Development of a Sustained Attention Task for Touchscreen Operant Chambers
Brittany Wicks, Kyle White, Nina Duncan, Sarah Cohen, Joy Bergmann, Brittnay Yegla, Vinay Parikh, PhD, David Waxler, and Debra Bangasser, PhD
Department of Psychology and Neuroscience Program, Temple University

Introduction
Sustained attention is the ability to continuously detect rare and unpredictable events. To study sustained attention in the laboratory, a Sustained Attention Task (SAT) has been developed for rodents, in which they are trained to distinguish trials with a signal (a brief light presentation) from non-signalled trials. The traditional version of this task utilizes an operant chamber with a central panel light for the signal and two retractable levers on which the rats can respond to indicate whether the signal was present or absent. However, with the rise in popularity of touchscreen operant chambers, in which one side of the chamber is a touchscreen and no levers are present, the adaptation of the SAT to this style of chamber could enhance the versatility of the task making it more widely available.

Materials and Methods

Traditional

Touchscreen

Figure 1. Comparison between the traditional operant chamber (left) and the touchscreen operant chamber (right). In the traditional operant chamber, levers extend to signal that the rat can respond. The rat then presses the lever corresponding to their choice. Additionally, the water reward port is located on the same side of the box as the levers. In the touchscreen box, no levers extend. The response time is signaled by the onset of a tone, and the rat then makes their response using a nose poke in one of the designated response squares. In addition, the food reward port is on the opposite side of the box.

Figure 2. Illustration of possible responses.

Vigilance Index: Takes into account hits and false alarms

Table 1. Stages of SAT touchscreen training.
*Correction trials were given when a rat responded incorrectly. The rat had four opportunities to make a correct response before the trial type changed.

Table 1.  Stages of SAT touchscreen training.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Max. Trials</th>
<th>Duration (s)</th>
<th>Special Conditions</th>
<th>Criterion to move to next stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pokeshape</td>
<td>120</td>
<td>No stimulus</td>
<td>Houselight off</td>
<td>120 trials in 40 minutes</td>
</tr>
<tr>
<td>SAT Training</td>
<td>162</td>
<td>0.5</td>
<td>*Correction trials.</td>
<td>&gt;70% Hits, &gt; 70% CR, &lt; 20% Omissions for 3 consecutive days</td>
</tr>
<tr>
<td>Phase 1</td>
<td></td>
<td></td>
<td>Houselight off</td>
<td></td>
</tr>
<tr>
<td>SAT Training</td>
<td>162</td>
<td>0.5</td>
<td>Houselight off</td>
<td>&gt;70% Hits, &gt; 70% CR, &lt; 20% Omissions for 3 consecutive days</td>
</tr>
<tr>
<td>Phase 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAT Training</td>
<td>162</td>
<td>0.5</td>
<td>Houselight on</td>
<td>&gt;70% Hits, &gt; 70% CR, &lt; 20% Omissions for 3 consecutive days</td>
</tr>
<tr>
<td>Phase 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAT</td>
<td>162</td>
<td>0.5, 0.05, 0.02</td>
<td>Houselight on</td>
<td>&gt;70% Hits, &gt; 70% CR, &lt; 20% Omissions for 3 consecutive days</td>
</tr>
</tbody>
</table>

Touchscreen SAT Behavioral Training

Figure 3. Boxplot comparing number of days to baseline SAT acquisition between males run in the traditional version of the task and males run in the touchscreen version of the task. No significant difference was detected (U=31, Z=0.105, p=0.959).

Figure 4. The visual distractor (flashing light) that was presented during Block 2 impaired SAT performance in the touchscreen version [F(2,16)=7.8, p=0.004], post-hocs revealed that performance on Block 2 was different than the other blocks (p<0.05). This result is similar to a previous study that used the distractor during the traditional version (McGaughy & Sarter, 1995).

Figure 5. Bar graph depicting days to baseline SAT acquisition for each individual male and female rat in the touchscreen version of the task.

Figure 6. Boxplot comparing number of days to baseline SAT acquisition between male and female rats in the touchscreen version of the task. Baseline differences in days to criteria detected using Mann-Whitney (U=9.5, Z= 2.426 p=0.015).

Conclusions
- Acquisition was similar between the traditional and touchscreen versions of SAT.
- The visual distractor impaired touchscreen SAT performance. This is consistent with previous studies using a similar visual distractor with the traditional version (McGaughy & Sarter, 1995).
- This is the first time SAT acquisition between males and females has been directly compared; females took longer to acquire SAT.
- Collectively, these studies indicate that the touchscreen version of SAT is similar to the original. Our next step is to validate that the touchscreen version of SAT requires the basal forebrain cholinergic system, like the traditional version (McGaughy, Kaiser, & Sarter, 1996). If, as anticipated, the touchscreen version engages the same attentional systems, this would indicate that the touchscreen version is a useful alternative to traditional operant chambers, which have limited flexibility for running a variety of tasks.
- Given the widespread use of touchscreen systems this method will enable many more researchers to study sustained attention.

Acknowledgements: The authors would like to thank Robert Cole for his technical assistance. Supported by PHS grant MH092438 to DAB.