

Role versus action mismatches in situated language comprehension: a blank screen study

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When people listen to spoken sentences, they tend to inspect the location where an object had previously been located even if that object is no longer present. Such eye movements towards absent objects on a blank screen occur closely time locked to when the object is mentioned and resemble language-mediated object-directed eye movements in a co-present scene (e.g. Altmann, 2004). Language-mediated eye movements to object locations on a blank screen have been interpreted as reflecting that listeners access the representation of the objects (e.g. Spivey & Geng, 2001).

To our knowledge nobody has investigated whether these 'blank screen effects' are also observable for picture-sentence mismatches. These mismatches are a common phenomenon, because language does not always perfectly match the visual context (speakers can refer to the past, make mistakes, or talk about hypothetical events). Furthermore, different types of mismatch might be processed differently, as evidence from event-related brain potentials suggests (Knoeferle et al., 2014). Specifically, we know that there is a difference between the integration of roles and actions. To gain more insights into these processes, we replicated the study by Knoeferle et al., 2014, but instead of EEG we took eye movements as a behavioral measurement of visual attention. We wanted to find out more about the locus of attention during language-vision integration. Our motivation was to integrate the results in the Coordinative Interplay Account (Knoeferle et al., 2014), a processing account that accommodates how representations are built during situated language comprehension.

The study was carried out as a picture-sentence verification study, in which we recorded participants' eye movements. The sentences consisted of SVO (subject – verb – object) sentences with NP1, verb, and NP2 as word regions, while the pictures always showed two clipart characters, of which one (the agent) was depicted as performing an action on the other character (the patient). We analyzed looks towards agent versus patient, as well as looks towards an AOI located at the position of the depicted action. In addition, we measured participants' verification response time and accuracy. We manipulated picture visibility (co-present vs. blank screen, blocked design), action, and role congruence within participants. This enabled us to have a direct comparison between a) blank screen and co-present scene conditions, and b) between role and action matches versus mismatches.

We hypothesized that if the blank screen and the co-present conditions do not affect how people interrogate the scene, we should see identical eye movements in both of these conditions (Altmann, 2004). If participants use locations of objects as a pointer to object representation (Spivey & Geng, 2001), we predicted longer fixations towards scene areas depicting a mismatch. We also expected to see a difference in gaze behavior between role mismatches and action mismatches due to different timing in the processing of these mismatches. We further predicted to replicate higher accuracy for

role mismatches versus matches and faster reaction time for action matches versus mismatches (Knoeferle et al., 2014). Overall we expected faster reaction times and higher accuracy in the co-present scene condition than in the blank screen condition.

When the picture was visible, the analysis of the eye-gaze data revealed distinct gaze pattern for all of the conditions (action mismatch, role mismatch, full mismatch) compared with the full match baseline. In the baseline, participants first looked to the agent of the sentence and started looking to the patient at the end of the verb region. We observed an action mismatch effect in the form of delayed looks to the patient for action mismatches. We also observed a role mismatch effect in the form of opposite eye movements in the role mismatch compared to the role match condition: Instead of starting out looking at the depicted agent and later looking at the depicted patient, participants looked at the depicted patient, which was the agent of the sentence they received. Interestingly, in the full mismatch condition there was a tendency for participants to look towards the depicted agent (the patient of the sentence they heard) later compared to the role mismatch condition, reflecting an action mismatch effect similar to that in the role match conditions. Furthermore, participants showed a tendency to look more to the action AOI when hearing the verb compared to the previous word regions.

In the blank screen condition the time course of the gaze towards the depicted agent versus patient displays a tendency similar to the visibility condition, although overall participants tended to look more towards the position of the depicted agent. While role mismatch effects persisted in the blank screen condition, no action mismatch effect emerged.

In the overt verification task the analysis corroborated, as predicted, significantly higher accuracy for the role mismatches than the role matches. Participants further were more accurate in the co-present scene condition than in the blank screen condition. Looking at the reaction times, participants were faster in the action match compared to the action mismatch condition. Furthermore, they were faster to respond in the blank screen condition compared to when the picture was visible.

To sum up we observed that role mismatches and action mismatches in situated language comprehension affect gaze behavior in different ways. The referential gazes towards agent and patient in the blank screen condition indicate that participants make use of the prior locations of objects to process sentences. The clear differences between gaze in the blank screen and co-present scene, by contrast, highlight the effects of visibility on processes in situated language comprehension (i.e., in contrast with the results by Altmann, 2004).

References

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