Visual Vigilance: Detecting Critical Signals in Sustained Attention Tasks

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Background

Vigilance, or sustained attention tasks, typically require observers to look for infrequent critical signals over extended periods of time (Warm et al., 2003). Past research has proposed that the decline in vigilance is caused by "mindlessness" or withdrawal of attention from the monitoring task. Robertson (1999) has also shown that the routinized behavior required for vigilance tasks leads to the decline in the ability to respond to infrequent signals. Gulian (1970) found that overconfidence occurs in attention, perception and decision tasks, though no research exists exploring the decline of confidence and vigilance in a sustained attention task. Pilots and technicians are required to monitor streams of visual stimuli for prolonged periods of time, often resulting in stress and perceptions of increased mental workload. The consequences of any missed critical signals could be catastrophic.

Hypotheses

1.) Perceived mental workload will increase from the beginning to the end of the task. Specifically, the perception of stress will increase while actual task engagement will decrease.

2.) Accuracy in detection of critical signals will decline over time; similarly, confidence in correct detections will decrease, though less rapidly, resulting in distinct overconfidence.

References

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Method

Undergraduate participants were presented with two types of visual stimuli (Figure 1). For neutral signals, all arrows were oriented in the same direction, either clockwise or counterclockwise. For critical signals, one of the four arrows was oriented in the direction opposite the other three. After a short practice period, participants were presented with a series of 600 total visual stimuli, including 24 critical signals spread randomly throughout the test. Participants were instructed to respond whether they thought a stimulus was critical or neutral. After each critical signals and 24 randomly selected neutral signals, participants were asked to give a percentile value for their confidence in the accuracy of their previous response. Perceived mental workload was measured following the task.

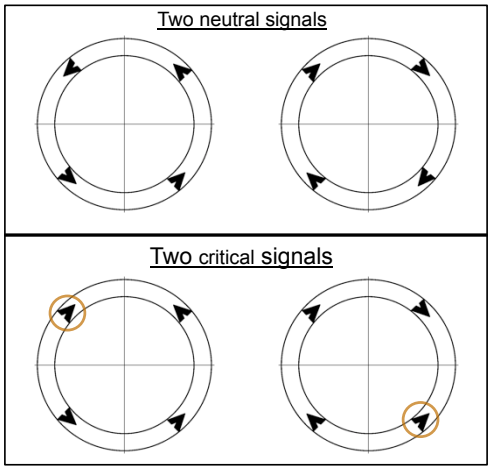

Figure 1

Expected Results

Participants' accuracy will steadily decrease over the duration of the test. Their response time will increase as well, especially for critical signals, as the participants strain to recognize signals as critical or neutral. This decrement in ability to spot critical signals will come from the routinized behavior that Robertson cites in his 1999 experiment. Furthermore, it is believed that confidence will decrease as the test proceeds, though not as quickly as accuracy, reflecting our hypothesis of overconfidence. The perceived mental workload and stress will also increase as the participant continues the test. The participants' perceived workload will increase in contrast with actual task engagement, which is shown by the response time as well as accuracy.

Implications

Future research on sustained attention tasks can be applied to many fields. Current research has been focusing on children with primary language development, narcoleptic patients, and ADHD sufferers who seek the natural ability to sustain their attention, but having difficulties doing so.

Investigations into the cerebral blood flow during vigilance tasks could make way for scientists and researchers to understand the allocation of nutrients to the cortex when performing tasks that require sustained attention. Measuring individual differences within sustained attention tasks has become a new frontier for research in human factors.

Further investigation into the possibility of altering or increasing an individuals' attention span while simultaneously decreasing workload is another promising avenue of future research.