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# A Delay-dependent Switch in the Information Children Use to Remember Locations

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## Abstract

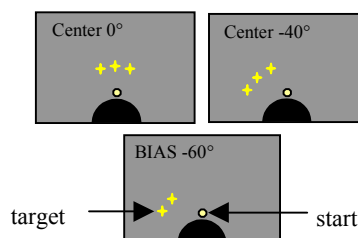
Several types of information can be used to remember the location of an object over short-term delays. The current study looked at how young children integrate three specific types of information over delays—metric information (i.e., direction and distance), reference locations (i.e., landmarks), and longer-term memories of where objects have been found in the past. Three-year-olds pointed to remembered targets in a large, homogeneous task space. The layout of the targets and how often each target appeared was varied across conditions. Three-year-olds' responses were biased toward the center of the task space and toward an average remembered location, and these biases increased as delays increased. In addition, the bias toward the average remembered location was stronger when the memory of a single location was differentially strengthened.

## Introduction

There are many ways to remember the location of hidden objects. For example, the location of a set of car keys might be remembered as being “on the desk”, in the upper left corner of the desk, or, more specifically, a few inches from the left edge. Evidence suggests that young children use three specific types of information: metric information (i.e., direction and distance), reference locations (i.e., landmarks), and longer-term memories of where objects have been found in the past (Huttenlocher, Newcombe, & Sandberg, 1994; Smith, Thelen, Titzer, & McLin, 1999). Here, we investigated how young children integrate these three types of information in memory during delays.

## Method

Thirty-six to 40-month-olds were asked to remember the location of small, spaceship-shaped lights on a large table with no salient landmarks in the task space. On each trial, a marker was moved to a start location. Then a spaceship appeared for 2s and disappeared. This was followed by a delay of 0, 5, or 10s, after which participants heard a go signal instructing them to move the marker to the



**Figure 1.** Examples of the target layouts on the table top. The child stood within the black arc.

remembered spaceship location. In each condition, targets were separated by 20°, but the number and layout of the targets was varied across conditions. In the Center 0° condition, three targets were used. These targets were positioned symmetrically with respect to the midline of the table (see Figure 1). In the Center 40° conditions, three targets on the same half (right or left) of the table were used, with the center target at 40° or -40° (see Figure 1). In the Bias 60° conditions, the participants moved to two possible targets located at 40° and 60° (or -40°, -60°). Participants moved to the 60° (-60°) target twice as often as the 40° (-40°) target to differentially strengthen this location in memory.

## Results

As the delay increased in the Center 0° condition, participants made larger directional errors toward the midline of the table when moving to the left and right targets. In the Center 40° conditions, three-year-olds' responses to the 60° and -60° targets were biased inward, toward the midline of the table, but responses to the ±20° and ±40° targets were not significantly biased. Data from the BIAS conditions clarified why these responses were not biased towards midline. In the BIAS conditions, responses to the non-biased (±40°) targets were pulled toward the biased (±60°) targets over delays. Thus, memory responses are pulled towards two types of information—the midline of the table and a longer-term memory of an average remembered target location.

## Discussion

Results from the present study demonstrate that there are systematic delay-dependant biases in how young children maintain location information in memory. As delays increase, children's memory responses are biased towards reference axes—the midline of the table—and towards a longer-term memory of previously moved-to locations. Three-year-olds' resultant memory errors depend critically on the delay duration and the relative strength of each type of information.

## References

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