Probing the effects of visual distraction during natural behavior using VR technology

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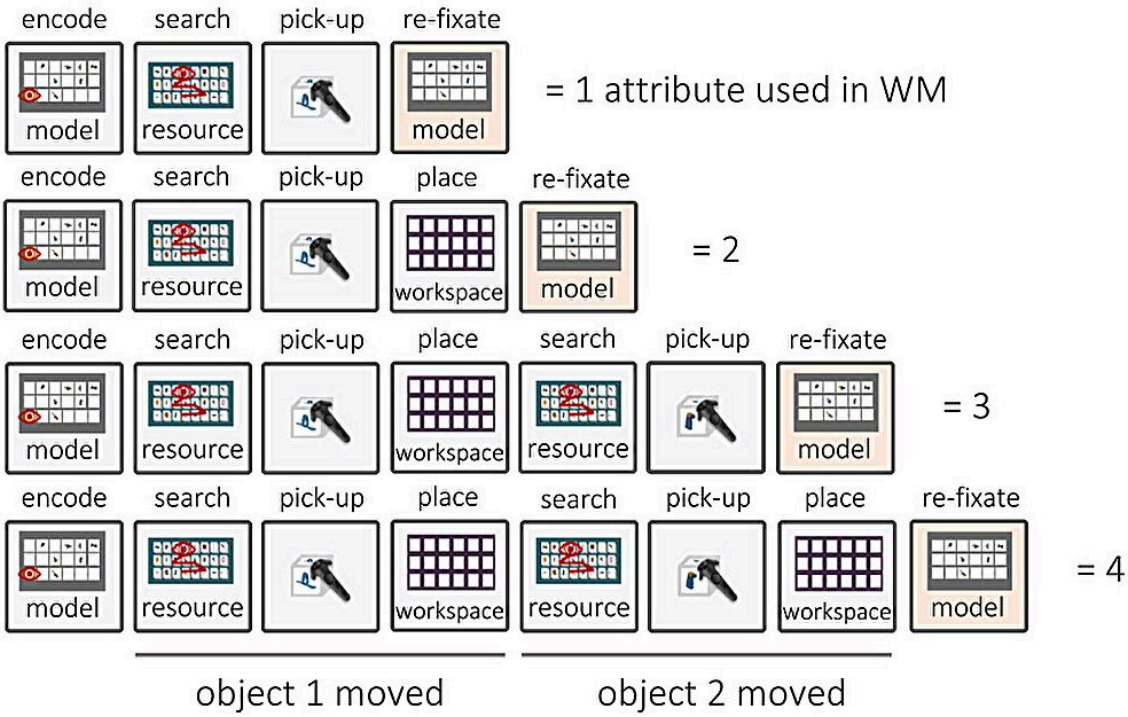

Trade-off between reliance on WM and gathering information from the external world. a Our implicit metric for working memory (WM) usage: Copying each object requires its identity and location information (attribute) to be held in memory. Counting successful pick-ups (i.e., identity attribute used) and placements (i.e., location attribute used) in between model fixations provided a metric for the number of attributes used in WM. b Average number of attributes used in WM in both movement effort conditions as a function of distraction, c distribution of attributes used in WM (%). Error bars depict the standard error of

the mean (N = 30). Lines show individual participant data. N shows the number of overall sequences included in the analysis The symbols *, **, and *** in the figure denote statistical significance with p-values less than 0.05, 0.01, and 0.001, respectively. Credit: Kumle et al. (Communications Psychology, 2024, Springer's Nature).

Humans are innately well-equipped to complete procedural tasks, such as following a recipe and assembling furniture. While completing these tasks, however, people can sometimes encounter visual distractors, such as irrelevant ingredients in the same cupboard as those listed in a recipe.

Ignoring these distractors, focusing on relevant objects and successfully completing a task typically comes easy to humans, yet their presence might nonetheless affect how tasks are completed. Exploring the potential effects of visual distractors during extended tasks in experimental settings has so far proved challenging.

Researchers at University of Oxford and Goethe University Frankfurt recently set out to investigate these effects using virtual reality (VR) technology. Their findings, published in *Communications Psychology*, suggest that visual distraction does have some consequences, specifically slowing down the movements of people as they complete tasks and forcing them to perform more actions.

"Visual distraction is a ubiquitous aspect of everyday life," Levi Kumle, Melissa L. H. Võ, and their colleagues wrote in their paper. "Studying the consequences of distraction during temporally extended tasks, however, is not tractable with traditional methods. We developed a virtual reality approach that segments complex behavior into cognitive subcomponents, including encoding, visual search, working memory usage, and decision-making."

Kumle, Võ and their colleagues recruited 30 participants and asked them to take part in two experimental trials, approximately one week apart. During these trials, the participants were asked to complete a task in VR, wearing an HTC Vive Tobii Pro VR headset and a HTC Vive controller.

The participants navigated two different virtual environments, dubbed the instruction room and trial room. After confirming that they could effectively use the VR equipment in the instruction room, they could proceed to the trial room, where they completed a simple task.

This task entailed selecting 8 target objects from a resource pool containing 24 objects, some of which were irrelevant to the task and thus visual distractors. On a model display, the participants could see the target objects they were supposed to select and how they were meant to arrange them within a workspace.

Their task was to reproduce the configuration of objects on the display by picking up objects from the resource pool and placing them on the workstation, all within a limited amount of time. The researchers changed the location of the model display and the opacity of objects in the resource pool (i.e., making them harder or easier to identify), to determine whether this affected the participants' performance on the task.

"Participants copied a model display by selecting objects from a resource pool and placing them into a workspace," the researchers explained. "By manipulating the distractibility of objects in the resource pool, we discovered interfering effects of distraction across the different cognitive subcomponents."

Interestingly, the researchers found that visual distractions affected the study participants' sensory-mnemonic decisions. This affected their ability to coordinate their working memory and encode information

while trying to complete the task, which was manifested in a slowing down of their actions and the performance of more costly body motions.

"We successfully traced the consequences of distraction all the way from overall task performance to the decision-making processes that gate memory usage," the team said. "Distraction slowed down behavior and increased costly body movements. Critically, distraction increased encoding demands, slowed visual search, and decreased reliance on working memory."

Overall, the findings suggest that visual distractions while humans are performing natural goal-oriented behaviors might not necessarily prevent them from accomplishing a goal, yet they still have cascading consequences, slowing down their movements and increasing the efforts necessary to complete a task. In addition to shedding new light on the effects of visual distractions, their study highlights the potential of using VR paradigms to conduct psychological and behavioral experiments.

More information: Levi Kumle et al, Multifaceted consequences of visual distraction during natural behaviour, *Communications Psychology* (2024). DOI: 10.1038/s44271-024-00099-0