

Science Education Collection

Multiple Object Tracking

URL: <http://www.jove.com/science-education/10019>

Overview

Source: Laboratory of Jonathan Flombaum—Johns Hopkins University

In a staggeringly complex and engaging world, it is crucial to selectively process some stimuli at the expense of others. Experimental psychologists call this ability attention. Specifically, visual attention refers to the ability to selectively process aspects of a visual scene.

Many paradigms used to study visual attention involve brief, punctuated, and repeated trials. However, everyday situations often place sustained demands on attention, as opposed to requiring only brief focus. For example, compare driving through busy city streets, which demands sustained attention, with crossing a busy street, which demands just a few moments of caution. To investigate sustained visual attention, experimental psychologists typically rely on a paradigm called multiple object tracking.

This video demonstrates standard procedures for investigating sustained visual attention through multiple object tracking.

Procedure

1. Stimulus design (Figure 1).

Schematic Depiction of a Typical Multiple Object Tracking Trial

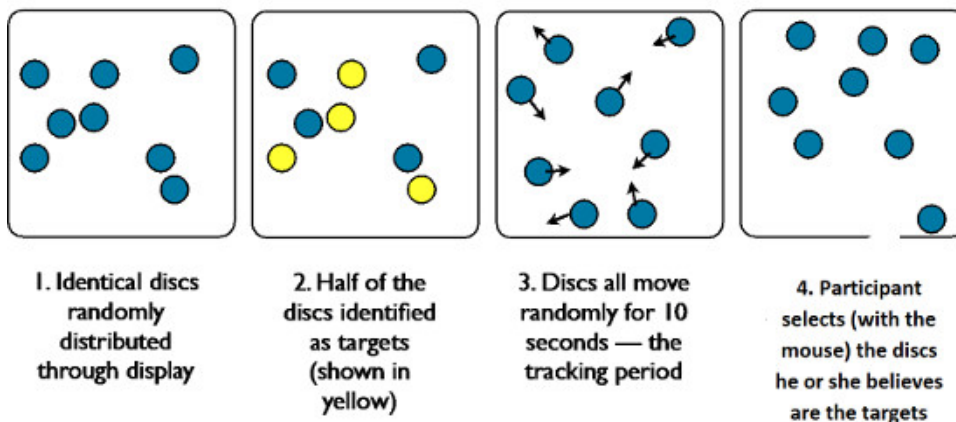


Figure 1: Schematic depiction of a typical multiple object tracking trial. A participant tracks a subset of discs that move randomly among a group of identical nontargets.

1. The basic design of a multiple object tracking (MOT) trial is relatively straightforward: begin the trial with a number of identical objects (such as blue discs) in a display. For the typical trial, include 8 discs in total, but varying the number is a crucial manipulation.
2. Randomly select half of the discs to turn yellow. Turning yellow indicates to the participant which discs are the targets.
3. After they turn yellow, have all the discs become an identical blue color again, and move all, including the non-targets, around the display randomly for about 10 s.
4. Instruct the participant to mentally track the target discs.
5. After the motion period is complete, stop all the discs from moving, and tell the participant to use the mouse to click once on each disc they believe is a target.

2. Procedure.

1. In order to determine how many objects people can track on average, use the basic design described in Step 1 and translate it into a procedure for a whole experiment.
2. For this demonstration, find how many objects a group of college-aged males can track.
3. Recruit at least 10 participants within the age group (ages 18-22) to participate in the study.
 1. For students in this age group, researchers on college campuses usually have mechanisms in place by which students can be recruited from Psychology courses.

4. When the participants arrive, ask them to consent in writing to participate in the experiment.
5. Ask the participants if they have any known eyesight impairments or if eyesight is close to 20-20 once any necessary glasses or contacts are worn. If the participants have close to 20-20 vision, either with or without correction, they are qualified to run in the experiment.
6. Seat a participant in front of a computer that runs the experimental program. Ensure that the participant sits approximately 60 cm away from the monitor (a piece of tape on the floor in front of the computer marks the position of the leading edge of the participant's seat).
7. Explain the instructions to the participant, emphasizing that some trials may seem difficult, but they should always do their best, and if they find themselves uncertain about the identity of some targets in some of the trials, then they should just guess.
8. Have the participant complete 5 practice trials with only 2 targets in each. Remain in the room, using the practice trials to ensure that the participant has understood the instructions.
9. Leave the testing room and have the participant complete 60 trials in a random order with 10 trials each including 2, 3, 4, 5, 6, and 7 targets (and equal numbers of non-targets).

3. Analysis.

1. Compute the number of targets correctly identified in each trial (*i.e.*, the number of items selected as targets that were actually targets).
2. On each trial, the result is an accuracy score between 0 and 100%. Average these scores together for all trials with the same tracking load. This gives the experimenter a sense of the number of targets the individual can track.

Results

The results of the experiment include several subjects, and the average performance for the group of participants is reported as a function of tracking load (**Figure 2**).

Tracking Performance as a Function of Tracking Load

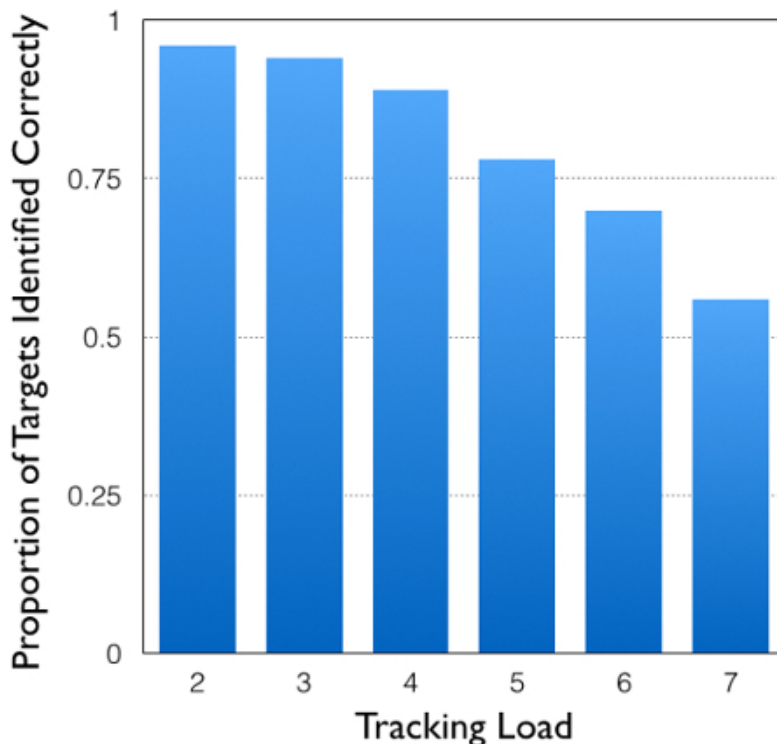


Figure 2: A depiction of typical tracking performance as a function of target load. Researchers often find that participants perform relatively accurately with only 2-4 targets to track, then suffer large costs when asked to track more than 4 or 5.

Applications and Summary

For the last 25 years, multiple object tracking has been one of the primary methods for investigating the limits of human sustained attention and the causes of those limits. It can be used to investigate differences in attentional abilities between individuals in different populations, such as

those with ADHD compared to age-matched controls. And it can also be used to investigate the efficacy of interventions for improving sustained attention, for instance, the effects of drugs, such as Ritalin or Adderall.

The paradigm has been used productively and influentially in investigating the human ability to multitask. When a person is driving a car down the highway—a task that clearly requires sustained attention—what will the impact be of talking on a cell phone, for example? Asking people to do this for the purpose of an experiment is ethically questionable. Instead, researchers have used multiple object tracking to investigate the impacts of engaging secondary tasks on the performance of sustained attention, including the secondary task of talking on a cell phone. The result, perhaps unsurprisingly, is that participants make significantly more tracking errors when asked to engage in a conversation over the phone with an experimenter in another room.