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Brooke Snelgrove  
*Chapman University, snelg102@mail.chapman.edu*

Taylor Stephens  
*Chapman University, steph138@mail.chapman.edu*

Yasmin Akbari  
*Chapman University, akbar102@mail.chapman.edu*

Reyn Yoshiura  
*Chapman University, yoshi126@mail.chapman.edu*

Lilian Andrade  
*Chapman University, andra112@mail.chapman.edu*

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

Brooke Snelgrove, Taylor Stephens, Yasmin Akbari, Reyn Yoshiura, Lilian Andrade
Department of Psychology
Steven Schandler Ph.D., Faculty Mentor

Introduction
Children with a parental history of alcoholism display the greatest risk for developing alcohol problems in their youth and adulthood. This risk appears associated with altered processing of visuospatial information. Our previous studies both present the structure of attention and emphasize differences between adult children of alcoholics (ACOA) and persons who are not ACOAs (NACOA) and demonstrate the utility of incorporating direct evaluations of the cognitive differences in these populations. These 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, 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., visual to auditory learning. If the disruption results in inefficiency and delays in the ACOA's attention systems, then these persons may show enhanced, and, perhaps, not 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. Modulation of response period and response evaluation period have been reported as beneficial to persons with attentional disorders.

This is an ongoing investigation of why 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 either to the visual or the verbal tasks. Their verbal responses were monitored by a research technician. Determination of a response occurrence and timing was achieved using an on-screen timer that was 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.

Visuospatial Learning Task. Slight modifications of the visual task stimuli were created 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 and third fingers of the nondominant hand. HR electrodes were applied to the upper surface of the left wrist and to the lateral malleolus of the left ankle.

Visuospatial Learning Response / Information Review Periods

<table>
<thead>
<tr>
<th>Group (n = 15 /condition)</th>
<th>Short respond /Short review</th>
<th>Long respond /Short review</th>
<th>Short respond /Long Review (&quot;Normal&quot;)</th>
<th>Long respond /Long Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>NACOA</td>
<td>8.1</td>
<td>5.9</td>
<td>6.9</td>
<td>5.6</td>
</tr>
<tr>
<td>ACOA</td>
<td>9.7</td>
<td>6.8</td>
<td>8.8*</td>
<td>6.4</td>
</tr>
</tbody>
</table>

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 responses/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 the longer response and review periods. These 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. This finding supports the implementation of tuning information processing parameters to compensate for processing disruptions related to ACOA-status. This outcome conditioning was provided 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 offspring. 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.

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References