How Does Variable Response Effort Influence Risk-Sensitive Decision Making in Pigeons?

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Introduction

➢ Many animals are attuned to the variability of food intake rate (referred to as foraging risk) which can induce preferences for future decision making[1]

➢ Classic risk-sensitivity paradigms offer two alternatives: **constant** or **variable**

➢ Pigeons have been shown to prefer an alternative that offers constant food amount, yet prefer ones with variable reinforcement delay[2]

➢ Modified scalar expectancy theory (SET) is a cognitive model used to explain preferences toward any type of risk[3]

➢ Response effort has been shown to fit this model[4], but it is still unclear whether the time associated with increased effort duration is a confound
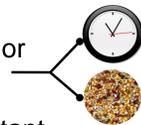
Purpose: To investigate temporal aspects of pecking response effort, in order to test whether modified SET can predict this behaviour.

Hypothesis: We hypothesized that pigeons would prefer the variable alternative in both effort and matched delay manipulations, but that the preference would be stronger in the response effort condition over the delay condition due to the additional costs of pecking responses.
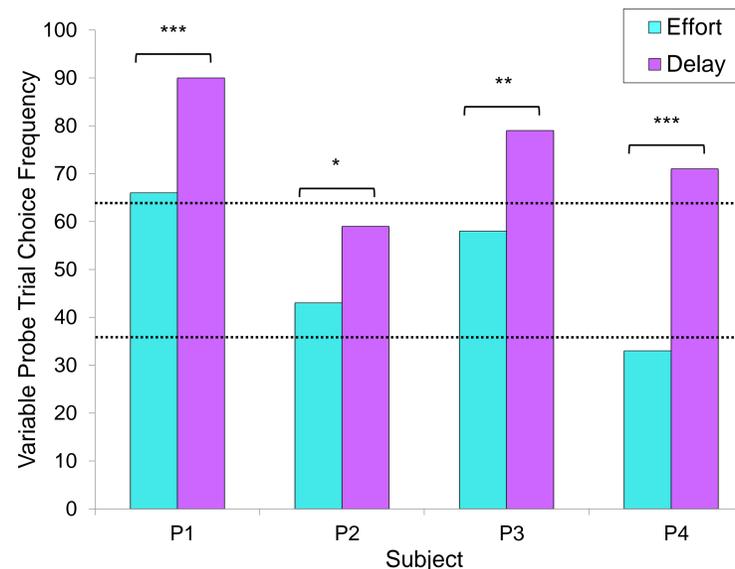
Results

Figure 1. Frequency of variable choice in probe trials in effort and delay conditions for each bird. Dotted lines indicate upper and lower bounds of preference for constant or variable stimuli that are significantly different from chance responding. Asterisks indicate Fisher's exact test results for difference between conditions (* $p < .05$, ** $p < .005$, *** $p < .0001$).

Discussion

➢ Our hypothesis was not supported; however, we found the opposite pattern

➢ Reduction in variable preference in response effort condition compared to delay condition suggests cognitive SET model may not apply to effort directly

➢ In contrast to previous researchers' assumptions, we propose that response effort is not encoded in the same way as reinforcement delay

➢ Differences observed could be due to varied magnitude estimation across modalities of delay and response effort despite the model's unitary scale

➢ Limitations of divided attention may also reduce accuracy of magnitude scaling in active effort task compared to passive delay manipulation

➢ The use of our novel colour discrimination probe trial method is supported by the replication of strong preference for variable delay

Methods

➢ 4 pigeons (*Columba livia*) trained in operant conditioning colour discrimination tasks

➢ 2 conditions, within-subjects design. Delay condition used duration time from initial sessions of the effort condition to match temporal distributions experienced during pecking

➢ 10 risk exposure & 10 decision probe sessions per condition; 40 trials per session with fixation & 2 alternative forced discrimination

(i) **Autoshaping:** birds learned to peck at touch screen for 5 seconds of food reinforcement

(ii) **Colour discrimination:** birds learned to peck on positive stimuli; pecks on the red negative stimulus were punished with delay

(iii) **Risk exposure:** risk contingencies were imposed on positive stimuli

(iv) **Decision probes:** probe trials pair 2 positive stimuli to measure preference, replaced 25% of trials per session
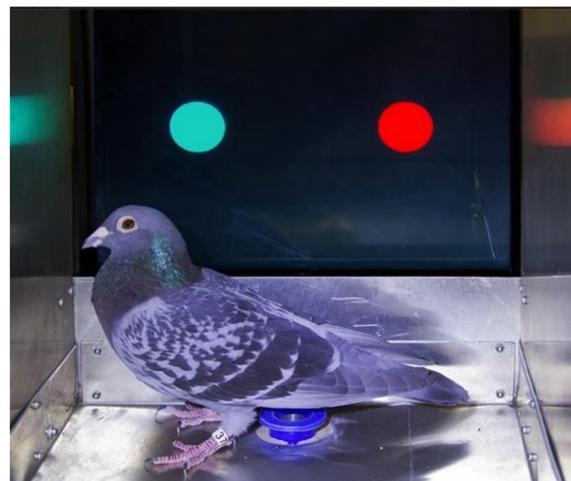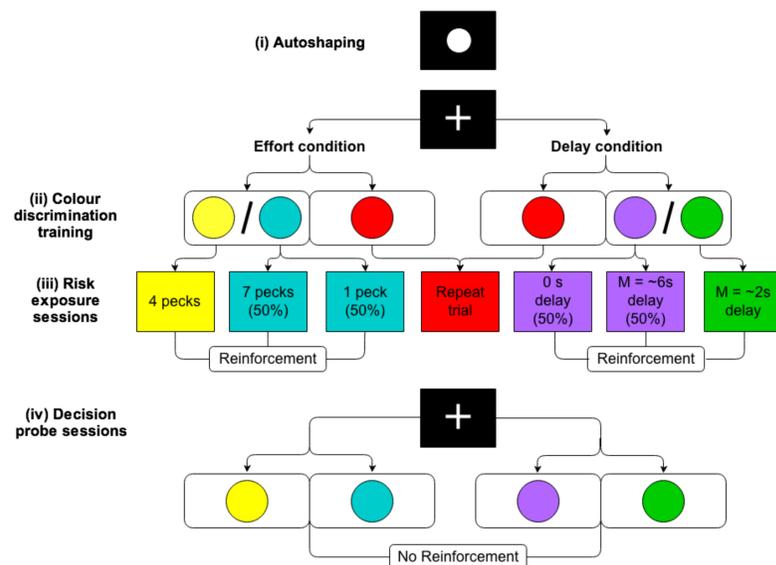
➢ **IV:** Condition

➢ **DV:** Frequency of variable probe trial choice

➢ Trials analyzed as random variable

➢ Binomial tests to assess preference within conditions

➢ Fisher's exact tests to assess difference in preference between conditions

Conclusions

➢ Modified SET should be expanded to explain differences in magnitude estimation and cognitive scaling between modalities

➢ Our work demonstrates the importance of testing all aspects of complex experiences such as response effort that may be a more ecologically valid approximation of foraging compared to other laboratory paradigms
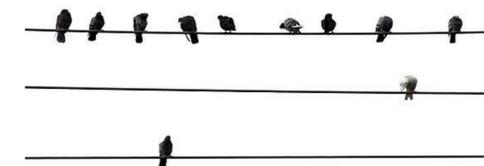
References

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