



Contributions of hippocampal-dependent declarative memory to on-line processing of global syntactic ambiguity

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INTRODUCTION

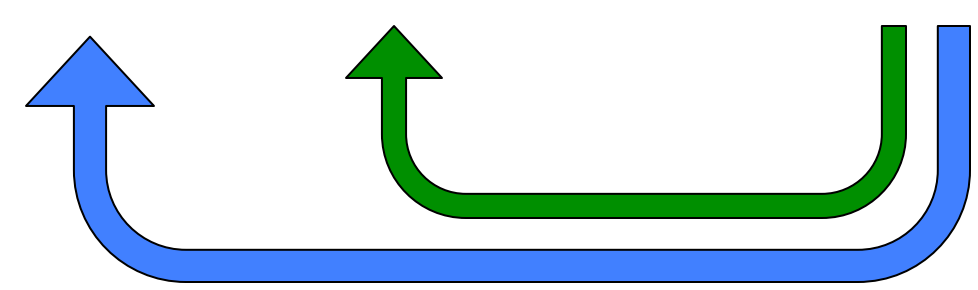
What is the contribution of the hippocampal dependent declarative memory system to on-line processing of verb-argument structure?

WELL ESTABLISHED are the contributions of hippocampus to the formation of new enduring (long-term) memories (Ranganath, 2010; Squire, 1992), and its contributions to relational binding and representational flexibility (Eichenbaum & Cohen, 2001).

EMERGING RESEARCH shows that hippocampus additionally contributes to on-line processing, even across minimal delays (Hannula & Ranganath, 2008; Öztekin, McElree, Staresina, & Davachi, 2008; Hannula, Tranel, & Cohen, 2006).

THE PRESENT RESEARCH examines contributions of hippocampus to on-line processing of verb argument structure. We focus on syntactic ambiguities such as:

Feel the frog with the cup.



Whether listeners attach the PP (*with the flower*) to the verb (*Feel*) or the noun (*pig*) varies systematically by verb (Snedeker & Trueswell, 2004). Here we ask whether use of verb-specific statistical cues requires the hippocampal-dependent declarative memory system.

METHOD

Participants: 4 participants with bilateral damage to hippocampus and MTL, 4 matched healthy comparison participants, 13 undergrads. Patients were free of aphasia but exhibited profound deficits in long-term memory acquisition (amnesia).

Design: Critical trials contained 2 animals, e.g. a frog holding a small cup and a whale with a small necklace, and two large potential instruments: a large necklace and a large cup. Participants completed 24 critical trials with globally ambiguous instructions plus 24 fillers. Critical sentences contained biased verbs from Snedeker and Trueswell (2004), e.g. *Feel the frog with the cup*.

8 modifier bias verbs (e.g., *choose*)

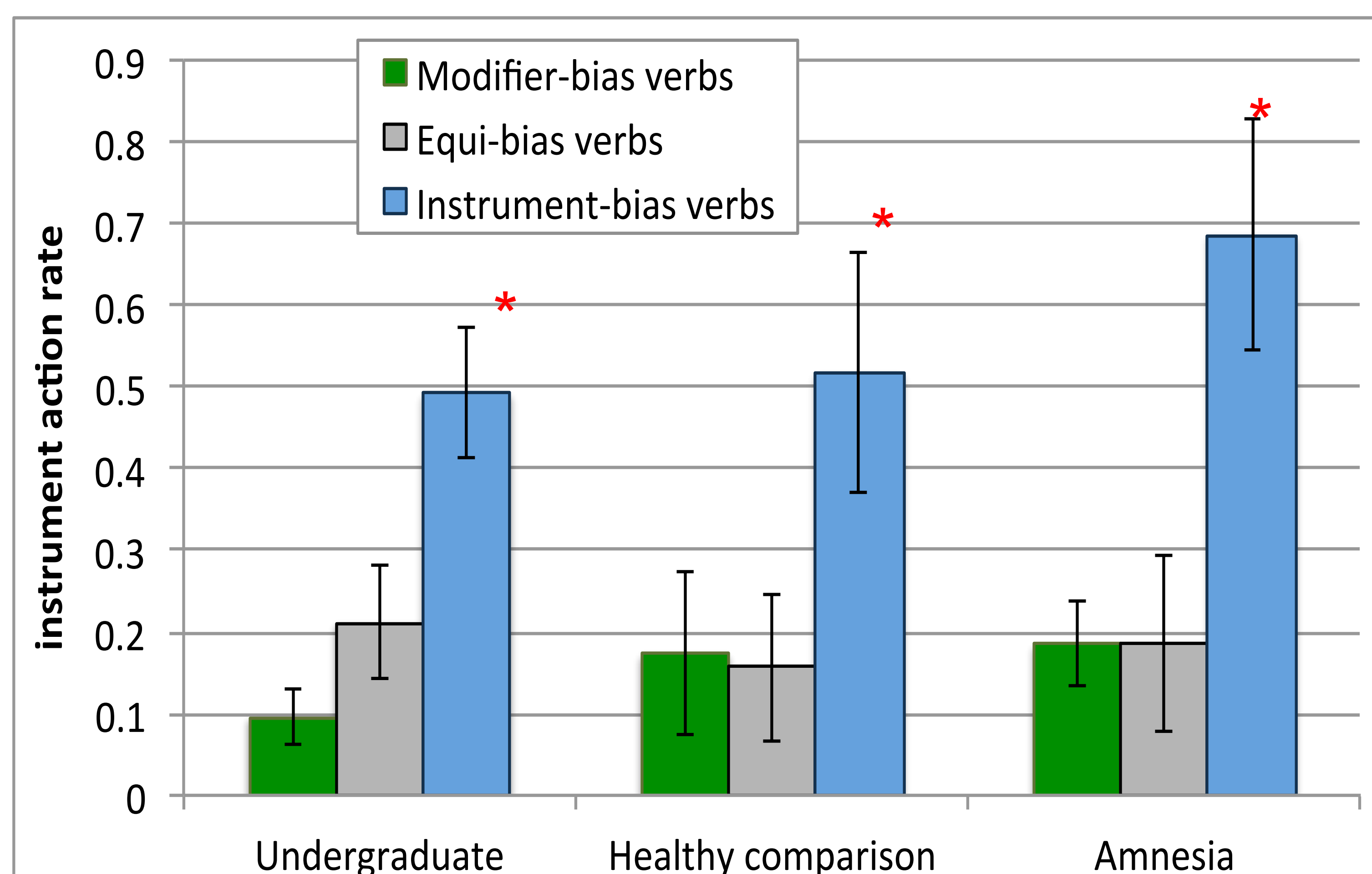
8 equi-bias verbs (e.g., *feel*)

8 instrument bias verbs (e.g., *hit*)



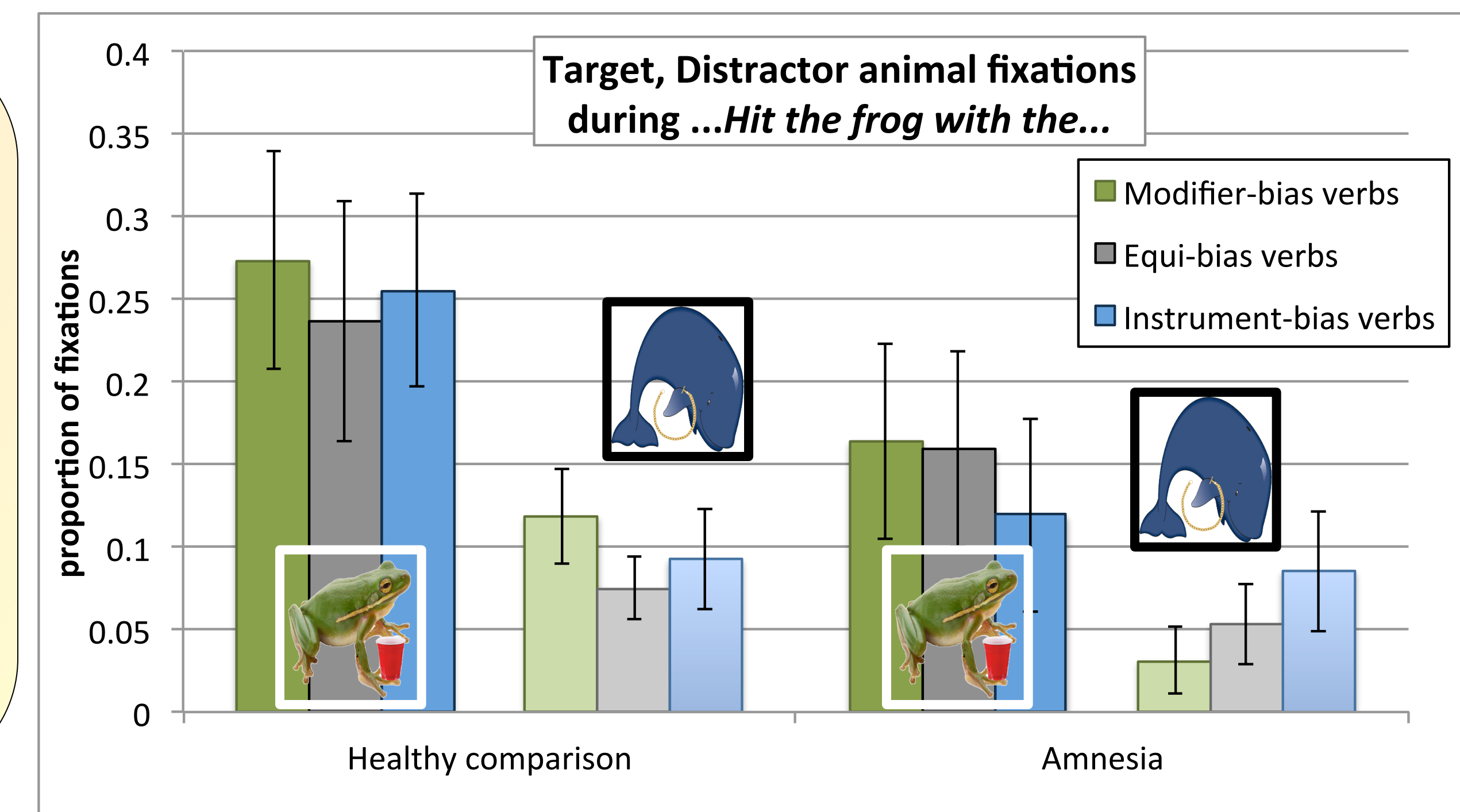
ACTION RESULTS

All groups execute more instrument actions for instrument-biased verbs ($z_s > 4.30$, $p_s < .0001$). Patients not significantly different from comparisons ($z_s < 1.5$, $p_s > .15$)

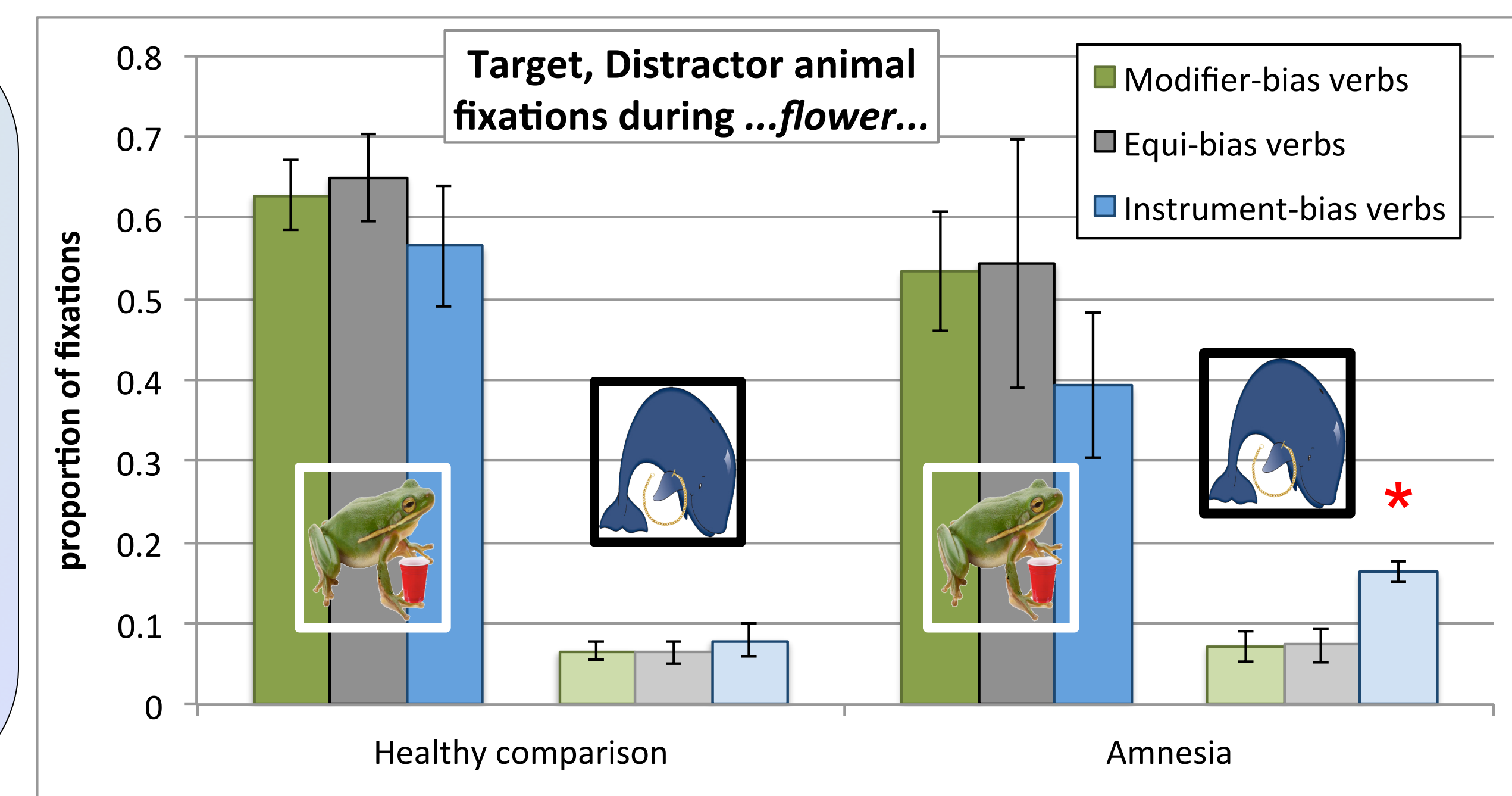


ONLINE RESULTS: Eye movements

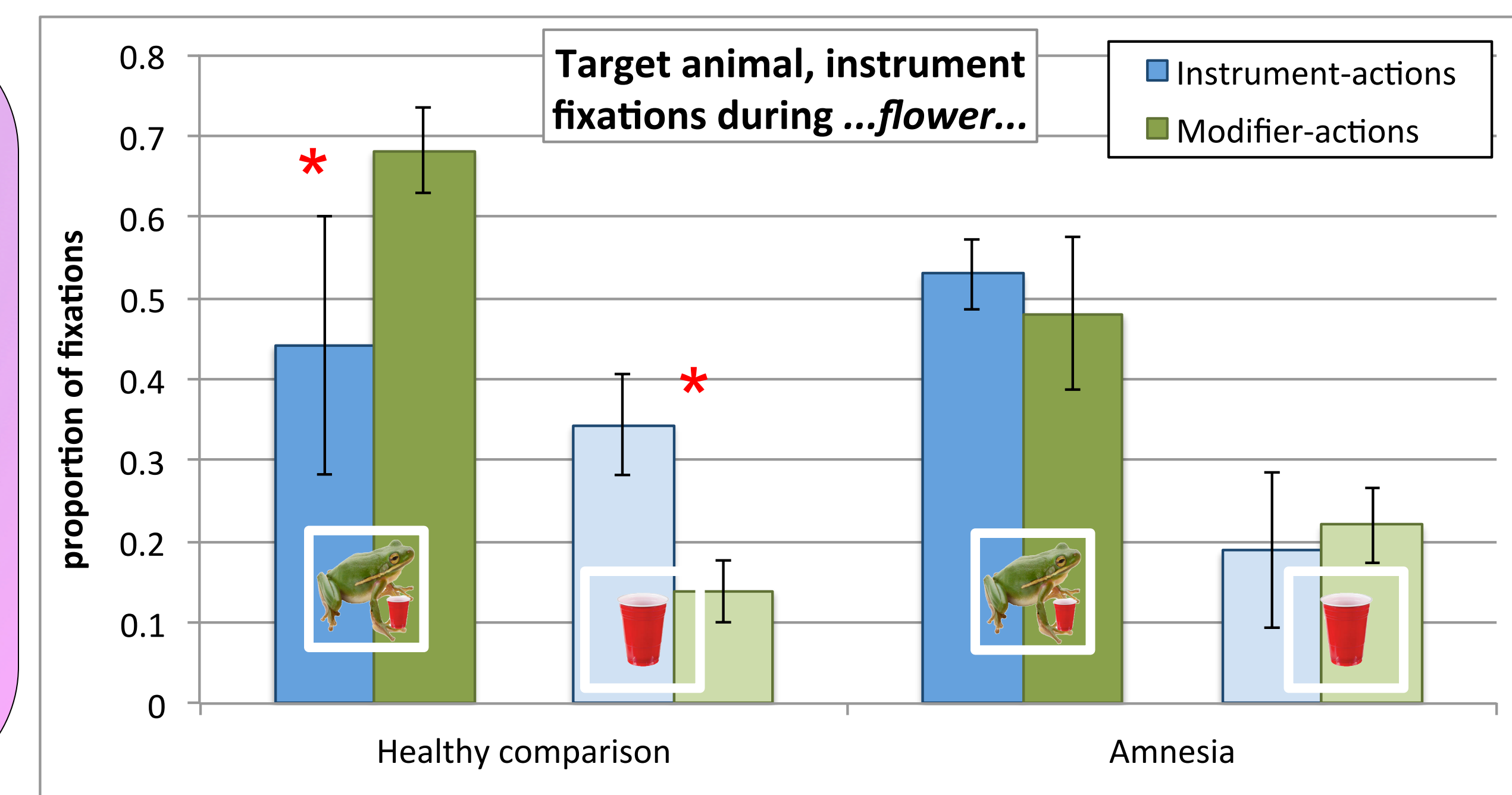
(1) During **Choose/Feel/Hit the frog with the...**, marginal interaction between bias and group for fixations to the incorrect animal ($t = 1.91$). Healthy comparison participants look slightly more at animals following modifier-bias verbs. No group differences for target animal ($t_s < 1.0$).



(2) During **flower**, individuals with amnesia look more to the incorrect animal ($t = -2.02$), particularly for instrument-biased verbs ($t = 2.39$); fixations to target animal not significantly different between participant groups ($t_s < 1.0$).



(3) During **flower**, action – fixation link differs by participant group for both target animal ($t = -4.79$) and target instrument fixations ($t = 5.74$). Healthy comparisons exhibit different fixation patterns consistent with final interpretation ($t_s > 7.5$). Individuals with amnesia do not ($t_s < 1.0$).



CONCLUSIONS

- Severe declarative memory impairment resulted in subtle changes to the processing of verb-argument structure in on-line processing. While participants with amnesia showed NO DEFICIT in use of verb bias to guide final interpretation, the PROCESS was different.
- Intact off-line processing consistent with classic characterization of amnesia as sparing general language faculties (Milner et al., 1968). On-line processing impairment may reflect:
 - Difficulty integrating verb-bias information with unfolding sentence, leading to late looks to the wrong animal.
 - Difficulty restricting attention to the action-relevant objects during interpretation.

These findings are consistent with claims that hippocampus plays a key role in on-line processing of language (Duff & Brown-Schmidt, 2012), due to its contributions to relational binding and representational flexibility (Eichenbaum & Cohen, 2001).

References

Duff & Brown-Schmidt (2012) *Frontiers in Human Neuroscience*, 6, 1-9.
Eichenbaum & Cohen (2001). Ranganath (2010) *Hippocampus*, 20, 1263-1290.
Snedeker & Trueswell (2004) *Cognitive Psychology* 49, 238-299.

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