

Pigeons' Memory for Number of Events: Effects of Intertrial Interval and Delay Interval Illumination

Angelo Santi and Chris Hope
Wilfrid Laurier University

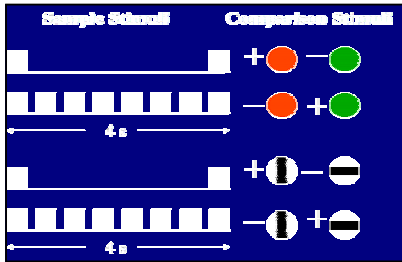
PURPOSE

Pigeons' memory for number of events has been studied in a symbolic delayed matching-to-sample task by training them to discriminate sequences of light flashes that vary in number, but not in time. For example, the small sample could consist of two flashes of light in 4 s (2f/4s), whereas the large sample could consist of eight flashes of light in 4 s (8f/4s). A peck to the red comparison is reinforced if the sample was small, and a peck to the green comparison is reinforced if the sample was large. Roberts, Macuda, and Brodbeck (1995) found that during delay testing pigeons responded with high accuracy following the small sample, while accuracy following the large sample dropped to below chance. Santi and Hope (2001) replicated this choose-small bias at long delays and demonstrated that a choose-large bias occurred at delays shorter than the baseline training delay.

The purpose of the present experiments was to examine the effect of similarity of the ambient illumination condition during the intertrial interval (ITI) and the delay interval (DI) on memory for number of light flashes.

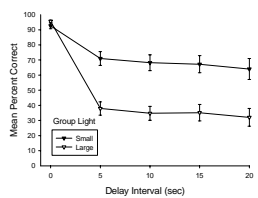
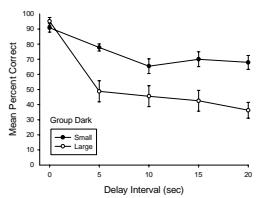
GENERAL METHOD

Twelve Silver King pigeons were trained to discriminate small (2f/4s) and large (8f/4s) samples of hopper light flashes (200ms). Following the number samples, color comparisons were presented for 6 birds, and line comparisons for the remaining birds.



During the 15s ITI, the overhead houselight was on for Group Light (n=6), and off for Group Dark (n=6).

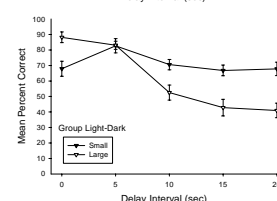
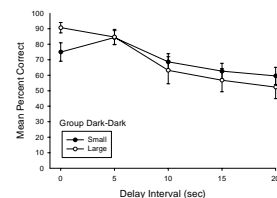
EXPERIMENT 1A: 0-s Training Delay and DI Testing with Dark Delays



RESULTS

- 1) A choose-small response bias occurred at all delays greater than 0s for both groups. These results replicate those of Roberts et al. (1995) and Santi & Hope (2001).
- 2) For Group Light, the ambient chamber illumination (houselight-on) during the intertrial interval was differentiated from the delay interval (houselight-off), but this did not attenuate the choose-small response bias.

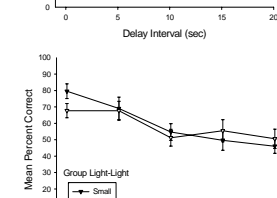
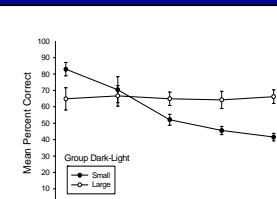
EXPERIMENT 1B: 5-s Dark Training Delay and DI Testing with Dark Delays



RESULTS

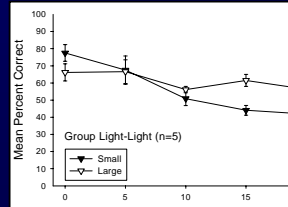
- 1) At the 5-s training DI, accuracy was equivalent on small and large sample trials.
- 2) At the DI shorter than the training DI, a choose-large response bias occurred for both groups.
- 3) At DIs greater than the training DI, a choose-small response bias occurred which appeared stronger for Group Light-Dark.
- 4) Differentiating the ambient illumination conditions during the DI from those during the ITI did not attenuate either the choose-small or the choose-large response bias.

EXPERIMENT 2: 5-s Illuminated Training Delay and DI Testing with Illuminated Delays

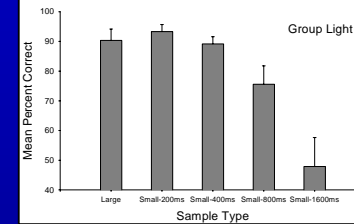
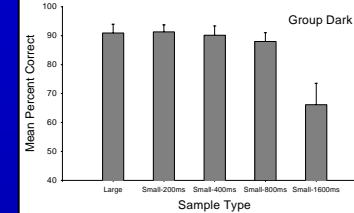


RESULTS

- 1) At the 5-s illuminated training DI, accuracy was equivalent on small and large sample trials.
- 2) At the 0-s DI, a choose-small effect was evident in both groups.
- 3) At DIs longer than the 5-s illuminated training delay, a choose-large effect was clearly evident in Group Dark-Light.
- 4) The averaged data for Group Light-Light in the middle graph is somewhat misleading. One bird exhibited a large choose-small bias. When this bird's data was removed, a choose-large bias was clearly evident in this group (see bottom graph).
- 5) The birds may have been summing flash duration and continuing to time while the houselight was illuminated during the DI.



EXPERIMENT 3: Increasing Duration of the Second Flash on Small Sample Trials



RESULTS

- 1) Accuracy dropped to approximately chance levels when the duration of the second flash on small-sample trials was equal to the total flash duration on large-sample trials (i.e., 1600ms).
- 2) This result is the direction predicted by the hypothesis that birds coded the sequence of light flashes by timing and summing the flash duration, rather than by using an event switch.
- 3) However, if flash duration was the only factor affecting choice, then accuracy should have been well-below chance when the duration of the second-flash was 1600 ms.

SUMMARY OF MAIN FINDINGS AND CONCLUSION

- 1) These data replicate previous findings of asymmetrical retention for sequences of light flashes at DIs longer than the training DI, and a reversed asymmetry at DIs shorter than the training DI when the delay interval is dark.
- 2) Response biases observed during DI testing were not eliminated when the ITI was disambiguated from the DI by presenting ambient light during the ITI but not the DI. These results are consistent with those of Kelly and Spetch (2000) and incompatible with the instructional failure hypothesis (Sherburne, Zentall, & Kaiser, 1988).
- 3) Pigeons appear to discriminate small and large numbers of equally spaced 200-ms light flashes by relying on temporal properties of the flash sequence (such as total flash duration) rather than by using an event switch to count flashes.
- 4) The present study as well as those of Roberts et al. (1995) and Santi and Hope (2001) may actually have been studies of memory for event duration not memory for number of light flashes.
- 5) Future studies need to vary number independently of the temporal properties of sample sequences in order to be confident that memory for number of events is being tested.

REFERENCES

- Kelly, R., & Spetch, M. L. (2000). Choice biases in delayed matching-to-sample duration with pigeons: Manipulations of ITI and delay illumination. *The Quarterly Journal of Experimental Psychology*, *53B*, 309-323.
- Roberts, W. A., Macuda, T., & Brodbeck, D. R. (1995). Memory for number of light flashes in the pigeon. *Animal Learning & Behavior*, *23*, 182-188.
- Santi, A., & Hope, C. (2001). Errors in pigeons' memory for number of events. *Animal Learning & Behavior*, *29*, 208-220.
- Sherburne, L. M., Zentall, T. R., & Kaiser, D. H. (1998). Timing in pigeons: The choose-short effect may result from pigeons' "confusion" between delay and intertrial interval. *Psychonomic Bulletin & Review*, *5*, 516-522.