Developing Baseline Performance in an Animal Model of Learning and Memory

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Introduction

- Repeated acquisition of response chains is a systematic method used to study learning and memory.
- Subjects complete sequences of responses in order to earn reinforcers.
- Subjects must learn the correct sequence of responses for the session through trial-and-error.
- As the subject completes more correct sequences over session time, the number of errors should be reduced throughout the session.
- This within-session error reduction is defined as learning.
- In order to study learning and memory, we need to establish baseline error rates for our subjects and response sequences.

Questions

- Do some subjects have higher error rates than other subjects?
- Do some sequences produce more errors or lower completion rates?
- Do some subjects display learning on certain sequences but not on others?

Method

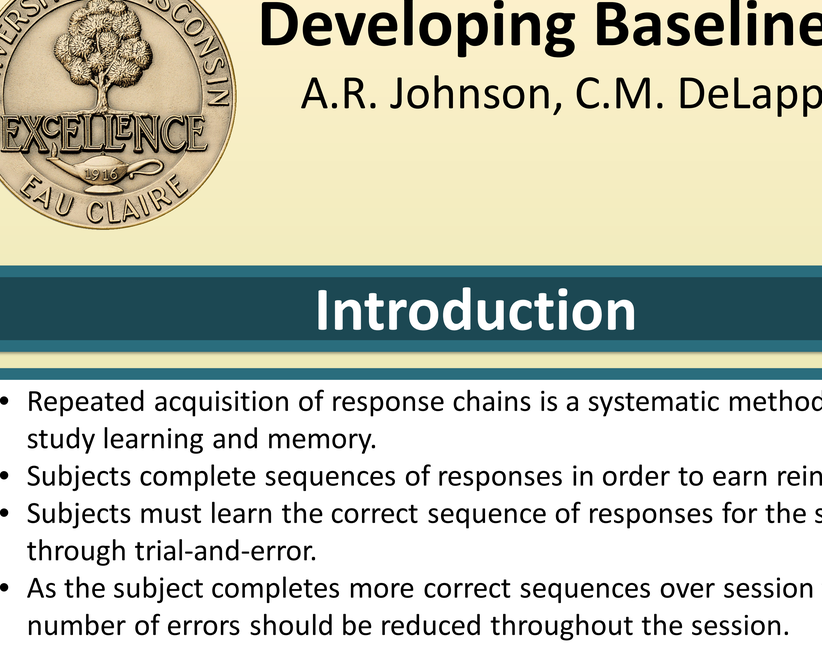
Subjects and apparatus:

- 8 Long-Evans male rats individually caged in a room with a 12:12 light/dark cycle.
- Operant chambers (Med-Associates) with three response options (pigeon keys or rodent nose poke response modules) were used for this study.
- 45-mg food pellets (Bioserve F#0021) were delivered as reinforcers.

Behavioral Training:

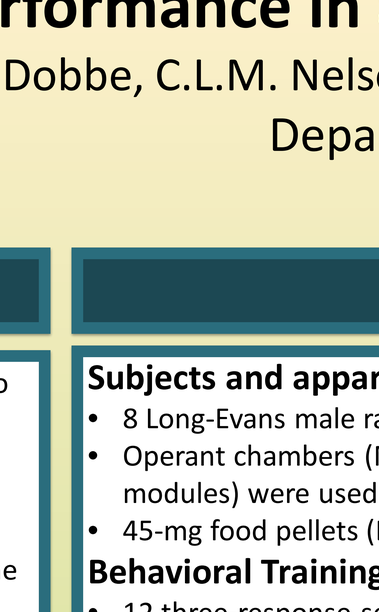
- 12 three-response sequences were used in the course of this study: Left, middle, right (LMR), LRM, LML, LRL, MLR, MRL, MLM, MRM, RML, RLM, RLR, RMR.
- The response options were backlit by different colors (yellow, green, or red). The color of the keys represented the different stages of the sequence.
- The order of the color presentation was held constant while the order of the correct responses changed daily.
- Incorrect responses resulted in 2 seconds of darkness and did not reset the sequence.
- Reinforcers were delivered after each sequence completion.
- Sessions lasted for 60 sequence completions or 45 minutes.
- Total errors and error rates were collected for every 5 sequence completions throughout each session.

Subject Learning Curves



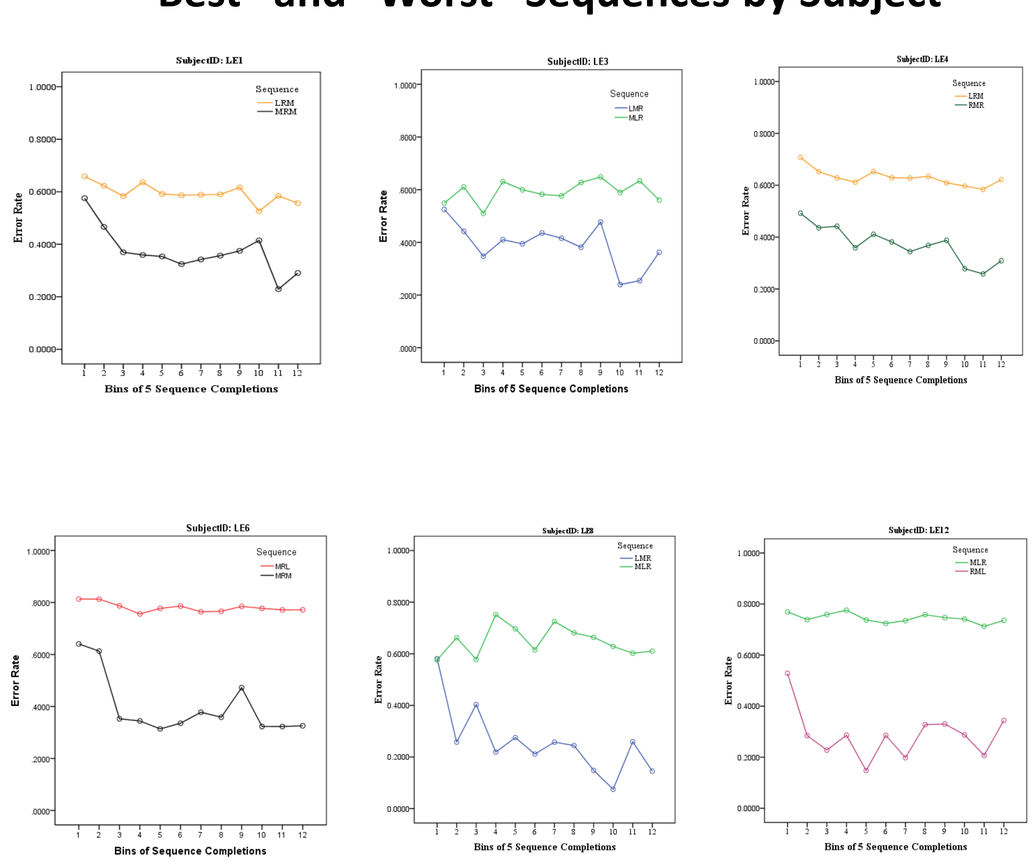
Error rate was calculated by dividing number of errors by total responses in each bin of 5 sequence completions. Each graph represents the average of 7 days of sequences. Week 3 includes the sequences RML, LMR, MLR, LML, RLM, MRM, RLR and week 10 includes RLR, LRL, RLM, MRM, RML, LRM, RLR, LMR.

Sequence Learning Curves



Error rate was calculated by dividing number of errors by total responses in each bin of 5 sequence completions.

"Best" and "Worst" Sequences by Subject



Sequences that produce the most errors (top line) and the fewest number of errors (bottom line) for individual subjects.

Results and Conclusions

- Subjects display different patterns of errors and error rates throughout sessions.
- Almost all subjects show within-session error reduction on at least 1 sequence. The sequence is not the same for all subjects.
- All subjects have at least 1 sequence for which they show no within-session error reduction.
- Some sequences do produce more errors and less within-session error reduction than others.

A stable baseline of error rates must be achieved before any generalization testing can occur using this paradigm. This study gives us insight into which sequences may be useful as test sequences and which may not be useful. Test sequences may need to be determined for each subject individually.

Acknowledgements

- University of Wisconsin- Eau Claire Office of Research and Sponsored Programs
- University of Wisconsin- Eau Claire Faculty/Student Research Collaboration
- University of Wisconsin- Eau Claire Differential Tuition Program
- University of Wisconsin- Eau Claire Student Travel for the Presentation of Research Results