Effects of Ethanol on Encoding and Retrieval of Serial Rule Switch Operant Task

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Acute exposure to low doses of ethanol is associated with detrimental effects on various aspects of cognitive functioning, including components of learning and memory (White et al., 2000). Alcohol has differential effects on encoding and retrieval depending on the memory task, the type of memory involved, and the limb of the Blood Alcohol Concentration (BAC) curve (Söderlund et al., 2005). The main purpose of this study was to adapt a well-validated operant conditioning behavioral task (Dudchenko, 2004) into a serial rule-switching paradigm to assess the effects of ethanol on memory encoding and retrieval for task rules. We hypothesized that rats would be able to learn task rules proficiently, perform multiple switches between rule contingencies and that acute exposure to low doses of ethanol would disrupt memory encoding for new task rules.

Methods

Subjects: 5 adult male Long-Evans rats
Operant Task Rule Contingencies: (See Figure 1)
- Delayed match to sample (DMTS)
- Delayed non-match to sample (DNMTS)
- Rules were counterbalanced across all switch sessions
Performance Criterion:
- >75% session accuracy for 3 sessions
Single Rule Switch Model
- Day 1: Pre-Switch = Rule A
- Day 2: Injection 10 min before Switch = Rule B
- Day 3: Post Switch = Rule B
Double Rule Switch Model
- Day 1: Pre Switch = Rule A
- Day 2: Injection 10 min before Switch = Rule B
- Day 3: Post Switch = Rule A
Intraperitoneal Ethanol Injections:
- 10 minutes prior to rule switch
- 0.0, 0.25, 0.50, 0.75, or 1.0 g/kg ethanol (10% w/v)
Data Analysis
- Repeated Measures ANOVA with 2 within-subjects factors: Dosage (6 levels) x Time (3 levels)

Results

Figure 1: Schematic Diagram of Operant Task Trial: In the sample phase, 1 of 2 lights was randomly illuminated and required a correct lever press to advance to a 5 sec delay period. When a tone sounded, either the MTS or NMTS lever was rewarded (depending on the rule for the day). The intertrial interval lasted 10 seconds, and a session continued for 90 minutes or 150 trials.

Figure 2: All rats showed similar high performance in the pre-switch session. In general, ethanol on a switch session dose-dependently impaired accuracy on the post-switch session. There were main effects of Dosage (F(5, 20)=4.11, p<.05) and Time (F(2, 8)=150.98, p<.05). Asterisks indicate significant (p<.05) difference from no injection in paired sample t-test of post-switch time point.

Figure 3: When rats received ethanol on the switch day they demonstrated slightly improved performance on the switch back to the original rule. There were significant main effects of Dosage (F(1, 4)=11.50, p<.05) and Time (F(2, 8)=31.78, p<.05).

Conclusions

- The single switch paradigm produced a dose-dependent impairment in memory encoding for task rules demonstrated by decreased overall accuracy for the post-switch session.
- The double switch paradigm showed that ethanol produced a slight improvement in switch 2 performance relative to controls suggesting less interference due to a failure to encode the new contingency on switch 1.
- These results support the hypothesis that ethanol disrupts memory encoding for task rules and these effects are not due to a general cognitive impairment.
- Experiments are currently underway to use the serial DMTS/DNMTS rule switch operant task paradigm as a behavioral framework to study neurophysiological mechanisms underlying the effects of ethanol on memory encoding and retrieval.

References & Acknowledgments


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