Fading in and out of time: Interventions to promote self-control

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Introduction

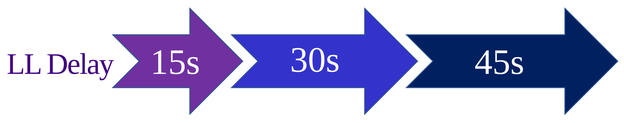
- Impulsivity often leads individuals to choose a smaller reward sooner, rather than a larger reward later[1]
- Timing interventions can be implemented to improve self-control and decsion-making[2]
- Two different types of timing interventions were evaluated in this study:
  1. **Fading**: Shorter LL delays increased over time
  2. **Reverse Fading**: Longer LL delays decreased over time
- Directly comparing these two interventions will help determine whether an increasing or decreasing delay is more effective to improve timing and self-control, or if both intervention types work to improve different aspects of self-control

Methods and Analysis

Subjects: 36 male Sprague-Dawley rats

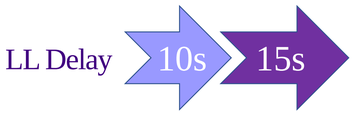
Choice Task: Rats offered a smaller sooner (SS) reward of 1 pellet (p) after 10s or a larger later (LL) reward of 2p after 15, 30, and 45s

- Choice task administered pre- and post-intervention
- LL Delay increased every 10 sessions

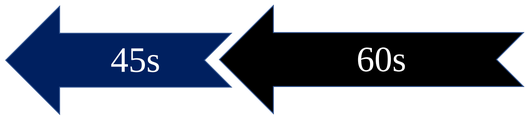


Interventions: Rats offered LL lever with 2p reward after delay

Fading Intervention



Reverse Fading Intervention

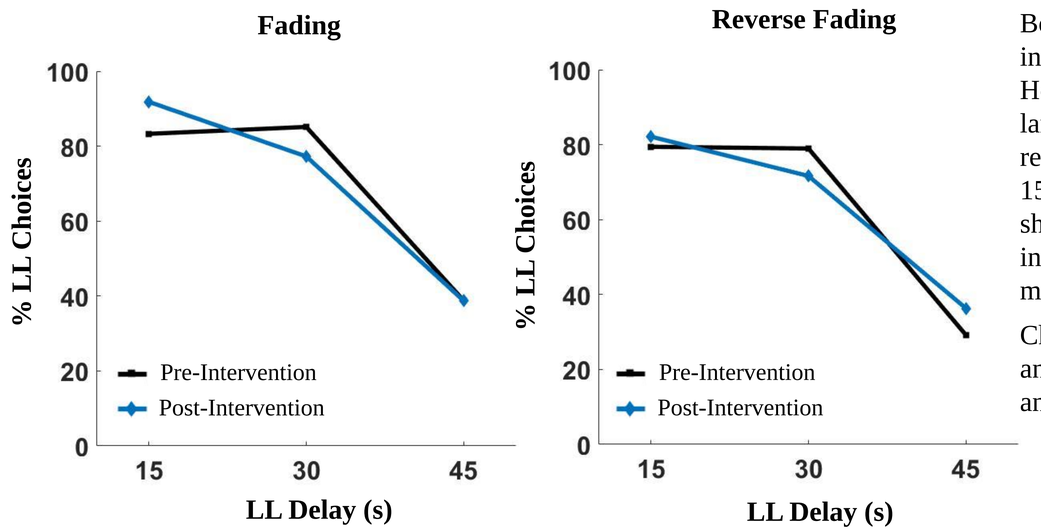


Data Analysis: Multilevel mixed effects regression modeling

- Choice ~ 1 + Group*LLDelay*Prepost + (1|Subject)

Results

Mean Pre- and Post-Intervention LL Choices

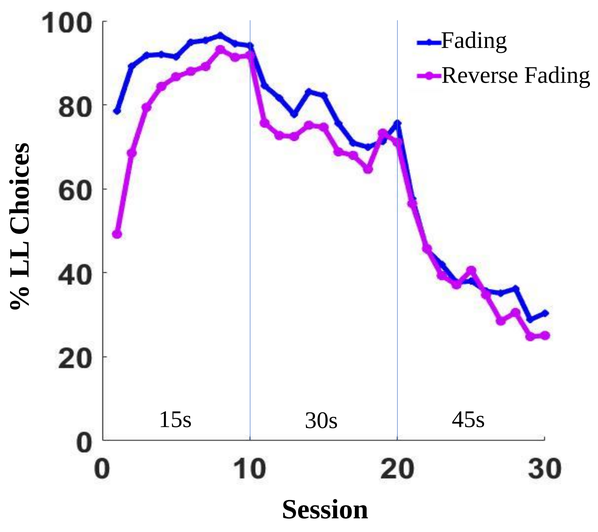


Both interventions significantly increased LL choices at the intercept. However, the intervention effect was larger in the fading group compared to reverse fading at the intercept and at the 15-s delay. The reverse fading group showed a flatter slope in their post-intervention task. In addition, they made more LL choices at 45s.

Change in LL choices between the pre- and post-intervention phases by group and delay (s)

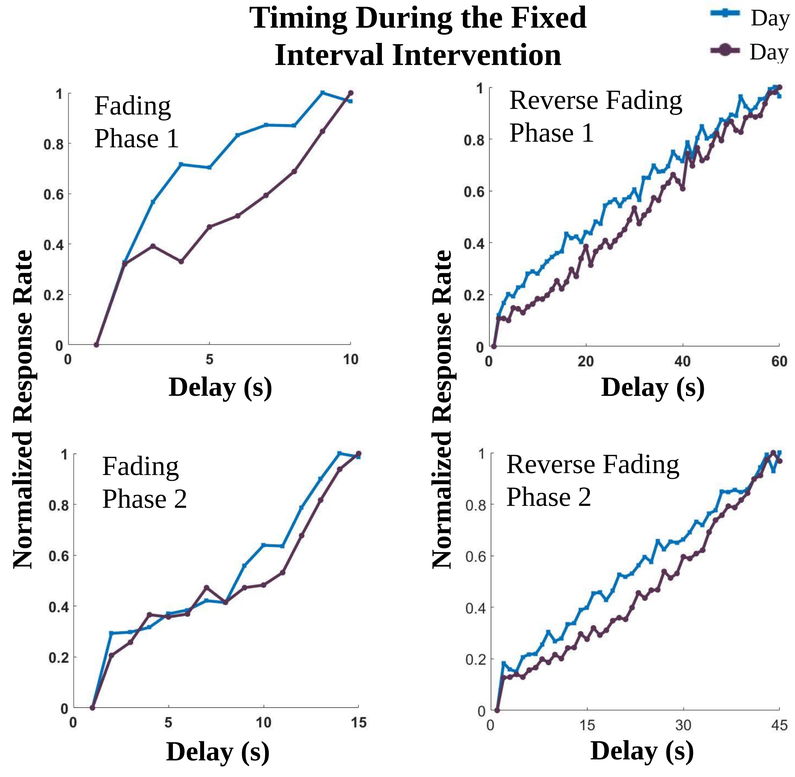
Group	15	30	45
Fading	+8.5*	-7.9	+0.1
Reverse Fading	+2.7	-7.3	+7.1*

LL Choices During the Post-Intervention Choice Task



During the post-intervention choice task, the fading intervention group (light purple) made more LL choices to the shorter LL delays compared to the reverse fading group (dark blue). As the difference in delay got larger, the groups made similar choices (SS: 10s, LL: 45s). There were no overall differences between groups.

Timing During the Fixed Interval Intervention



Rats increased their response rates as a function of time. By the last day of each phase of the intervention, responding had shifted to starting later (purple lines), reflecting improved timing of the delays.

References

1. Odum, A. L. (2011). Delay discounting: Trait variable? *Behav Processes*, 87(1), 1-9.
2. Smith, A. P., Marshall, A. T., & Kirkpatrick, K. (2015). Mechanisms of impulsive choice: II. Time-based interventions to improve self-control. *Behav Processes*, 112(1), 29-42.

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Discussion and Future Directions

- Both interventions increased LL choices at the intercept of the model (at 10 s)
- Fading and reverse fading interventions produced different effects on LL choices
  - The fading group had an advantage at the shortest LL delay
  - The reverse fading group had an advantage at the longest LL delay
- Timing improved over the course of each intervention phase in both groups
- The reverse fading intervention may not have been as robust on the shorter delays due to the descending nature of the intervention phases compared to the ascending nature of the delays in the choice task
  - Future work may test with a choice task with ascending and descending delays
- The best intervention may ultimately be a combination of these two interventions