



Durability and Generalizability of Neurocognitive Intervention Effects on Impulsive Choice in Rats

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Introduction

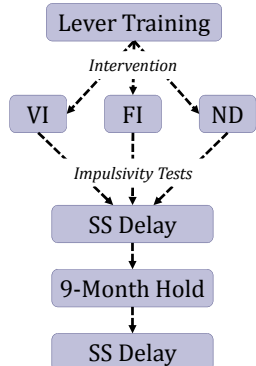
- Impulsive Choice:** Preference for a smaller-sooner (SS) reward over a larger later (LL) reward when the LL reward is the more optimal choice;¹ associated with ADHD,² schizophrenia,³ depression,⁴ substance abuse,⁵ obesity,⁶ and gambling⁷
- Delay discounting:** Reduction in reward value as reward delay increases¹
- Delay aversion:** Avoidance of longer delays to reward⁸
- Delay aversion is related to temporal processing deficits and higher rates of delay discounting⁹
- Goals:** Determine the durability and generalizability of a time-based intervention on impulsive choice
- Hypotheses:** Experiment 1 - Intervention effects will be long lasting; Experiment 2 - Intervention effects will generalize across different choice conditions

Methods

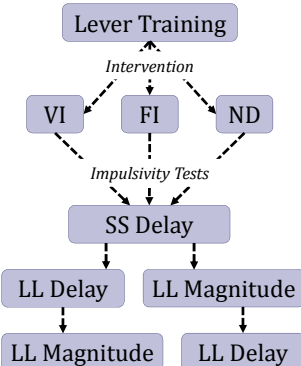
- 48 experimentally-naïve male Sprague Dawley rats (24 per experiment)
- 3 groups ($n=8$) per experiment: Different time-based interventions (i.e., exposure to differential reward delays on SS and LL levers)
 - Variable-interval (VI): SS [1 p, Mean = 10 s]; LL [2 p, Mean = 30 s]
 - Fixed-interval (FI): SS (1 p, 10 s); LL (2 p, 30 s)
 - No-Delay (ND) [Fixed-ratio]: SS (1 p); LL (2 p)
- Impulsive choice tasks
 - SS Delay Manipulation: SS = 1 p, 5→10→20 s; LL = 2 p, 30 s
 - LL Delay Manipulation: SS = 1 p, 10 s; LL = 2 p, 15→30→45 s
 - LL Magnitude Manipulation: SS = 1 p, 10 s; LL = 2→3→4 p, 30 s

p = pellet

Durability (Exp. 1)

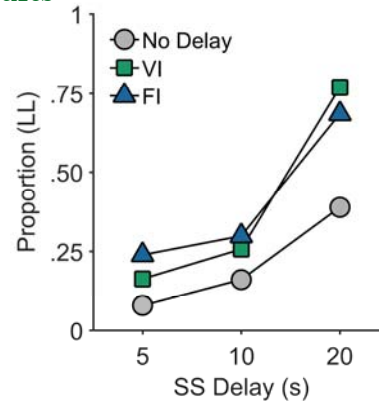


Generalizability (Exp. 2)

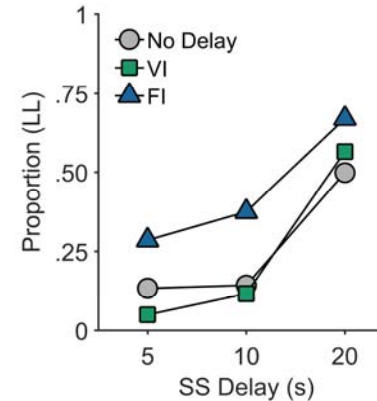


Results

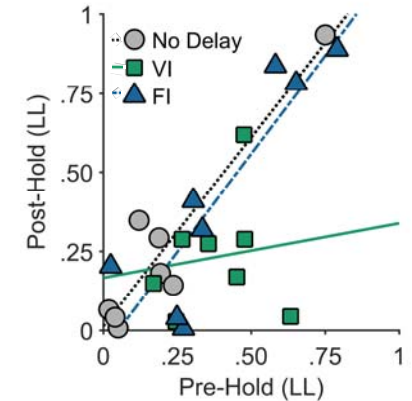
Durability (Exp. 1)



Pre-Hold: Groups exposed to time-based interventions (FI, VI) made more LL choices

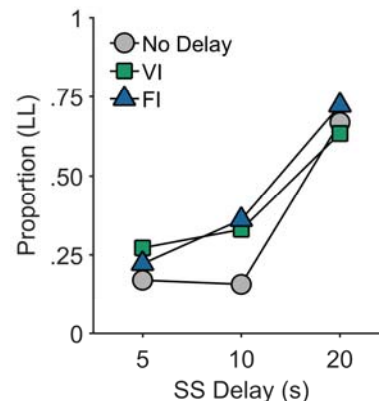


Post-Hold: After 9-month hold, intervention effect was only maintained in FI group

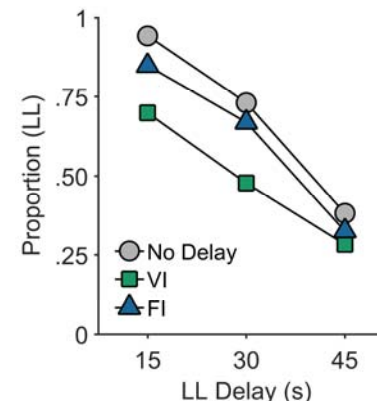


Good test-retest reliability in FI and No Delay groups ($p < .005$); not in VI group ($p = .741$)

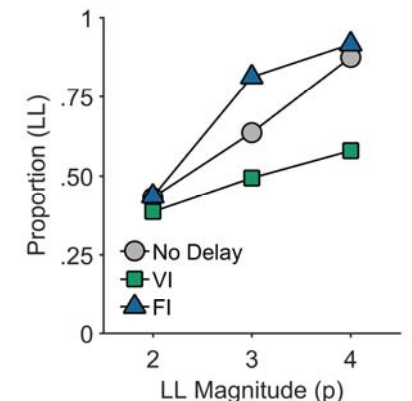
Generalizability (Exp. 2)



SS Delay: Groups exposed to time-based interventions (FI, VI) made more LL choices



LL Delay: No general time-based intervention effect on LL choice behavior



LL Magnitude: No general-time based intervention effect on LL choice behavior

Conclusions

- Durability (Experiment 1)**
 - Rats exposed to time-based interventions made fewer impulsive choices,⁹ and exhibited steeper increases in LL choices when the SS delay increased
 - FI intervention was durable over a 9-month period, suggesting that exposure to fixed reward delays may promote long-lasting self-control
- Generalizability (Experiment 2)**
 - Time-based interventions reduced impulsive choice in the SS Delay task, but did not generalize to the other tasks. This may have been a wash out effect from repeated testing.
 - Future research will aim to improve generalizability of the interventions.

References & Acknowledgments

- Mazur, J. E. (2000). Tradeoffs among delay, rate, and amount of reinforcement. *Behav Process*, 49, 1-10.
- Antrop, L., Stock, P., Verté, S., Wiersma, J. R., Baeyens, D., & Roeyers, H. (2006). ADHD and delay aversion: The influence of nontemporal stimulation on choice for delayed rewards. *J Child Psychol Psychiatry*, 47, 1152-1158.
- Heerey, E. A., Robinson, B. M., McMahon, R. P., & Gold, J. M. (2007). Delay discounting in schizophrenia. *Cogn Neuropsychiatry*, 12, 213-221.
- Imhoff, S., Harris, M., Weiser, J., & Reynolds, B. (2014). Delay discounting by depressed and non-depressed adolescent smokers and non-smokers. *Drug Alcohol Depend*, 135, 152-155.
- Bickel, W. K., Odum, A. L., & Madden, G. J. (1999). Impulsivity and cigarette smoking: Delay discounting in current, never, and ex-smokers. *Psychopharmacology*, 146, 447-454.
- Nederkorn, C., Braet, C., Van Eijs, Y., Tanghe, A., & Jansen, A. (2006). Why obese children cannot resist food: the role of impulsivity. *Eat Behav*, 7, 315-322.
- Dixon, M. R., Marley, J., & Jacobs, E. A. (2003). Delay discounting by pathological gamblers. *J Abnorm Psychol*, 112, 449-458.
- Sonuga-Barke, E. J. S., Taylor, E., Sembl, S., & Smith, J. (1992). Hyperactivity and delay aversion. I. The effect of delay on choice. *J Child Psychol Psychiatry*, 33, 387-398.
- Smith, A. P., Marshall, A. T., & Kirkpatrick, K. (2015). Mechanisms of impulsive choice: II. Time-based interventions to improve self-control. *Behav Process*, 112, 29-42.

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