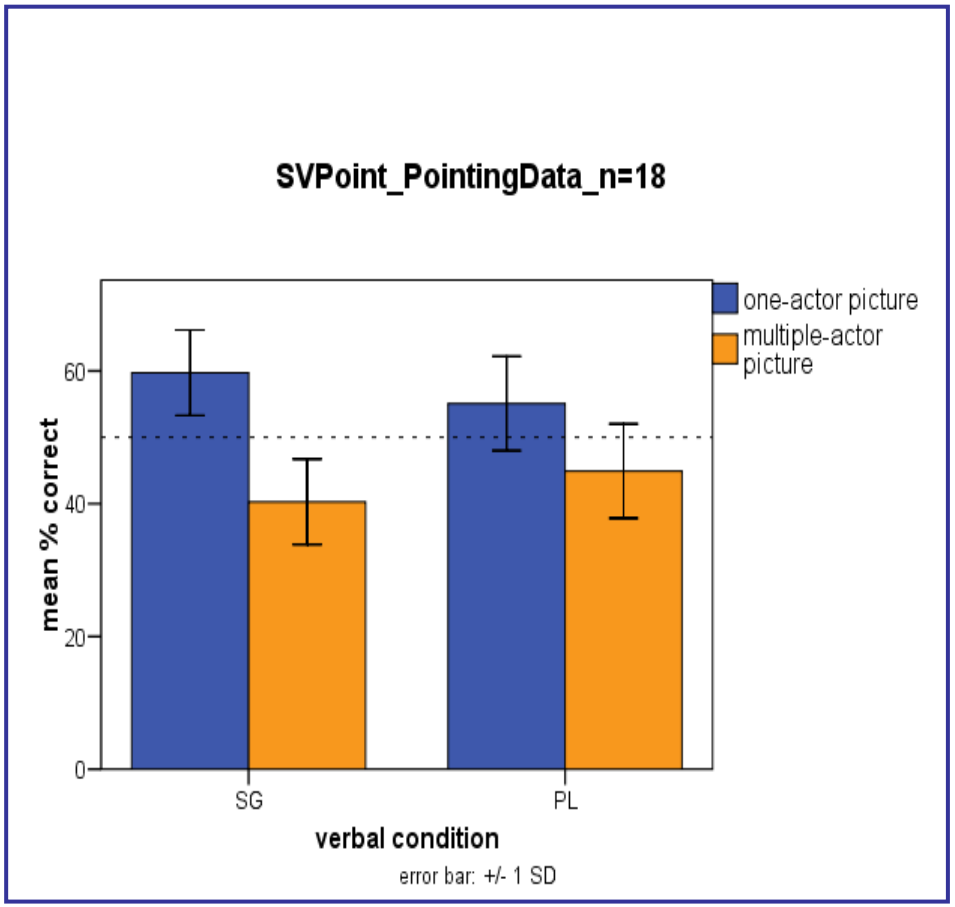
Exp. 2: Results – Pointing Data

Children (3 – 4 years)

- no interaction
  (verbal condition * picture)
  $F_{1,17} < 1$

- no main effects
  SG-verb: $F_{1,17} = 2{,}282$; $p > .1$
  PL-verb: $F_{1,17} < 1$

- no statistical difference from chance-level



Experiment 2 – Discussion

- Eyetrack-Data:
  - no significant results, but
  - data point into the same direction as in pure IPLP-Experiment (Exp.1)
  - shorter looking times are obtained altogether

- Possible explanation:
  - children have to make an explicit decision for the pointing-reaction – this probably leads to less fixations and less stable looking patterns

- Pointing-Data:
  - results do not show understanding of verbal inflectional affixes
  - not even comprehension of singular-affix (-t) can be proved

Summary of results

- Adults looking behaviour is affected by verbal input → IPLP-paradigm is suitable for testing the comprehension of morphological markers
- children aged 3-4 years do show comprehension of verbal inflectional affixes (at least singular-affix) in pure IPLP task
- for children aged 2-3 years, comprehension of verbal inflectional affixes can not be shown
- using a pointing-task understanding of verbal inflectional affixes in children aged 3-4 years can not be shown

Conclusion

1. IPLP- vs. Pointing-data

- The more indirect testing paradigm reveals sensitivity to and comprehension of morphological markers, while this cannot be found using an explicit picture-pointing task.

- Preferential Looking-experiments seem to provide more sensitive data than picture-pointing.

- More direct comparisons of paradigms using different (morphosyntactic) structures are needed.

Conclusion

2. Singular-plural:

- Both production and comprehension data show an earlier mastery of singular-inflected forms than plural-inflected forms.

- this might be due to:
  - semantic-pragmatic difficulty concerning plurality
  - for German (and English): homophony between infinitival and 3rd person plural-inflected verbs
  - input-frequency

Conclusion

3. Production-comprehension-asymmetry?

- In German-speaking children, no production-comprehension gap for verbal inflections can be found:
  - productive mastery at the age of 3;7
  - comprehension found at the age of 3;7 (IPLP – Exp. 1)
- contrary to findings and interpretations of Johnson et al. (2005) and Perez-Leroux (2006)
- more comparisons on a single-subject basis are needed!

Thank you!