Developmental Changes in Interval Time-Place Learning

Christina M. Thorpe, Darcy Hallett, Adam R. Brown, Darlene Skinner & Joshua A. Quinlan

Department of Psychology, Memorial University of Newfoundland, St. John's, NL, A1B 3X9

Introduction

The ability to learn the spatio-temporal regularity of biologically significant events is known as Time-Place Learning (TPL). This ability has been studied extensively in the comparative cognition field, but only one previous study (Thorpe, Hallett, Murphy, Fitzpatrick & Bakhtiar, 2012) has investigated it in humans.

In *interval* TPL, the participant is trained that Place A provides reinforcement for the first X minutes, followed by Place B for the next X minutes and Place C for the last X minutes.

Two measures are used to determine if subjects are timing:

1. Anticipation: Animals *anticipate* which lever will provide food next as demonstrated by them pressing on that lever just prior to that lever being activated. This suggests that the animals are timing.
2. Probe trials: Stronger evidence for timing comes from probe trials in which all locations provide reinforcement for the entire session. Animals typically move from lever to lever at the correct times despite there being no contingencies in effect to necessitate their doing so.

Thorpe et al. (2012) found that young children (N = 14, M = 7.18 years old, SD = 1.80) quickly learned both the timing and the sequence of the task. Surprisingly there was no evidence of anticipation, but performance on the probe trials provided strong evidence that the children had learned the task.

The current study used a similar design on an iPad with more children to determine if the lack of anticipation would be replicated and whether there were age related changes in interval TPL.

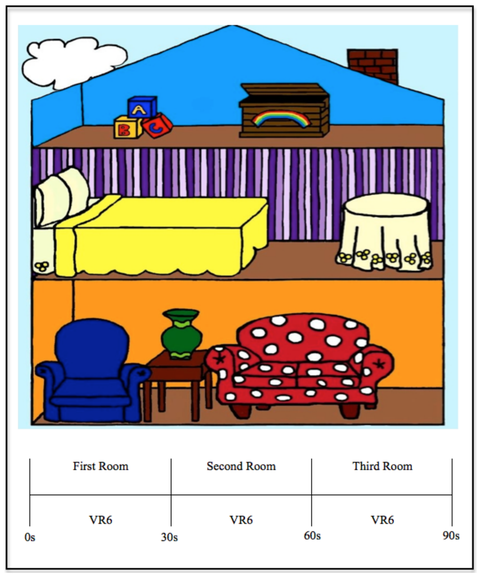
Methods

Participants: 21 children, 16 girls (M = 8.22 years old, SD = 0.43) and 5 boys (M = 7.25 years old, SD = 0.72), recruited from two daycares in St. John's, NL, Canada. The children ranged in age from 5 to 11 years old.

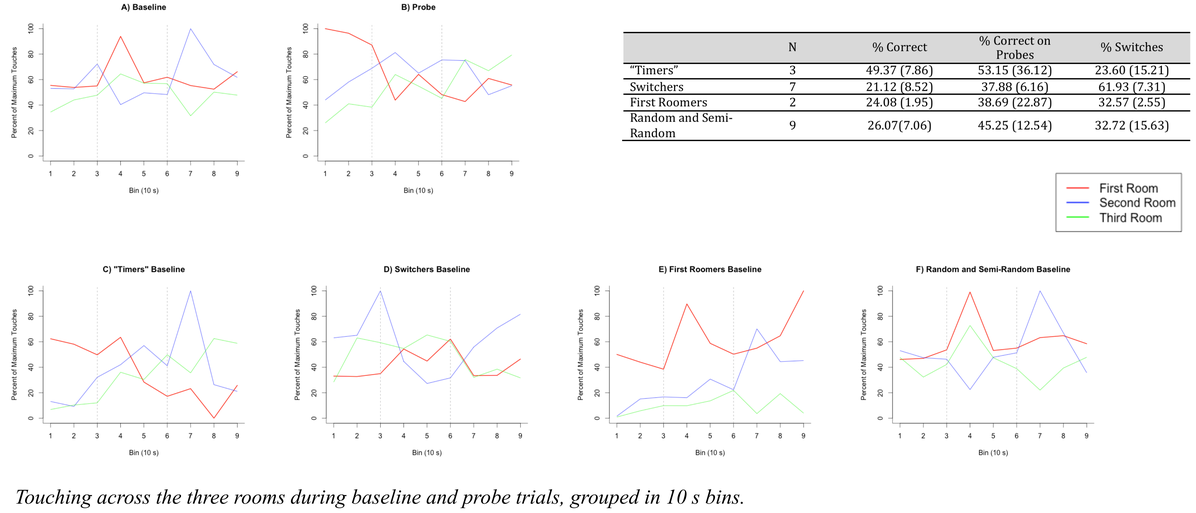
Methods: Children were asked to find a toy that was hidden in one of three rooms by touching the room on the screen. They were told that they might have to press the correct room more than once before the toy would appear (VR6). Reinforcement consisted of animation, sound, stickers, praise and playtime with the experimenter.

The game was designed so that one room was correct for the first 30 s period, then another room for the next 30 s, and the third room for the last 30 s period. Children were not told anything about the timing or the order of the rooms.

After 10 baseline sessions children were given a probe test that was identical to the regular sessions with the exception that all rooms provided rewards for the entire session.



Results



	N	% Correct	% Correct on Probes	% Switches
"Timers"	3	49.37 (7.86)	53.15 (36.12)	23.60 (15.21)
Switchers	7	21.12 (8.52)	37.88 (6.16)	61.93 (7.31)
First Roomers	2	24.08 (1.95)	38.69 (22.87)	32.57 (2.55)
Random and Semi-Random	9	26.07(7.06)	45.25 (12.54)	32.72 (15.63)

Touching across the three rooms during baseline and probe trials, grouped in 10 s bins.

(A) The percent of maximum touches by room for baseline sessions. The average rate of touching the correct room during the correct period was 27.56 % (SD = 11.67%), which was significantly less than a chance value of 33% (t(20) = -2.267, p = .035). **(B)** The percent of maximum touches by room for probe sessions. The average percent correct was 43.30 % (SD = 16.14%), which was significantly greater than chance (t(20) = 2.830, p = .010) **(C-F)** The percent of maximum touches for each subset of participants.

Conclusions

The results of the current study failed to replicate the previous work of Thorpe, Hallett, Murphy, Fitzpatrick & Bakhtiar, 2012. This is surprising given that the only obvious difference between the two studies was the use of an iPad rather than a touchscreen monitor. (Anecdotally the children in the first study were more competitive with one another about the number of rewards found. This may have resulted in those participants being more invested in the task.)

Only three of the participants appeared to be using a "timing" strategy, however the timer was not very accurate.

Seven of the participants used a switching strategy, that is, every time that they received a reinforcer, they moved to a new location. Two of the participants had a preference for the first room. And the strategy used by the remaining participants seemed to be random or some other semi-random sequence. Interestingly, many subjects seems to act as if it would be unlikely that sticking with one room for a while would be a good strategy, i.e., there was a general tendency to switch.

Future research with this task may need to employ higher rewards so that participants are motivated to learn the task.

This research was supported by the Natural Sciences and Engineering Research Council of Canada (NSERC) to CT and DH. We would like to thank Megan Davis, Chelsea Ireland, Leanna Lewis, Justin Mahon & Nicole Ralph for help with data collection. We would like to give extra thanks to the children that participated in the studies as well as the amazing staff at Cowan Heights Little People's Workshop After School Program & Memorial University of Newfoundland Child Care Centre. Direct correspondence to Christina Thorpe (cthorpe@mun.ca).