



INTRODUCTION

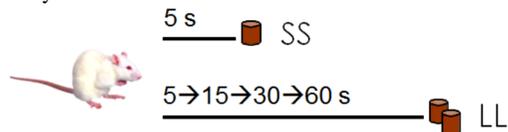
- Impulsive behavior is a common symptom in ADHD, schizophrenia, and drug abuse
- Impulsive choice procedures assess preferences between smaller-sooner (SS) and larger-later (LL) outcomes, with choices of the SS indicating impulsivity
- Understanding the complexities involved in measuring impulsive choice is paramount to understanding the sources of individual differences and the development of intervention strategies
- A number of different procedures have been developed to study impulsive choice in rats and these vary in their implementation of the manipulations of SS or LL delays and/or magnitudes, and the frequency and contingency of those manipulations
- The current study compared three commonly used impulsive choice procedures^{1,2,3}, utilizing same-form test-retest and alternate-form test-retest within subjects designs

METHOD

- Forty-eight male Sprague-Dawley rats were randomly assigned to one of three groups ($n = 16$)
- The SS outcome was always a 5-s delay for 1 pellet and the LL was always 2 pellets but the delay was altered
- Comparisons of point of subjective equality (PSE) and mean percent LL choice were used to evaluate choice behaviors

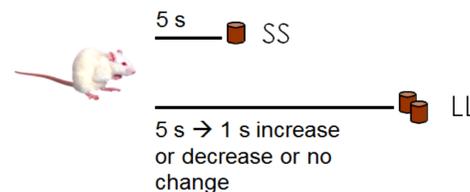
Systematic Delay Procedures

- Green & Estle (G&E)²**
- 20 4-trial blocks each day
 - 2 Forced Choice and 2 Free Choice per block
 - LL delay incremented systematically across phases, increasing every 5 days
- Evenden & Ryan (E&R)¹**
- Same number and type of trials as G&E
 - LL delay incremented systematically across blocks within each session



Mazur³ (M) Adjusting Delay Procedure

- Same number and type of trials as the systematic procedures
- LL delay increased or decreased by 1 s as a function of the most recent choice



DESIGN

Phase 1

- Rats trained on one of the three procedures
- Timeline
 - 10 day baseline (5-s LL)
 - 20 day procedure

Phase 2 Alternate-form test-retest reliability

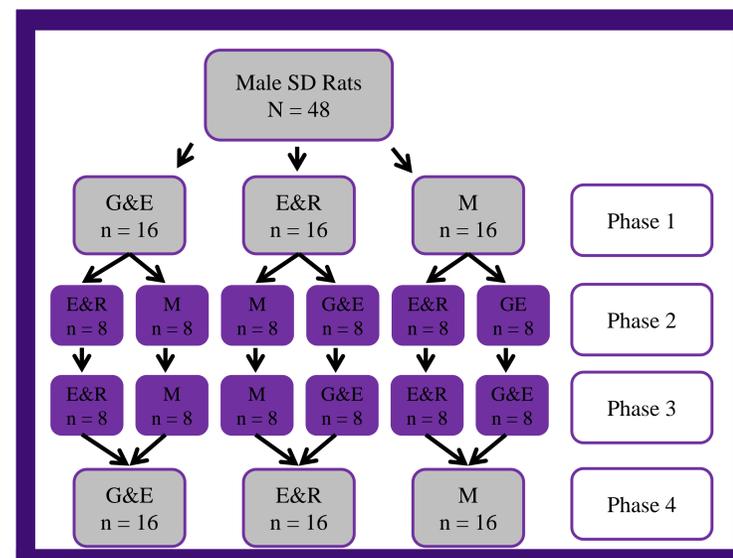
- Rats from each group trained on a new procedure
- Timeline
 - 5 day baseline (5-s LL)
 - 20 day procedure

Phase 3 Same-form test-retest reliability

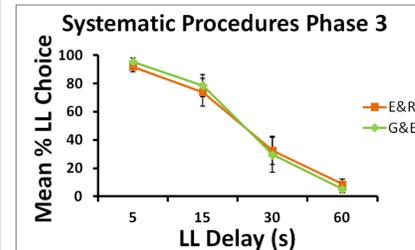
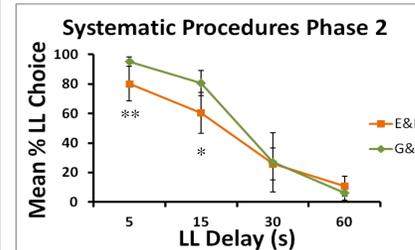
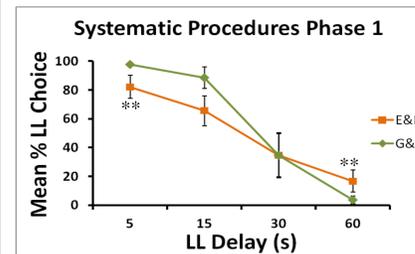
- Repeat Phase 2

Phase 4 Same-form test-retest

- Return to Phase 1
- Testing currently in progress

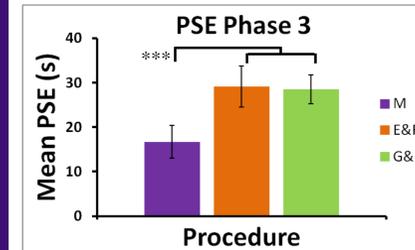
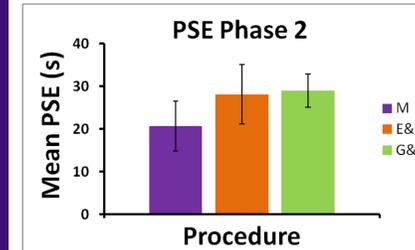
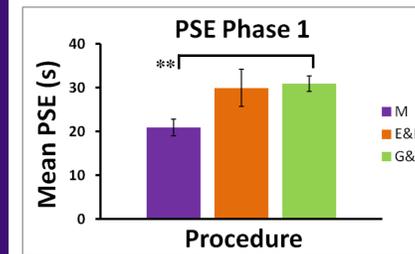


RESULTS



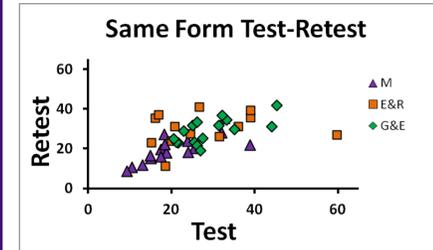
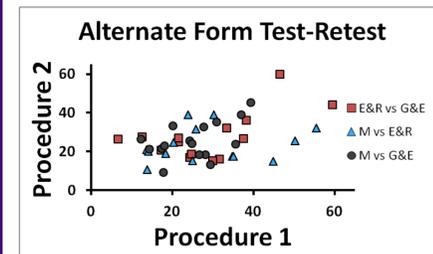
Mean percent LL choices for systematic procedures in Phases 1-3.

- *** $p < .001$, ** $p < .01$, * $p < .05$.
- Significant differences were found between systematic procedures in Phases 1 and 2 at several LL delays, with the G&E procedure showing better differentiation of choice behavior across delays.
 - The E&R procedure eventually resulted in better performance by Phase 3, but only after extensive training.



Mean PSE for Phases 1 - 3 collapsed across subgroups.

- *** $p < .001$, ** $p < .01$.
- The mean PSE for the adjusting procedure (M) was significantly lower than G&E in Phase 1 and lower than both G&E and E&R in Phase 3 but this difference was reduced in Phase 2.
 - Therefore, the adjusting procedure appeared to generally underestimate the PSE compared to the systematic procedures.



Top: Alternate-form test-retest correlation revealed positive correlations for E&R vs. G&E and M vs. G&E, $r = 0.61, 0.50$, respectively. There was no significant correlation between M and E&R.

Bottom: Correlation for same-form test-retest. M, E&R, and G&E were all positively correlated between phases, $r = 0.75, 0.76, \& 0.67$, respectively.

- Alternate form test-retest reliability results suggest that the E&R and M procedures may have *different task demands* that reduced their cross-correlation, but G&E appeared to share variance with both E&R and M tasks.
- Same form test-retest results indicate that individual differences were stable *across repeated measurements* with the same procedure

CONCLUSIONS

- The general pattern of results is consistent with the notion that the three tasks may be measuring a similar underlying construct, but that there are also task-unique features that interact with the measurements of impulsive choice
- The G&E task yielded the most promising pattern of results: (1) good differentiation of the LL delays; (2) mean PSE estimates similar to E&R; (3) significant alternate form test-retest with both E&R and M tests; (4) significant same-form test-retest
- The M task underestimated the PSE compared to the other two tasks, suggesting this task may be biased to identify individuals as impulsive
- The E&R task required substantial training to achieve good differentiation of the LL delays, which may be a drawback of this task

REFERENCES

- ¹Evenden, J. L., & Ryan, C. N. (1996). The pharmacology of impulsive behavior in rats: the effects of drugs on response choice with varying delays to reinforcement. *Psychopharmacology (Berlin)*, 128, 161-170.
- ²Green, L., & Estle, S. J. (2003). Preference reversals with food and water reinforcers in rats. *Journal of the Experimental Analysis of Behavior*, 79(2), 233-242.
- ³Mazur, J. E. (1987). An adjusting procedure for studying delayed reinforcement. In M. L. Commons, J. E. Mazur, J. A. Nevin & H. Rachlin (Eds.), *Quantitative analyses of behavior: Vol. 5. The effect of delay and of intervening events on reinforcer value* (pp. 55-73). Hillsdale, NJ: Erlbaum.

ACKNOWLEDGEMENTS

*Thank you to the members of the Kirkpatrick RTD lab, past and present, for your help with this project: Andrew Marshall, Jim Provost, Maya Wang, Jon Smith, Keith Weber, Jeremy Lott, and Paul Brungardt

*This research was supported by National Institutes of Mental Health grant R01-MHO85739

*Email: jenpete3375@k-state.edu