

Prepotent negation: When a positive reward is rendered negative

J.D. Kralik, E.J. Knight, K.M. Klepac, and E.R. Xu *Dept. of Psychological and Brain Sciences, Dartmouth College, Hanover, NH, USA*

Introduction

The Reversed-Contingency Task has been used to study executive control processes in a variety of species^{1,2,4,6-9} (Fig 1).

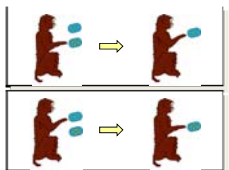


Figure 1. Illustration of the Reversed-Contingency Task

In Murray et al. (2005), we found evidence for three stages of learning in the Reversed-Contingency Task by rhesus monkeys (*Macaca mulatta*) (Fig 2); and the results strongly suggested that in the final stage, the selection of the smaller quantity was being released from a *prepotent inhibition*.

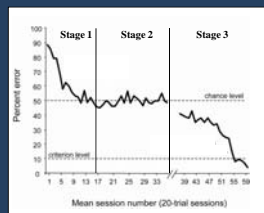


Figure 2. Reversed-Contingency Learning Curves: Group Means
Note the appearance of three stages

Recently, we have obtained more evidence for this additional component of executive control. Monkeys in a recent study were given a choice between 1 and 4 reward pellets, in which the selection of 4 resulted in receiving nothing, whereas the selection of 1 received 4 reward pellets. Once the monkeys had learned to avoid selecting the quantity 4, rather than switching to the quantity 1, they stopped responding altogether.

The extinguished behavior suggests that when a 1-pellet option is paired with a 4-pellet option, the 1-pellet alternative may in fact be considered less than zero in value.

Could the higher-valued option actually render the lesser-valued option negative?

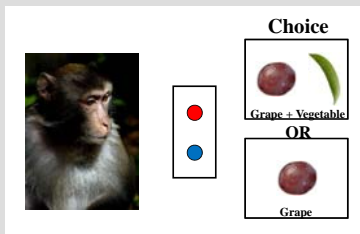
We designed our first experiment to test this possibility directly:



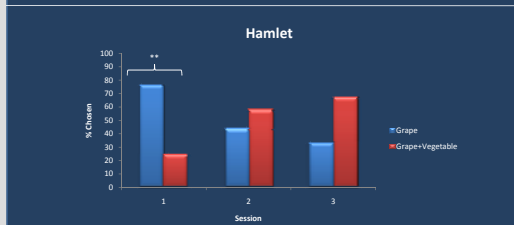
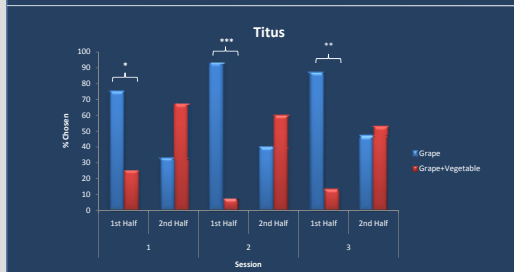
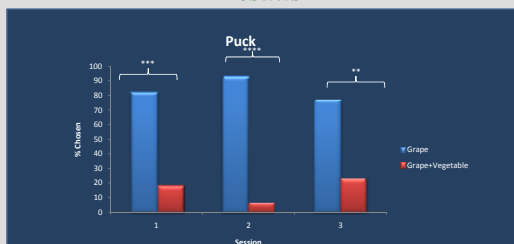
If the value of the lower quality food is negative, then the value of the combination is lower.

Behavioral Methods

- Subjects were 3 male rhesus monkeys.
- Each monkey sat comfortably in a custom-made primate chair, with its left arm comfortably restrained and the right arm free to reach.
- Three 30-trial sessions, analyzed with 2-Tail Binomial Tests, were conducted: *= $P < .05$, **= $P < .01$, ***= $P < .001$, ****= $P < .0001$.
- Higher quality = Grape; Lower quality = Vegetable (Green bean or Pea pod).



Results



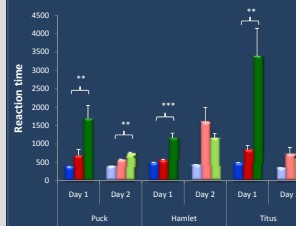
Experiment 1 Conclusions

- Puck preferred the single grape to the grape plus vegetable in all three test sessions; Titus preferred the grape in the first half of all three sessions; and Hamlet preferred the grape in the first session.
- These results cannot be explained by a potential disliking of the vegetable or the grape-vegetable combination:
 - The monkeys normally eat the vegetables when offered alone.
 - For two monkeys, there were cases when the grape-vegetable combination was preferred.
- Thus, a normally positively valued item can be rendered negative in the presence of a more highly valued one.

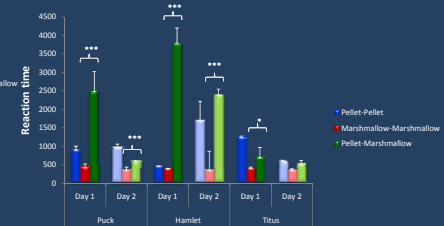
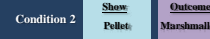
Experiment 2: 'Too Good To Be True'

To study the relationship of executive control processes to decision making, we have begun testing for behavioral economic phenomena such as anchoring effects with rhesus monkeys.^{3,5}

Experiment 2.1:



Experiment 2.2:



Conclusions and Future Directions

- All monkeys exhibited an *anchoring effect* in that their reaction time to accept the pellet after first seeing the marshmallow was significantly slower than in the pellet followed by a pellet condition (Experiment 2.1).
- All three monkeys exhibited a significantly *slower* reaction time when accepting the marshmallow after seeing the pellet as compared to seeing marshmallow then being offered marshmallow. Two monkeys were even slower to accept the marshmallow after seeing a pellet than they were to accept a pellet after seeing a pellet; and the monkeys' overall reactions suggested agitation, as if the offer was *too good to be true*.
- We will continue to examine the different components of executive control; and study the relationship of these processes to decision making phenomena such as anchoring.

References

- Anderson JR, Awazu S and Fujita K (2004). *J Comp Psychol* 118: 58-64
- Boysen ST and Berntson GG (1995). *J Exp Psychol Anim Behav Process* 21: 82-86
- Chen, MK, Lakshminarayanan, V., & Santos, LR (2006). *Journal of Political Economy*, 114(3), 517-537
- Chudasama Y, Kralik JD and Murray EA (2007). *Cereb Cortex* 17: 1154-1159
- Kahneman, D., & Tversky, A. (1979). *Econometrica*, 47(2), 263-291
- Kralik JD (2005). *J Comp Psychol* 119: 78-89
- Kralik JD, Hauser MD and Zimlicki R (2002). *J Comp Psychol* 116: 39-50
- Murray EA, Kralik JD and Wise SP (2005). *Anim Beh* 69: 991-998
- Silberberg A and Fujita K (1996). *J Exp Anal Behav* 66: 143-147