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# Adjusting Learning Parameters to Increase Cognitive Resource Allocation in Persons with Alcoholism Risk

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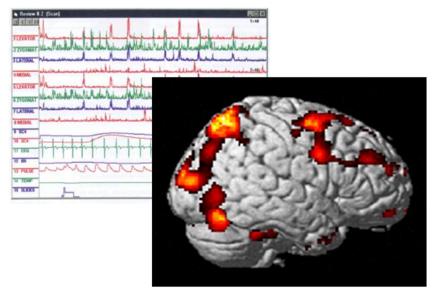

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## Introduction

Children with a parental history of alcoholism display the greatest risk for developing alcohol abuse when they become adults. This risk appears associated with altered processing of visuospatial information Our previous studies both support the presence of attention and encoding differences between adult children of alcoholics (ACOA) and persons who are not ACOAs (NACOA) and demonstrate the utility of incorporating direct evaluations of these operations to better understand these differences. The results support the hypothesis that the ACOA's information processing is disrupted by hyperarousal and reduced stimulus accommodation in the attention and orienting systems. These disruptions slow down but do not block information attention and encoding. Once the information is stored, its retrieval may be more difficult due to competition with continued information flow from the hyperaroused input systems. The effect would be most pronounced in those information processing forms most affected by ACOA-status, e.g., visuospatial learning. If the disruption results from inefficiency and delays in the ACOA's attention systems, then these persons may show enhanced and, perhaps, normal visuospatial learning if they are given more time to process information. Several investigators have incorporated the "tuning" of response periods and response evaluation periods to enhance general processing and visuospatial processing. Modifications of response period and response evaluation period have been reported as beneficial to persons with attentional disorders.

This is an ongoing investigation of whether the ACOA's disruptions in visuospatial information processing can be altered and reduced by the varying response times and response evaluation periods.

## Method

**Participants**. The study is in progress. To date, data are available for 60 ACOAs and 60 NACOAs, with each group equally partitioned into four experimental conditions. Participants were healthy, light social drinkers, with no history of alcohol or drug treatment. They were matched on relevant cognitive, neurological and psychological criteria. ACOA/NACOA status was determined using self-reports, the Children of Alcoholics Screening Test, and the Family History-Research Diagnostic Criteria,

**Apparatus**. Both visual and verbal learning task stimuli were presented on another computer controlled by main data acquisition computer to allow accurate event timing.

The participant responded verbally to the learning tasks. Their verbal responses were monitored by a research technician. Determination of a response occurrence and timing was achieved using a voice-operated digital switch directed to and evaluated by the computer. If the computer determined that a response had occurred within the time window, then the technician was queried by the computer as to whether the response was correct or an error.

Physiological signal conditioning was provided by a Grass Model 7D polygraph. A SCA-1 Conductance Coupler and 7P3 Amplifier processed the signals. Skin conductance (SC) and heart rate (HR) were recorded using 8 mm dia. recessed-disk, Ag/AgCl electrodes filled with 0.05m NaCl electrolyte and secured with double-faced adhesive washers. SC electrodes were placed on the volar surface of the first first and third fingers of the nondominant hand. HR electrodes were applied to the volar surface of the left wrist and to the lateral malleolus of the left ankle.

## Method

**Procedure**. All participants served individually in a single experimental session. After providing written informed consent, participants received the experimental learning tasks. One task required the subject to learn the positions of eight "nonsense shapes" on an eight position grid (visuospatial learning). The design was essentially paired-associate, with the shape serving as the stimulus and its grid position serving as the response. In a second verbal paired-associate task subjects learned a list of eight letter-word pairs (verbal learning). The letter served as the stimulus while the word served as the response associate. During the presentation of the stimulus, participants were required to verbally state the response associate grid position of word. The correct gird position or word associate was then presented to the subject. The eight different shape/grid positions or letter/word pairs were arranged and randomly presented in trial blocks with shape/grid or letter/word pairs presented randomly with in each. A random 9 – 15 intertrial interval was used. The learning criterion was two contiguous, correct trials, with the second trial serving as an overlearning period. Learning continued until the criterion learning point was achieved. A two minute rest period separated the learning of the first and second task. Presentation order of the visuospatial and verbal task was counterbalanced across subjects.

The primary study manipulations consisted of manipulations of the time to respond to the stimulus shape or letter and the time to review the presentation of the correct response grid position or associate word. Based on previously findings regarding response and response review periods, the study used short (2.5 s) and long (5.0 s) response periods and short (3.0 s) and long (6.0 s) response review periods. Within a completely crossed design, ACOA and NACOA participants were assigned to four groups of 10 subjects each. One group received a short response/short review period. A second group received a short response/long review period. A third group received a long response/ short review period which is normal learning. The fourth group received a long response/long review period.

**Data Collection and Analysis**. The data were analyzed using MANOVA with planned comparisons. Learning performance data for each experiment consisted of number of trials to learning criterion; total correct, error, and nonresponses, and response latencies. Since a subject requiring 10 trials to achieve learning could be expected to produce more correct responses than a subject who achieves learning in 7 trials, the data were transformed into ratios of total correct, error, and nonresponses divided by the total responses possible (number trials to achieve learning criterion x the eight stimuli).

Skin Conductance and Heart Rate baseline data were obtained from SC levels averaged across five 12 sec duration epochs during the rest periods and from 2 sec epochs immediately prior to each learning stimulus onset. SC and HR response data were obtained from each stimulus presentation during learning and overlearning. The SC response was defined as a 0.5 microsiemen minimum change from a 2 sec pre-stimulus level occurring 0.5 to 2.5 sec after stimulus onset. The HR response was assessed as the average beat-beat (R-spike to R-spike period) rate occurring a similar period.

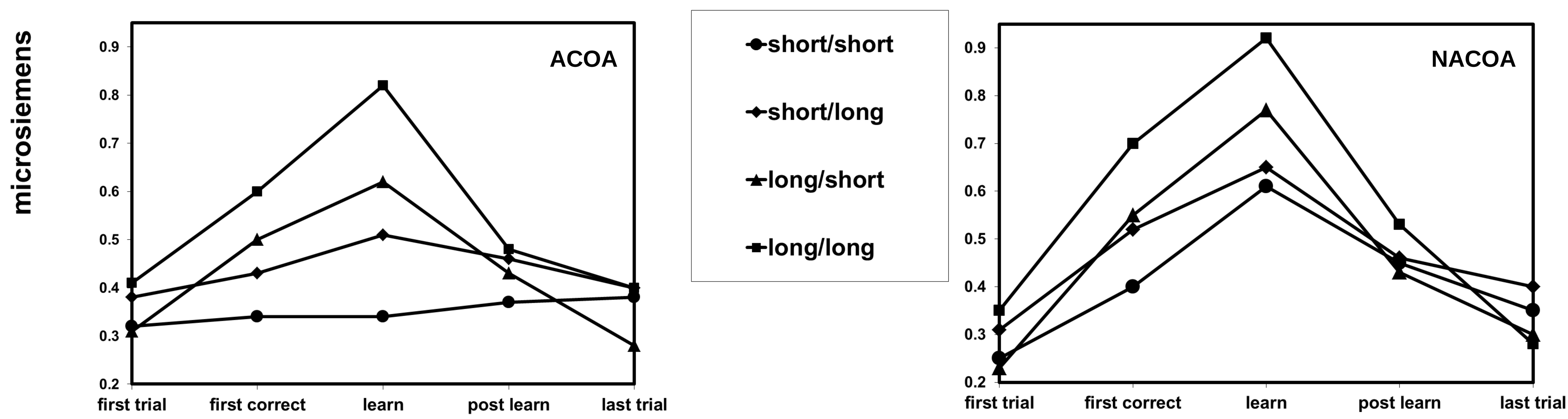
## Results

Learning performance data for adult children of alcoholics (ACOA).and subjects not adult children of alcoholics (NACOA) are presented in the following table. Consistent with all previous results, during the "normal" learning condition the groups showed equivalent verbal learning but ACOAs required significantly more trials to learn the visuospatial task (*p<.05). When provided more time to respond the question stimulus, the visuospatial learning performance of the ACOAs approached that of the NACOAs.

**Visuospatial Learning Response / Information Review Periods**

| Group (n = 15 /condition) | Short respond /Short review | Long respond /Short review | Short respond /Long Review ("Normal") | Long respond /Long Review |
|---|---|---|---|---|
| NACOA | 8.1 | 5.9 | 6.9 | 5.6 |
| ACOA | 9.7 | 6.8 | 8.8* | 6.4 |

Skin conductance response data from visuospatial learning are presented in the following figures. Characteristic flattened activation displayed by ACOAs during short response period conditions changed to clearer peaking (resource allocation) when response were lengthened. Lengthening response/review periods produced the greatest peaking effect. Regardless of information review period, a short response period was associated with little to no activation peaking. Heart rate showed a similar pattern.




## Discussion and Conclusions

The data support the selectivity and sensitivity of visuospatial information processing for differentiating cognitive operations between ACOAs and NACOAs. Further, visuospatial processing appears sufficiently sensitive to monitor disruptions and enhancements in ACOA information processing associated with modifications in the parameters of the information processing task. The literature indicates that cognitive rehabilitation paradigms that modify information processing demands and operations can be effective both in identifying which operations are deficient and in compensating for the deficiencies.

The objective of this study was to determine if alterations of visuospatial information processing parameters do reduce or remove the information processing disruptions experienced by the sober ACOA. The parameters for optimizing information delivery to achieve maximum encoding and storage have been well-developed. The present data show that both NACOA and ACOA benefit from longer response and review periods. There findings are consistent with information processing theory. However, it appears that, compared to the NACOA, the ACOA benefits most from a lengthening of the response period. The findings support the implementation of "tuning" information processing parameters to compensate for processing disruptions related to ACOA-status. This outcome could allow development of more accurately focused preventive strategies for persons at higher risk for alcoholism, reducing or eliminating what is now a 14 times greater probability that these persons will become chronic alcohol and substance abusers who produce high risk off-spring. Further, the ability to precisely adjust information processing dynamics and measure their outcomes on learning and performance would provide a valuable metric for objective determination of intervention and prevention program effectiveness.

## Acknowledgements

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## References

1. Schandler, S.L., Cohen, M.J., & Antick, J.R. Activation, attention and visuospatial learning in adults with and without a family history of alcoholism. *Alcoholism: Clinical and Experimental Research*, *16*, 566-571.

2. Schandler, S.L., Clegg, A.D., Cohen, M.J., & Thomas, C.S. Visuospatial deficits in active, recently detoxified, and long-term abstinent alcoholics. *Journal of Substance Abuse, 8(3),*321-333.

3. Schandler, S.L., Brannock, J.C., Cohen, M.J., & Mendez, J. Spatial learning deficits in adolescent children of alcoholics. *Experimental and Clinical Psychopharmacology* (Premier), *1*, 207-214.