Females in the forefront: The effects of a temporal intervention on impulsive choice in Sprague Dawley rats

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INTRODUCTION

- Impulsive choice: Preference for a smaller-sooner (SS) outcome when a larger-later (LL) outcome is advantageous in terms of reward rate
- More impulsive male Sprague Dawley rats exhibited poorer discrimination between temporal durations,[1,2] and greater aversion to longer reward delays[1]
- Time-based neurocognitive interventions improved self-control (i.e., reduced impulsive choice) and increased male rats' timing precision[3]
- There has been little research on female rats' impulsive choice and timing behavior, as well as neurocognitive intervention effects on these phenomena
- Experimental goals: Determine the effect of a time-based neurocognitive intervention on impulsive choice and timing behavior in female rats

METHODS

- 24 experimentally-naïve female Sprague Dawley rats

1) Impulsive Choice
SS: 1 p (5 → 10 → 20 s)
LL: 2 p (30 s)
[Free-choice, forced choice, and peak trials]

2) Control Task
Phase 1: FR 2 (1 p)
Phase 2: FR 2 (2 p)

Time-Based Intervention
Phase 1: FI 10 s (1 p)
Phase 2: FI 30 s (2 p)

3) Impulsive Choice
SS: 1 p (5 → 10 → 20 s)
LL: 2 p (30 s)
[Free-choice, forced choice, and peak trials]

DATA ANALYSIS

Impulsive Choice

- **Measure:**
  - SS vs. LL choices [SS = 0; LL = 1]
- **Statistical Analysis:**
  - Generalized linear mixed effects models
  - Distribution: binomial; Link: logit
- **Analytical Approach:**
  - Determined best random- effects structure
  - Then, determined best fixed-effects structure added to random-effects structure
- **Model Selection:**
  - Akaike Information Criterion (AIC)
- **Final Model:**
  - Fixed Effects: Intercept, Group* Pre/Post, Group*SS Delay*Session, Pre/Post*SS Delay*Session
  - Random Effects: Intercept, Session, Pre/Post*SS Delay
  - * Interactions included all lower-order interactions and main effects

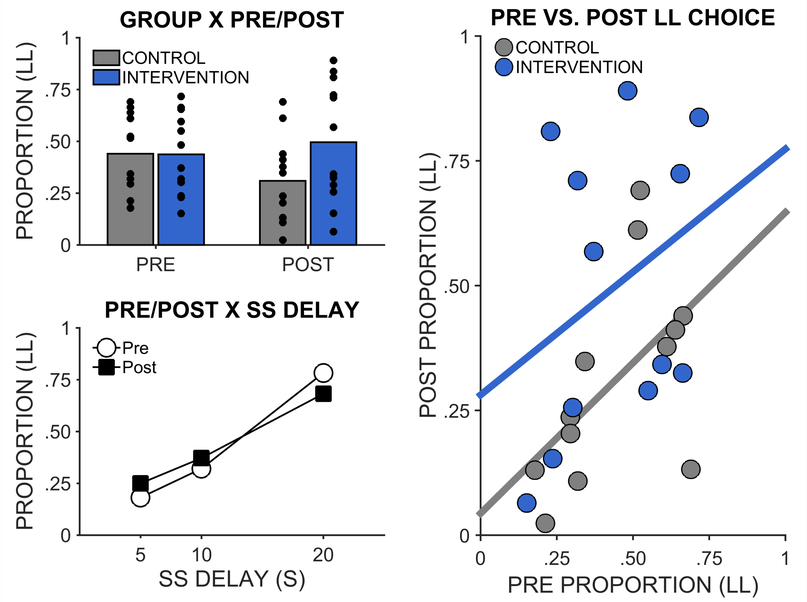
Interval Timing

- **Measure:**
  - Response rate (responses per minute) in peak trials
- **Curve Fitting Analysis:**

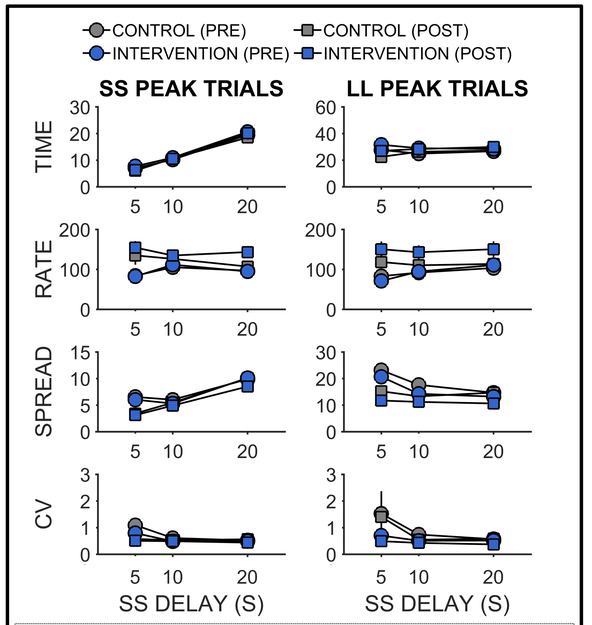
$$r + A\varphi(\mu, \sigma)$$

  - r: Baseline (operant) level of responding
  - A: Scaling parameter
  - $\varphi(\mu,\sigma)$: Gaussian probability density function
- **Derived Measures:**
  - Peak time (accuracy): μ
  - Peak spread (precision): σ
  - Peak rate: Value of equation at μ
  - Peak coefficient of variation: σ/μ
- **Statistical Analysis:**
  - Linear regression
  - Predictors: Group, Pre/Post, SS Delay for SS and LL levers
  - Measures: Peak time, spread, rate, coefficient of variation (CV)

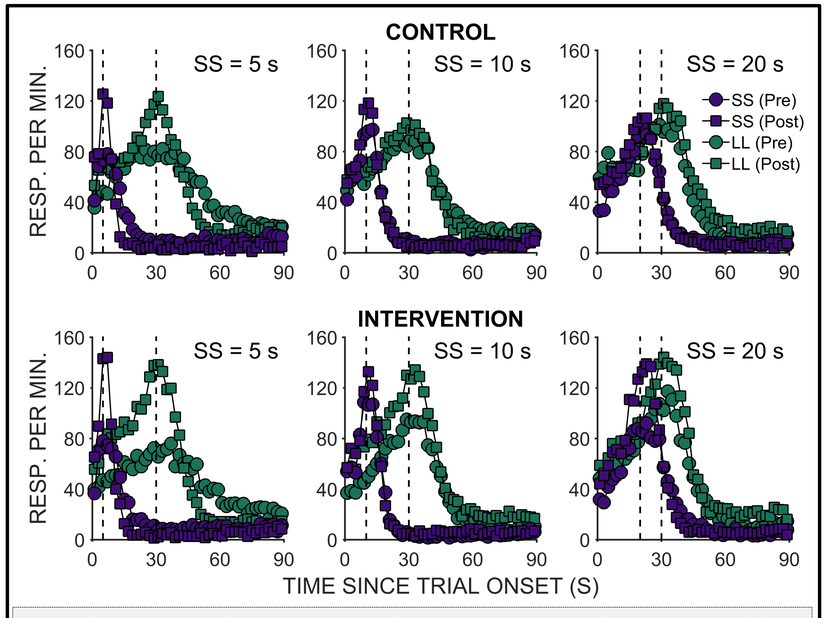
RESULTS



- Post-intervention LL choice increased in Intervention, decreased in Control Group
- Half of the intervention rats made more LL choices post-intervention, whereas the control rats were more mixed
- Greater pre-intervention sensitivity to SS delay



- Increased timing precision (decreased spread) post-intervention in both groups
- Larger post-intervention increase in LL peak rate in Intervention Group



- Both groups demonstrated sensitivity to changes in SS delay in their peak times
- Both groups exhibited more concentrated responding around the expected time of reward during post- than pre-intervention peak trials

DISCUSSION

- Females show a significant intervention effect, demonstrating generality of the time-based intervention across the sexes
- However, unlike male rats[3], the females did not display increases in timing precision (spread) post-intervention
- The results indicate that the time-based intervention in female rats may act more on motivational mechanisms, such as delay tolerance rather than specific core timing processes

REFERENCES

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