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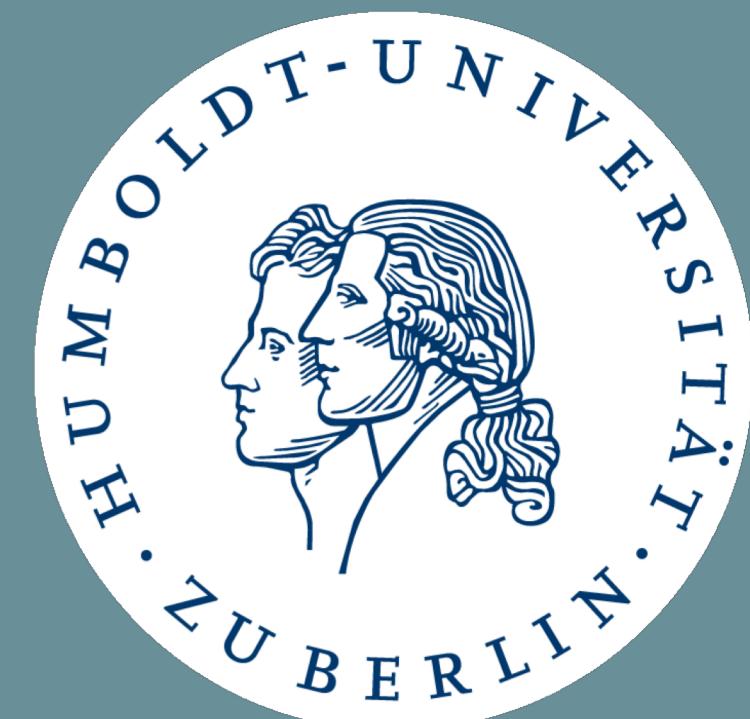
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Lexical versus compositional World-Language Relations: Event-Related Brain Potential effects during Second Language Processing

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Motivation

- Overt verification (hearing *piano* and matching it to its referent) occurs incrementally in native language comprehension.
- distinct by type: lexical verb-action relations are processed distinctly from compositional role relations (Knoeferle et al., 2014).
- For language learning, verification might also be relevant. Learners must:
 - identify words & thematic role relations
 - relate language to referents
 - verify (mis)match
 - convey matches to memory
- Argument for verification-in-learning receives support from backpropagation (verifying error between actual and target output to help learning, Elman, 1990; Rumelhart et al., 1986).
- (In)congruence and contrast are also key in human studies on learning (e.g., Yu & Smith, 2012) and language processing (Koehne & Crocker, 2014).

The Study (pilot)

Participants:

- 16 right-handed monolingual German adults (18-30 years, f=8) with advanced knowledge of English (C1/C2)

Materials:

- 80 critical + 160 filler items
- Sent. structure : The [SUBJ_NOUN] [VERB] the [OBJ_NOUN]

Method & Design (Fig. 2):

- EEG, word-by-word sentence presentation
- 2 (role match vs. mismatch) x 2 (action match vs. mismatch)
- Task: Please answer as quickly and as accurately as possible. Does the picture match the sentence?
- Yes/No button position counterbalanced

Conditions:

- While the sentence stays the same, the picture varies by condition.

Sentence: *The golfer_{SUBJ_NOUN} entertains_{VERB} the butler_{OBJ_NOUN}.*

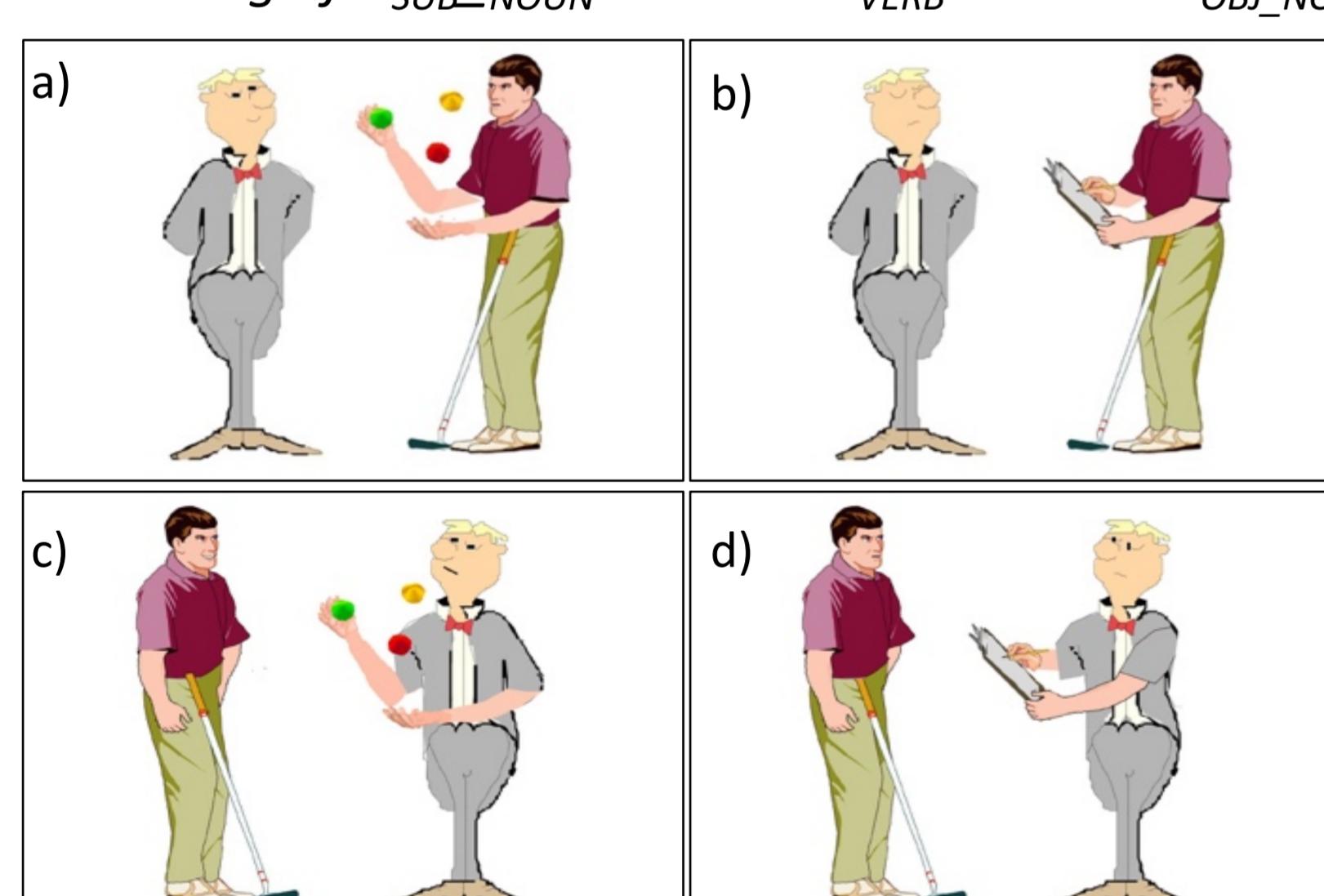


Figure 1:

- a) Example scene for the **full match** condition
- b) Example scene for the **action mismatch** condition
- c) Example scene for the **role mismatch** condition
- d) Example scene for the **full mismatch** condition

Preprocessing:

- Bandpass filter 0.016-100 Hz
- Baseline correction -200 for SUBJ_NOUN
- Baseline correction -100 for VERB and OBJ_NOUN
- Offline re-referencing to average of left and right mastoid
- Epochs contaminated by artifacts (e.g., blinks) excluded

Current research

If verification-in-comprehension is key in adult second-language (L2) learners too, then their verification should resemble that of L1 natives.

We investigated the functional brain responses associated with lexical (verb-action) and compositional (thematic role relation) mismatches in advanced L2 comprehenders.

Hypotheses

If lexical (verb-action) and compositional (role relation) mismatches are processed much like in native comprehenders, we should replicate results by Knoeferle et al. (2014), that is:

- Larger negativity for role mismatch (vs. match) in SUBJ_NOUN
- Larger negativity for action mismatch (vs. match) in VERB

Procedure

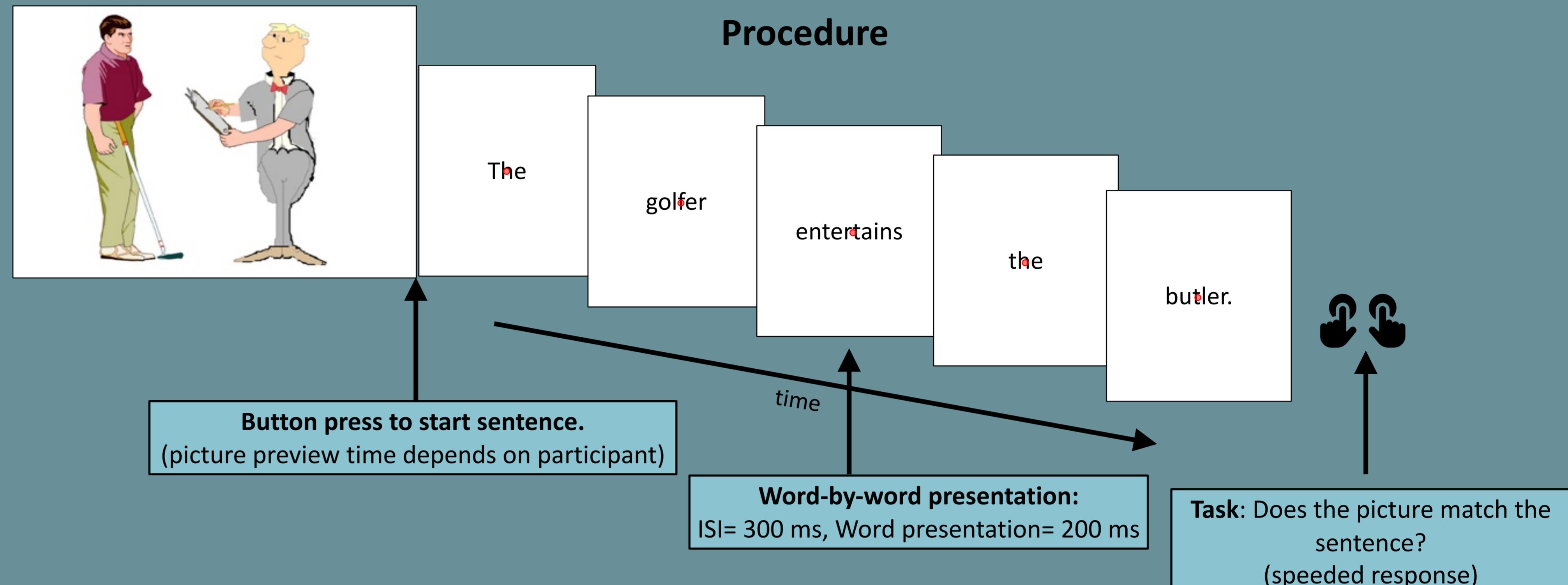


Figure 2: Procedure of a critical trial in condition d) full mismatch, i.e., role relations & action depiction mismatch the sentence
Note: The fixation dot was also present in between words.

Analyses

- Only correctly answered trials
- Word regions: SUBJ_NOUN (e.g., golfer), VERB (e.g., entertains) & OBJ_NOUN (e.g., butler)
- Epochs within each word region from word onset: 0 - 100 ms, 100 - 300 ms and 300 - 500 ms
- Omnibus ANOVA with role (match vs. mismatch), action (match vs. mismatch), hemisphere (left vs. right), laterality (lateral vs. medial) and anteriority (5 levels) as factors
- Bonferroni correction for all post-hoc tests

Results

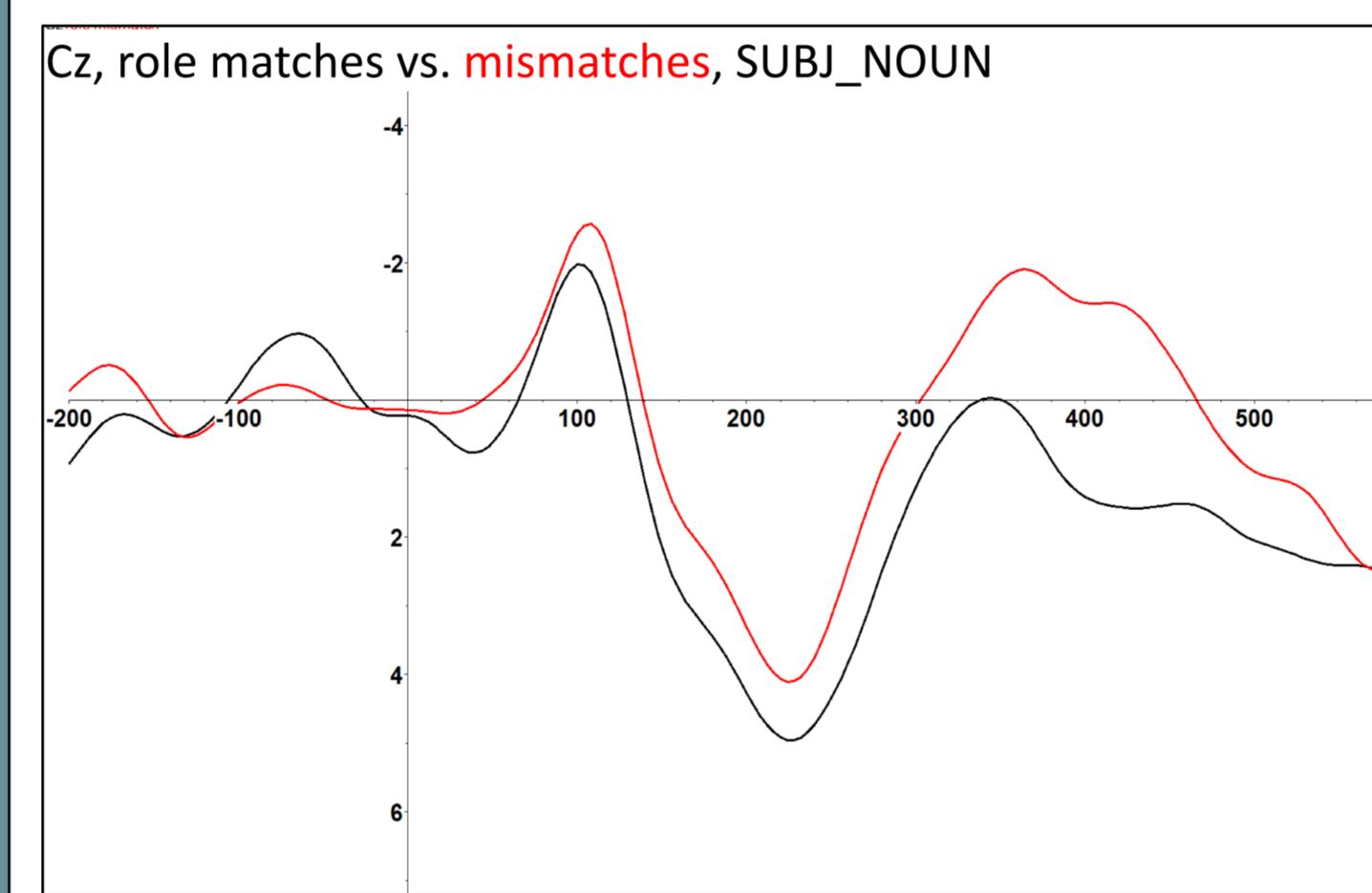


Figure 3: role effect in SUBJ_NOUN

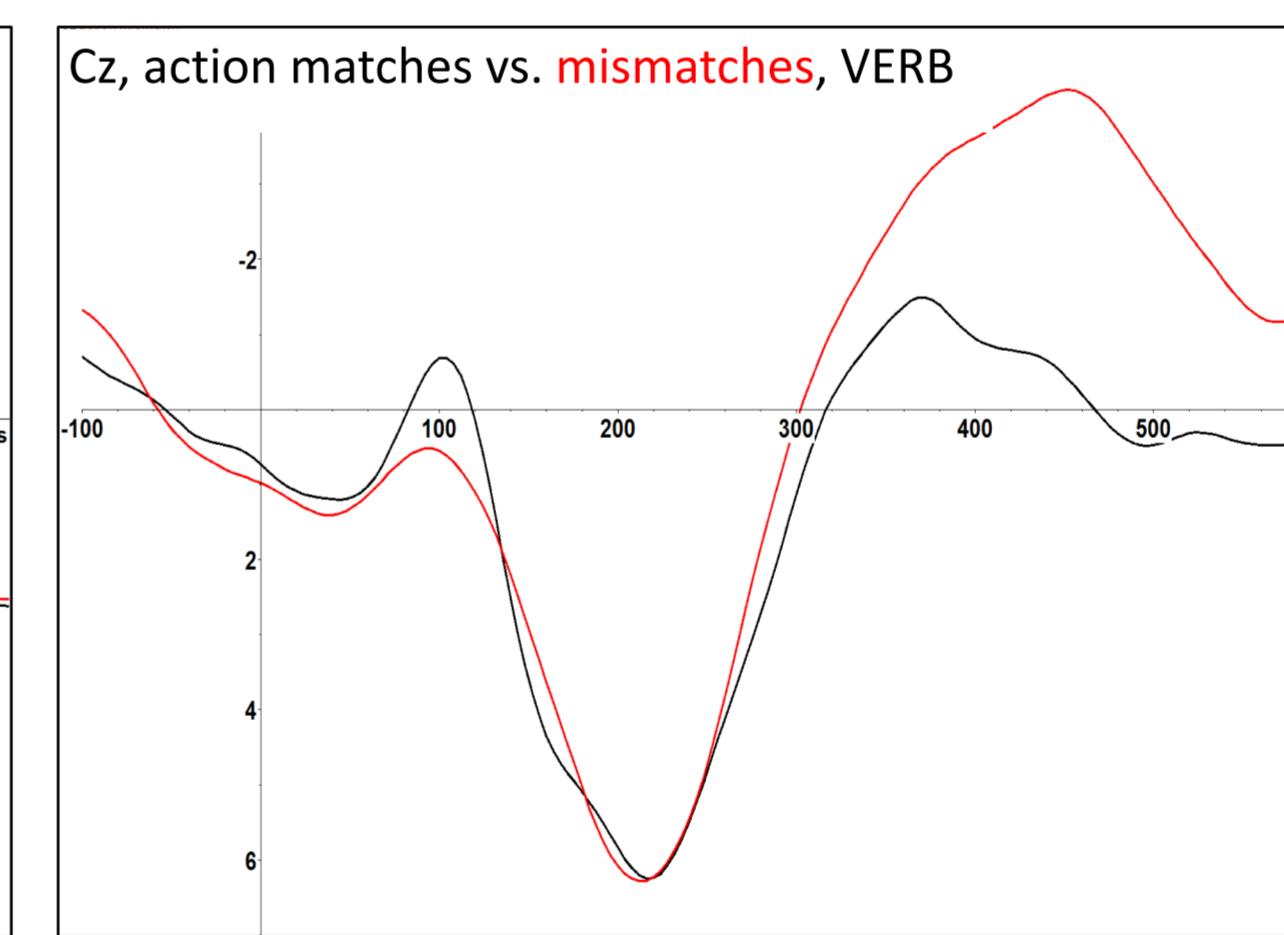


Figure 4: action effect in VERB

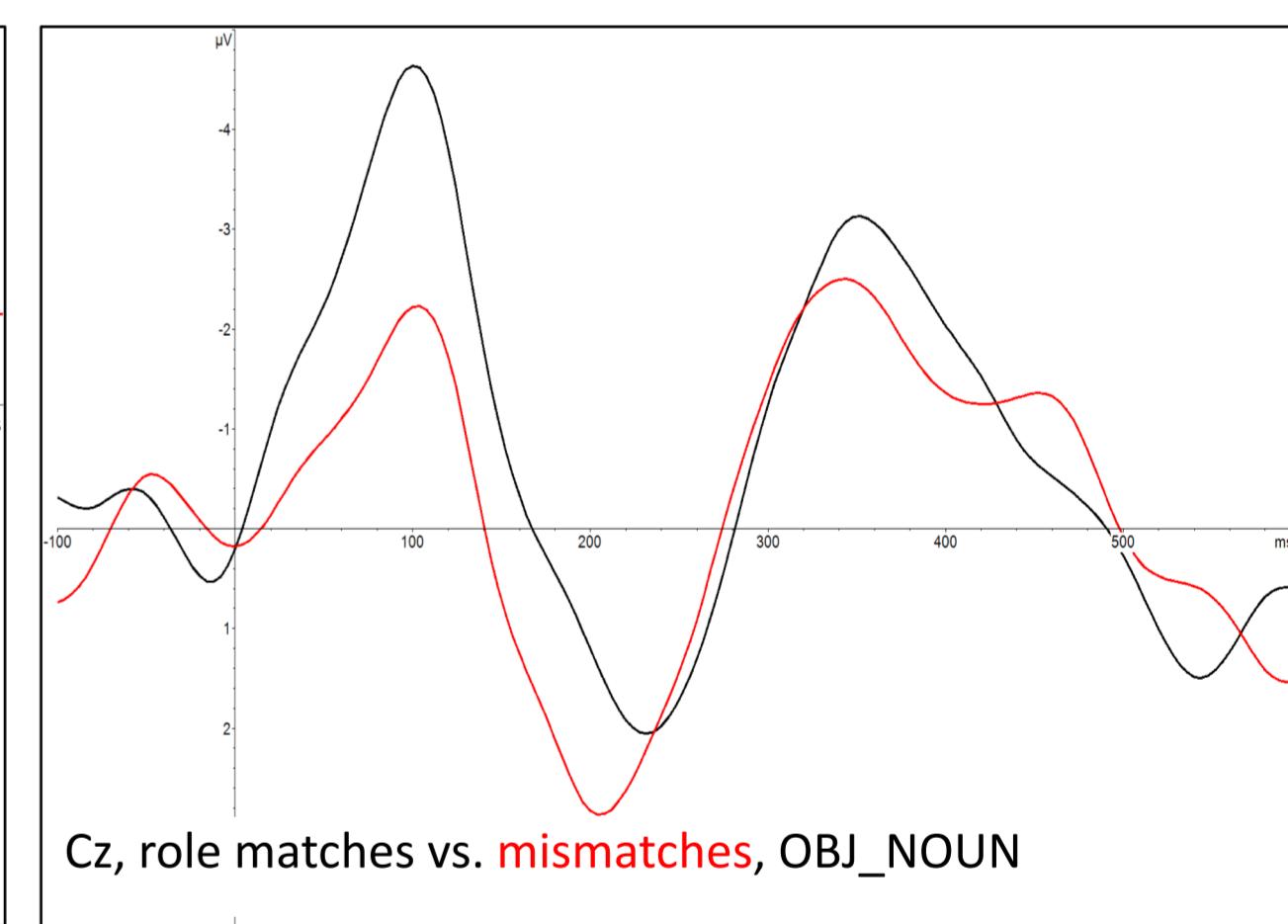


Figure 5: role effect in OBJ_NOUN

Results (replicated):

- Role mismatches: Significantly larger mean amplitude negativities to mismatches (vs. matches)
 - SUBJ_NOUN (*golfer*): 0 - 100 ms, 100 - 300 ms and 300 - 500 ms, **Fig. 3**
 - VERB (*entertains*): 0-100 ms
- Action mismatches: Significantly larger mean amplitude negativities to mismatches (vs. matches)
 - VERB (*entertains*): 300 - 500 ms, **Fig. 4**

Differences between L1 and L2 comprehenders:

L1 comprehension:

- Knoeferle et al., 2014 revealed a main effect of action but not of role congruence to the verb

L2 comprehension:

- A main effect of role congruence emerged to the VERB & early OBJ_NOUN, with larger relative positivities for role mismatches than matches
 - VERB (*entertains*): 300 – 500 ms
 - OBJ_NOUN (*butler*): 0 – 100 ms and 100 – 300 ms (**Fig. 5**)

Discussion and Conclusions

- Advanced L2 comprehenders of English processed role and action (mis)matches in sentence-picture verification studies incrementally, much like L1 comprehenders.
- Verification of lexical (verb-action) mismatches in L2 comprehenders resembled extant results in L1 comprehenders (Knoeferle et al., 2014).
- By contrast, verifying role relations differed between L1 natives and advanced L2 comprehenders:
 - The role congruence effect at the first noun phrase suggests that L2, just like L1 comprehenders perceived the role-mismatch at the earliest possible time.
 - However, it is possible that the associated revision and/or reconciliation is time-consuming and thus continues into the (mis)matching verb and post-verbal noun.
- Further cognitive tests for the full study (N= 24) and a follow-up study with beginning L2 learners are planned to further assess the observed lexical-compositional differences in L2 comprehension.