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Investigating the Change in State Boredom After Completion of the Attentional Blink Paradigm

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Abstract

Boredom is defined as an individual's feeling of dissatisfaction with surroundings causing disengagement and discontentment with the present. State boredom is specifically boredom in the present moment, and has been theorized to be caused by attentional failures. State boredom is measured using the Multidimensional State Boredom Scale (MSBS), a 29-question scale scored using a 7-point Likert scale. There are 5 subscales in the MSBS: disengagement, high arousal, inattention, low arousal and time perception. This study focuses on the change in the subscale scores after attentional failures take place. This study uses the attentional blink paradigm to trigger attentional failures in participants to see how their state boredom changes after completing the paradigm. The attentional blink is a phenomenon that reflects the cognitive failure explaining the inability to identify a target when it is presented within 200-500ms of a previous target. Participants completed the MSBS before and after completing the attentional blink paradigm. A 2-factor repeated measures ANOVA showed a significant increase in state boredom for the disengagement and time perception subscales. A paired samples t-test also showed a strong attentional blink across both the lag positions and the participants. Overall, there was evidence of a significant increase in state boredom for disengagement and time perception after completion of the attentional blink paradigm.

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Introduction

Boredom is defined as the feeling of disengagement from the outside world and being stuck in an endless and dissatisfying present, making a person's surroundings undesirable (Fahlman et al., 2013). According to a 2003 National Center on Addiction and Substance Abuse study, 91% of North American youth have reported experiencing boredom (The National Center on Addiction and Substance Abuse at Columbia University, 2003). This study demonstrates why it is so important to understand how boredom occurs and the possible ways to prevent it. Boredom is a common problem that affects most people at some point in their lives. Boredom is associated with psychological, physical, and social health decreases (Eastwood et al., 2012). Some examples of these are burnouts at work, decreases in attention spans (Fisher et al., 1993), increased restlessness and sleepiness (Dankert et al., 2018), increased levels of anxiety (Hartocollis, 1972), and riskier decision-making (Matthies et al., 2012).

Hunter and Eastwood (2018) connect the importance of attention and boredom. Boredom and someone's propensity to boredom have been seen when "a person's attentional ability has been compromised" (Hunter and Eastwood 2018, p. 2483). Attentional failures compromise an individual's attentional ability, possibly leading to the experience of state boredom.

Hunter and Eastwood (2018) analyze two types of boredom to which individuals are prone: state boredom and trait boredom. Trait boredom is defined as "the general propensity to experience boredom across a wide variety of situations" (Fahlman et al., 2013, p. 70). State boredom is defined as an individual's experience of boredom in a given moment (Fahlman et al., 2013). The relationship between trait boredom and attention has been studied more in the psychology field (Hunter & Eastwood 2018) compared to state boredom, but there have been consistent findings of state boredom being associated with poor sustained attention (Pattyn et al., 2008).

State boredom has been studied less due to difficulties within differentiating state and trait boredom combined with the lack of resources available to study state boredom in comparison to trait (Mercer-Lynn et al., 2014). Researchers desired a scale to measure the difference between state boredom and trait boredom and wanted “a measure that is full-scale in nature and multidimensional” (Vodanovich, 2003, p. 588). In order to properly measure state boredom, these desires drove researchers to develop the Multidimensional State Boredom Scale (Fahlman et al., 2013).

The Multidimensional State Boredom Scale (MSBS) is a validated scale of state boredom that was created by Fahlman et al., (2013) and has been used in many psychological studies to measure the relationship between state boredom and attention (Mercer-Lynn et al., 2014; Hunter and Eastwood 2018; Eastwood et al., 2012). The MSBS created a standardized measurement for studying state boredom (Fahlman et al., 2013), moving from past measurements that were created by individual researchers and were provisional measurements of state boredom, such as the work done by Cherrier, Small, Komo, and La Rue (1997).

The MSBS is comprised of 29-questions and uses a 7-point Likert scale (Mercer-Lynn et al., 2014). It consists of five state boredom subscales: disengagement, high arousal, low arousal, inattention, and time perception (Fahlman et al., 2013). MSBS total scores are negatively correlated with life satisfaction and purpose of life. They are positively correlated with high levels of depression, anger, anxiety, neuroticism and impulsivity (Fahlman et al., 2013). The higher the score for both total score and subscales, the more bored a person is perceived to be

(Fahlman et al., 2013). The "MSBS is a promising tool for investigating the actual phenomenon of boredom" (Eastwood et al., 2012, p. 491).

Attention has been investigated by researchers in many different ways in relation to boredom. When participants are presented with an attentionally simple task, they report being more bored compared to an engaging task (Westgate and Wilson, 2018; Mercer-Lynn et al., 2014; Hunter and Eastwood, 2018; and Eastwood et al., 2012). Westgate and Wilson (2018) use the Meanings and Attentional Components (MAC) model to discover that boredom has an attentional component and a meaning component. The MAC model is used to measure if participants are able to maintain attention when faced with low meaning (low stimulating) and high meaning (high stimulating) tasks (Westgate and Wilson, 2018). They provide evidence for boredom being a result of both under stimulation and overstimulation. They also provide evidence for a lack of attention and valuable goals independently causing boredom.

Mercer-Lynn et al. (2014) conduct a study using 5 different scales to measure boredom: the MSBS, Boredom Susceptibility Scale (ZBS), Boredom Proneness Scale (BPS), the behavioral activation system (BAS) and the behavioral inhibition system (BIS). The study posits that there are two types of state boredom: person-state boredom and situation state-boredom. Person-state boredom is similar to trait boredom in that a person will hold certain characteristics to make them bored more often (Mercer-Lynn et al., 2014). Situation-state boredom suggests a current activity is under stimulating for a participant and therefore will lead to boredom (Mercer-Lynn et al., 2014). The authors suggest further research to study whether causes of boredom are directly correlated with experiences of boredom, and if boredom is related to the situation or the propensity to be bored.

Hunter and Eastwood (2018) study if boredom causes attentional failures. Using the BPS, MSBS, Depression Anxiety Stress Scales, Adult ADHD Self-Report Scale and the Sustained Attention to Response Task, researchers' data showed a consistent correlation suggesting that attentional failures cause state boredom. Hunter and Eastwood (2018) also suggest further research be done to see the relationship between attentional failures and state boredom.

Eastwood et al. (2012) define boredom in terms of attention. They determine that an accurate definition of boredom in terms of attention is: "the aversive state that occurs when we are not able to successfully engage attention with internal or external information required for participating in activity, are focused on the fact that we are not able to engage attention and participate in satisfying activity, and attribute the cause of our aversive state to the environment" (Eastwood et al., 2012, p. 482). This is the definition of boredom I will use when analyzing the results of my experiment.

There are two types of attention that are important to define: endogenous (top down control) and exogenous (bottom up control). Awh et al. (2012) discuss the differences between exogenous and endogenous attention. Exogenous attention is driven by external factors popping out in the environment and grabbing our attention while endogenous attention is internally driven and voluntary. There is also a boundary between top down and bottom up control. Awh et al.'s (2012) review examines how the goals of a participant influence the response. The goals influence the attentional control participants use when completing experiments. If participants are focused on one target while other targets are acting as distractors, the distractors will capture the participants' attention and change their attentional control. Awh et al. (2012) highlight the importance of understanding how exogenous targets interrupt endogenous goals. If a participant is more focused on a goal and is able to ignore the distraction, they will have a different response than someone who is easily distracted.

Eastwood et al. (2012) discuss the connection between attention and boredom and the effect of attention on boredom. Boredom has been found to affect both endogenous and exogenous attention, connecting to both a sudden change in attention that is not internally motivated by grabbing participant's attention (exogenous) which can frustrate participants (Fisher, 1998) and a lack of satisfaction in what a person is attending to (endogenous). Exogenous stimuli act as distractors from an endogenous attentional goal. The number of distractors affect the level of attentional engagement of participants, as can be seen when the number of distractors is manipulated (Fisher, 1998).

Fisher (1998) conducted multiple studies where individuals completed a task that involved directed attention. A distractor would appear in different time intervals throughout the experimental sessions. After the experiment was completed, participants were asked to fill out a questionnaire to explain how they are feeling after experiencing the attentional focus and the distractors. Researchers suggested when the number of distractors increased, the amount of information that was taken in regarding the current topic was interrupted. According to Eastwood et al. (2012), this makes the topic less interesting for participants and interrupts the informational processing of a topic, increasing negative mood.

The argument of state boredom being either a cause or consequence of attention has been discussed by Hunter and Eastwood (2018). According to the authors, the implications of state boredom being a cause or consequence of attention potentially explains the negative side effects of boredom. Westgate (2020) explains if a lack of attention is a consequence of boredom, it implies the task at hand lacks value or meaning for the participant. Westgate and Wilson (2018), however, explain that attentional failures may suggest boredom is caused by a lack of attention and implies a lack of importance of the task for the participant. There are many ways to test attentional failures, one being the attentional blink paradigm.

The attentional blink phenomenon was first introduced by Broadbent and Broadbent (1987) and is a cognitive failure that explains the lack of awareness of a stimulus presented within a few hundreds of milliseconds of another stimulus. Green and Bavelier (2003) further define the attentional blink paradigm as a task that begins with a stream of black letters rapidly shown fixed in the center of the screen. A white letter is randomly shown in the middle of the stream and is defined as target 1 (T1). An “X” appears 50% of the time after T1 is presented in the remainder of the stream of black letters (defined as the lag position). The “X” is defined as the second target (T2). The participants are instructed to identify T1 and are asked if T2 was present during the test trials. For the control trials, participants are asked to only identify if T2 was present and asked to ignore T1.

Shapiro et al. (1997) further define the attentional blink as the inability to accurately report the presence of T2 presented within 200-500ms of T1, even when T1 is accurately reported. Shapiro et al. (1997) also explain how past 500ms, subjects are able to accurately report the presence of T2. The attentional blink phenomenon and a physical eye blink are not the same thing, but it is important to know how information processing is interrupted during a physical eye blink to understand why the attentional blink paradigm works (Raymond et al. 1992). A blink of the eye lasts about 350ms (Volkmann et al., 1980), with visual suppression lasting between 180-240ms after the blink is complete (Raymond et al., 1992). The visual suppression is due to working memory encoding the stimulus into the brain, making it so that the second stimulus is less likely to be encoded in our memory (Dux and Marois, 2009). This helps to explain why humans are often unable to process information within 200-500ms of a previous target (Shapiro et al., 1997).

Dux and Marois (2009) explain that this phenomenon is connected to working memory interrupting the encoding process of T1 while T2 is shown. They explain how after the first target is flashed, retrieval processes of the first stimulus in the brain are taking place. This then interferes with the storage process of the second stimulus if it is flashed while the encoding process of T1 is occurring. When T2 is shown to participants, the brain is still working to process, identify and encode T1. This leaves the processing of T2 more open to interference in the brain and makes it be less likely to be encoded. This helps to explain why the attentional blink phenomenon works, because our brains have proven to have difficulty processing information presented to us within 200-500ms of previous information being presented. This provides evidence for the attentional blink acting as an attentional failure and an attentionally demanding task.

Although there have been studies on the relationship between attention and boredom, there is little discussion on the relationship between state boredom and attentionally demanding tasks. My study, in collaboration with Michael Grubb, Jack Miller, Raysa Leguizamon and Kefei Wang, measures the relationship between attentional failures and state boredom. In this study, I expect completion of the attentional blink to cause a significant change in the pre and post MSBS subscale scores. This is supported by the many works of literature outlining a relationship between state boredom and attention. Hunter and Eastwood (2018) claim that attentional failures cause state boredom, so based on this study we can expect state boredom to increase after participants undergo a paradigm to stimulate attentional failures. Westgate (2020) and Westgate and Wilson (2018) present contradicting evidence to support boredom being a cause or consequence of boredom, and this study will help to support some of their evidence. If MSBS scores significantly increase after completion of the attentional blink, Westgate (2020) provided evidence to support the claim that attentional failures cause an increase in boredom. If the scores do not significantly increase, Westgate and Wilson (2018) provided evidence to support the claim that attention does not cause an increase in boredom.

To study the relationship between attention failures and state boredom, I used an attentional blink paradigm and the MSBS. From the studies mentioned above, I expect there to be a significant increase in the MSBS subscale scores after completion of the attentional blink paradigm. Participants were instructed to complete the MSBS prior to completing the attentional blink paradigm. Once participants completed the attentional blink paradigm, the participants immediately completed the MSBS again. There was a successful average attentional blink present and average MSBS subscale scores showed a significant interaction between subscales and pre and post MSBS scores. There was also a significant difference between the pre and post MSBS scores for the disengagement and time perception subscales.

Method

Experimental Sessions

The study was distributed to participants through a digital flyer with an embedded link to the experiment. To begin, participants were provided with information regarding the study and risk factors involved. Participants were then prompted to indicate their consent in order to continue with the experiment. The duration of the study ranged from 30 to 45 minutes depending on the observer. Minimal information regarding the details of the study itself were provided. Participation required the use of a computer, as mobile phones were not supported. The experiment was created in PsychoPy and launched using Pavlovia, a platform for online behavioral science experiments. Once accessing the link, participants began the study. Participants currently enrolled in a Trinity College Psychology-101 course were able to receive research credit for their course by participating in the study. All participants who elected to provide their email address were placed in a lottery for the chance to win a $100 Amazon gift card for completing all sessions. Experimental procedures were approved by the Institutional Review Board at Trinity College, and all observers provided informed consent. Figure 1 shows the experimental sessions in order.

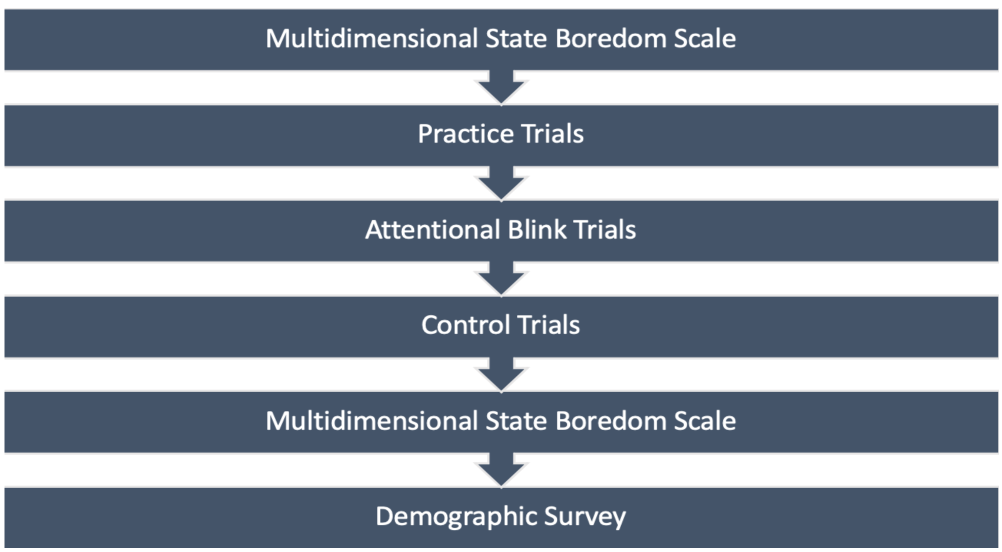

Figure 1 shows the experiment in order of events

Observers

100 sessions of the study were completed. Participant included adults aged 18-30 (mean age = 19.89; self-reported genders: 32 male, 62 female, 2 nonbinary). Ninety-one participants performed above chance in the task for necessary control analyses. *See Data exclusion criterion* below for more details.

Data Exclusion Criteria

Nine study sessions were excluded from all reported analyses. 1 participant completed the study twice and researchers removed one of these data sets from the analysis. Using the computer program, Matlab, researchers simulated chance performance for the hit rate of the attentional blink to determine the 95% confidence interval of the distribution for the 160 trial sessions to be in the range between 42.5%-57.5%. Researchers accounted for accuracy performance below chance to be below 57.5%. 8 data sets were eliminated as they did not meet the subsequent criterion of above chance performance. After these considerations and the removal of the duplicate data set, the study contains N = 91.

Multidimensional State Boredom Scale – Pre-Test

Participants were administered the MSBS both before and after completing the attentional blink paradigm (See Appendix A) (Fahlman et al., 2013). This consists of 29 questions analyzing participants' state boredom. Furthermore, the measure analyzes participants' total state boredom and its 5 subscales: disengagement, high arousal, inattention, low arousal, and time perception. Participants answered the questions on a 7-point Likert scale by clicking computer keys 1 through 7. The Likert scale was as follows: 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neutral, 5 = somewhat agree, 6 = agree, 7 = strongly agree.

Attentional Blink Trials

Participants were administered 160 test trials of the attentional blink paradigm. The design took place on a gray background. Each sequence of letters was black with one target letter (T1) rendered in white. Each letter had a height of 0.1 inches and was rendered in Arial font.

7-15 black letters were flashed in the center of the screen in a random order. T1 was then flashed in the stream of letters with 8 black letters always appearing after T1. Participants response key letters included: ‘A’, ‘B’, ‘C’, ‘D’, ‘E’, ‘F’, ‘G’, ‘H’, ‘I’, ‘J’, ‘K’, ‘L’, ‘M’, ‘O’, ‘P’, ‘Q’, ‘R’, ‘S’, ‘T’, ‘U’, ‘V’, ‘W’, ‘Z’, excluding the: ‘N’, ‘X’, ‘Y’ keys.

Each letter was presented for a duration of 2 frames (33.33 milliseconds) and the duration of the blank between each letter was 4 frames (66.67 milliseconds). The second target (T2), an ‘X’, had a 50% chance of appearing after T1 equally often at 1 of the 8 lag positions, which is the location of the X in the stream after T1 is shown. Participants were asked to identify which letter was rendered in white through pressing the corresponding computer key. Participants were then asked to identify if an ‘X’ was present by answering “yes” with the ‘Y’ key and “no” with the N key. Furthermore, the location of the white letter varies as well as the location of the ‘X’. Participants acclimated to the experiment through 16 practice trials of the attentional blink paradigm before completing the main attentional blink test trials. These practice trials were identical to the test trials except for the duration of the blank between each letter, which lasted for 18 frames (300 milliseconds). Figure 2 shows a visual description of the attentional blink test and control trials.

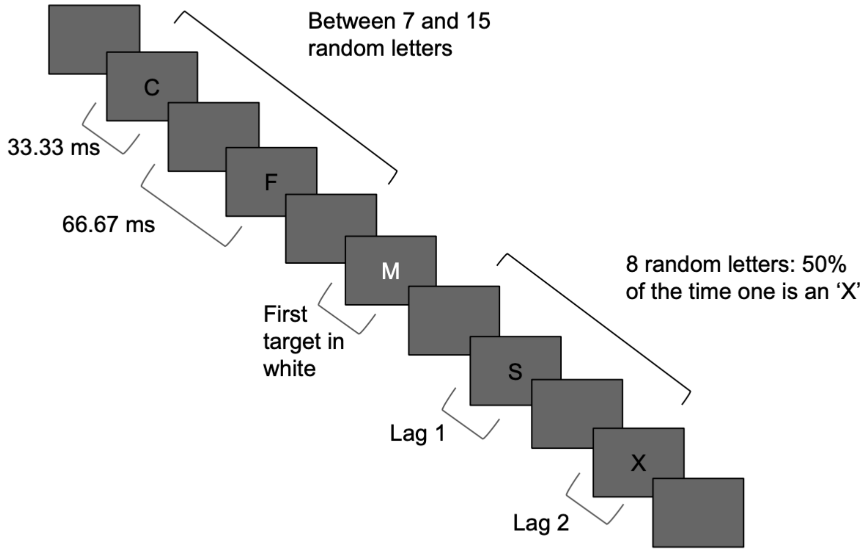

Figure 2 shows the attentional blink task

Control Trials

Participants were administered 160 control trials of the attentional blink paradigm. The control trials had the same design as the test trials, with one exception: participants were only asked if an X was present and participants were asked to ignore the letter rendered in white.

Multidimensional State Boredom Scale – Post-Test

Participants were asked to repeat the MSBS Post-Test. The experimental design was identical as when first administered to participants.

Demographic Survey

Following the experiment, participants were redirected to a Qualtrics survey in order to ensure their personal information was not connected to their experimental data. Participants were asked to provide: their age (in years), self-reported gender, their Professor's name in their

Psychology-101 course (if seeking research participation credit at Trinity College), and their name (first and last). Participants were asked to provide an email address if they wanted to be placed into the lottery for the Amazon gift card. A closing window then appeared to thank participants for completing the study.

Analyzing Results

Attentional Blink

The attentional blink is analyzed by calculating the hit rate for the identification of T2. For the test trials, the hit rate is measured by averaging the number of times a participant accurately identifies the "X" when the "X" is in fact present in the trial. This is also assuming T1 is correctly identified. The hit rate is identified for each lag position. The average hit rate across each lag position for all participants is then taken to determine the proportion of times participants correctly said "X" was present when it was in fact present.

The same calculation is done for the control group. Since there is no letter identification, the hit rate was calculated by taking the average times subjects correctly identified the "X" when the "X" was in fact present across all lag positions.

The average hit rate across all participants for each lag position is also taken in order to compare the average hit rates for both the control and the test trials. If the participant had a higher hit rate for the attentional blink compared to the control, this participant on average did not experience an attentional blink. If the participant had a hit rate that was higher in the control trials compared to the attentional blink, then the participant did experience an attentional blink.

Once the average hit rates were identified, a paired samples t-test was performed with the test and control average hit rates to measure the significance of the attentional blink.

MSBS Score Comparisons: Comparing Subscales

The MSBS consists of 5 subscales with a variety of questions corresponding to each subscale. Each subscale corresponds to specific questions within the 29 total questions asked. Participants are not aware of which questions correspond to which subscales when answering the questions. Disengagement corresponds to MSBS questions 2, 7, 9, 10, 13, 17, 19, 22, 24, and 28. High arousal corresponds to MSBS questions 5, 12, 14, 21, and 27. Inattention corresponds to MSBS questions 3, 16, 20, and 23. Low arousal corresponds to MSBS questions 4, 8, 15, 25, and 29. Finally, time perception corresponds to MSBS questions 1, 6, 11, 18, and 26. Using this information, the participant's subscale scores pre and post attentional blink were averaged. The higher the scores, the more bored the participant appeared to be.

The average MSBS scores before and after completing the attentional blink paradigm were then compared for each participant using a repeated measures two-factor ANOVA to determine the significance of the difference in boredom between subscales before and after completing the attentional blink.

Results

Attentional Blink

A paired samples t-test was conducted to compare the hit rate between the attentional blink data and the control data. When participants were instructed to ignore T2 in the control data (M= 0.866209, SD= 0.08747), the average hit rate went up significantly for the attentional blink data (M= 0.677286107, SD= 0.120237608); t(90)=2.74, p= $6.42353\text{x}10^{-27}$). These results suggest that there is a very strong attentional blink present and that participants did undergo attentional failures during the experiment. Figure 3A shows the attentional blink across all 91 participants for all lag positions. Figure 3B shows the visual representation of the attentional blink taking place across all 91 participants for all lag positions. Figure 4 shows the attentional blink across lag positions for all 91 participants.

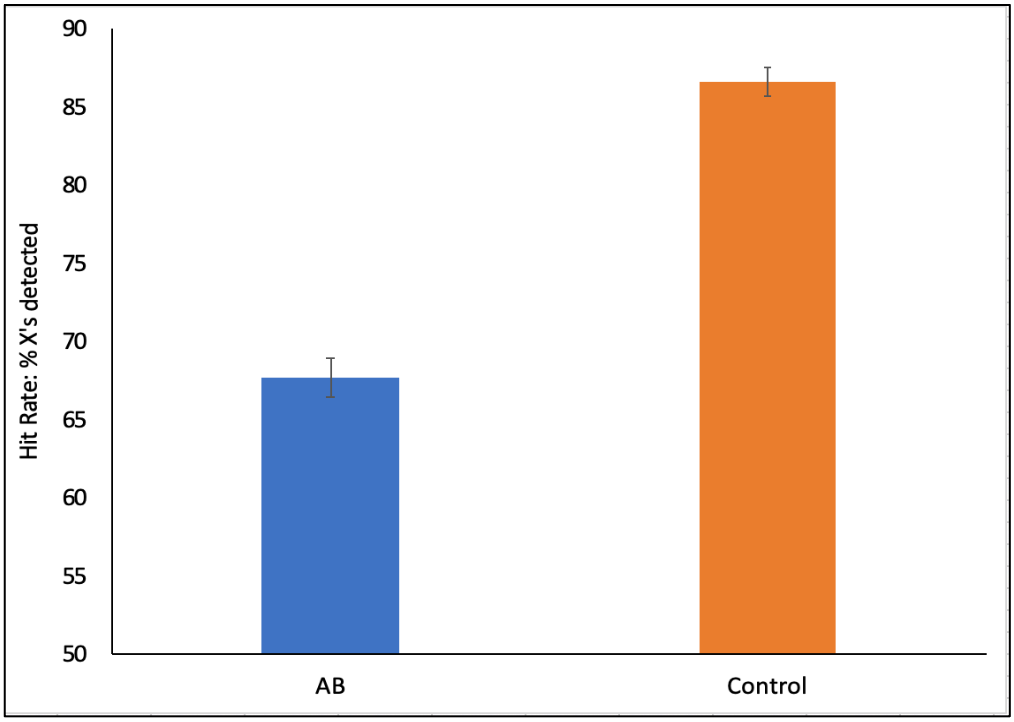

Figure 3A shows the hit rate across all participants for all of the lag positions.

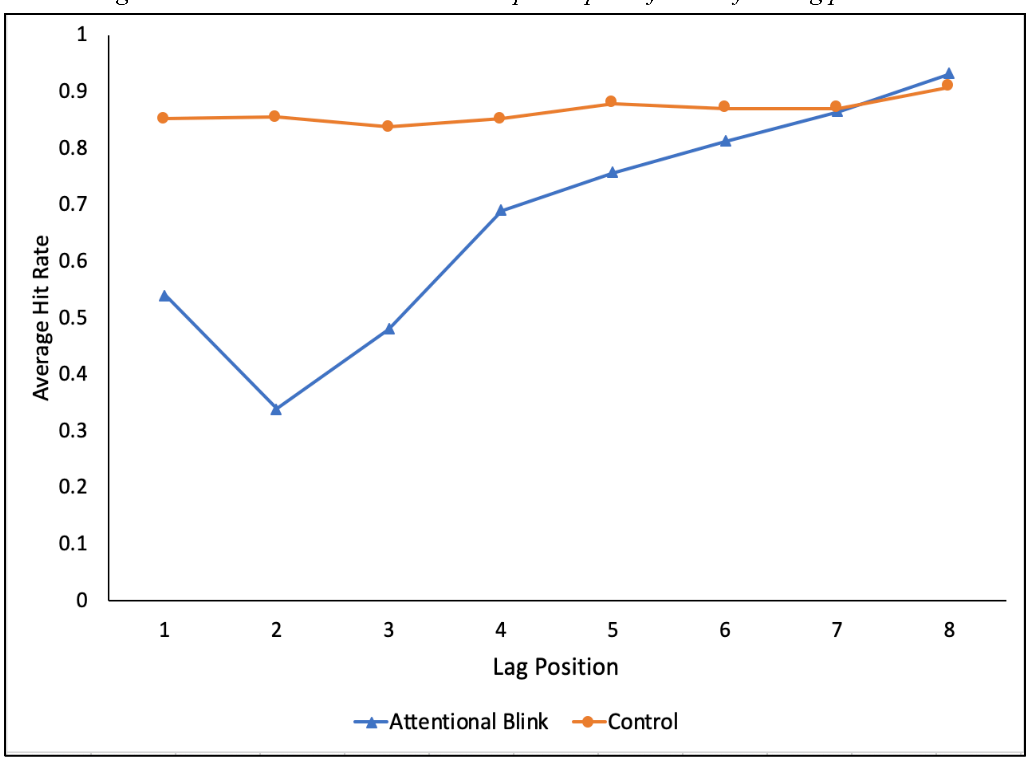

Figure 3B shows the proportion correct for each lag position for both the attentional blink (test data) and the control data.

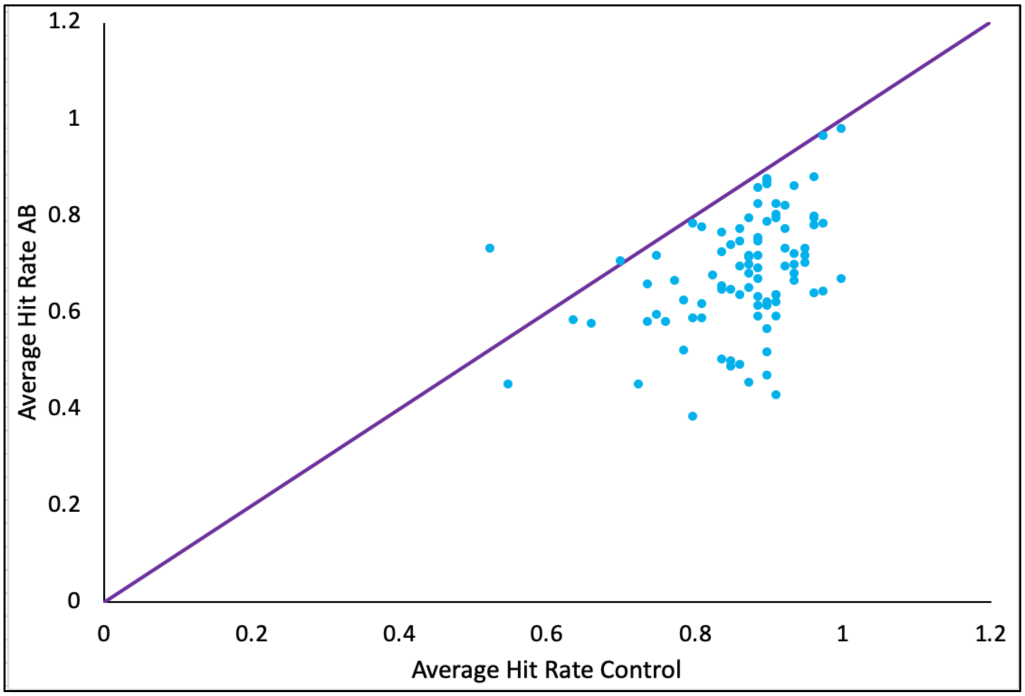

Figure 4 shows the average hit rate across lag position for all 91 participants comparing the control hit rate to the attentional blink hit rate. Anything that is above the unity line must have a higher hit rate in the attentional blink trials than in the control trials. Anything below the unity line must have a higher hit rate in the control trials than the attentional blink. The further below the unity line the point, the stronger the attentional blink.

State Boredom

A repeated measures two-factor ANOVA was conducted to explore the impact on state boredom after completing an attentionally demanding task. Since sphericity was violated ($\varepsilon = 0.884$), Huyhn-Feldt corrected results are reported.

There was a significant interaction between time for the pre and post MSBS scores and the subscales ($F(4, 360) = 1.453$, $p = 0.005$, $np^2 = 0.044$). Figure 5 shows the interaction between subscales and time.

There was a significant difference between pre and post MSBS scores for only two of the subscales (seen in Figure 5). Average pre MSBS scores for disengagement were significantly different ($p=0.048$) compared to average post MSBS scores. Average pre MSBS scores for time perception were also significantly different ($p=0.004$) compared to average post MSBS scores.

Average pre MSBS scores for high arousal (p=0.297), inattention (p=0.531) and low arousal (p=0.080) were not significantly different compared to average post MSBS scores. Figure 6 shows the difference in average pre and post MSBS scores for each subscale.

These results overall show that state boredom does change across subscales for the disengagement and time perception subscales.

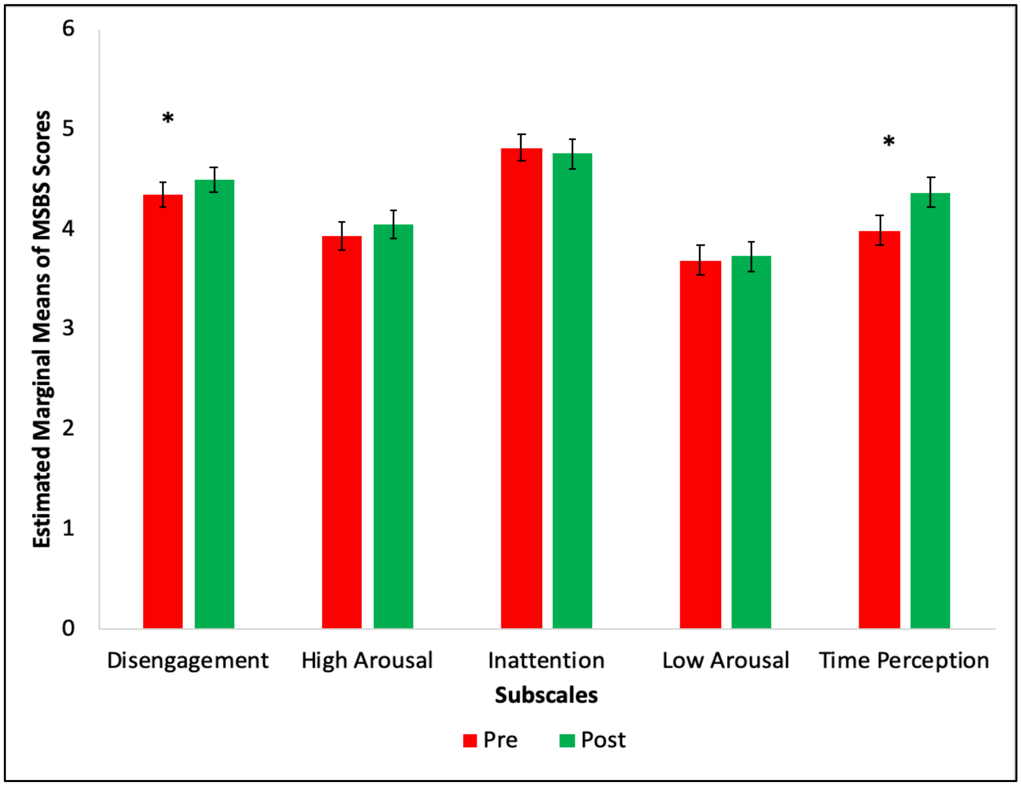

Figure 5 shows the average pre and post MSBS scores across all participants. Significant differences are shown with an asterisk.

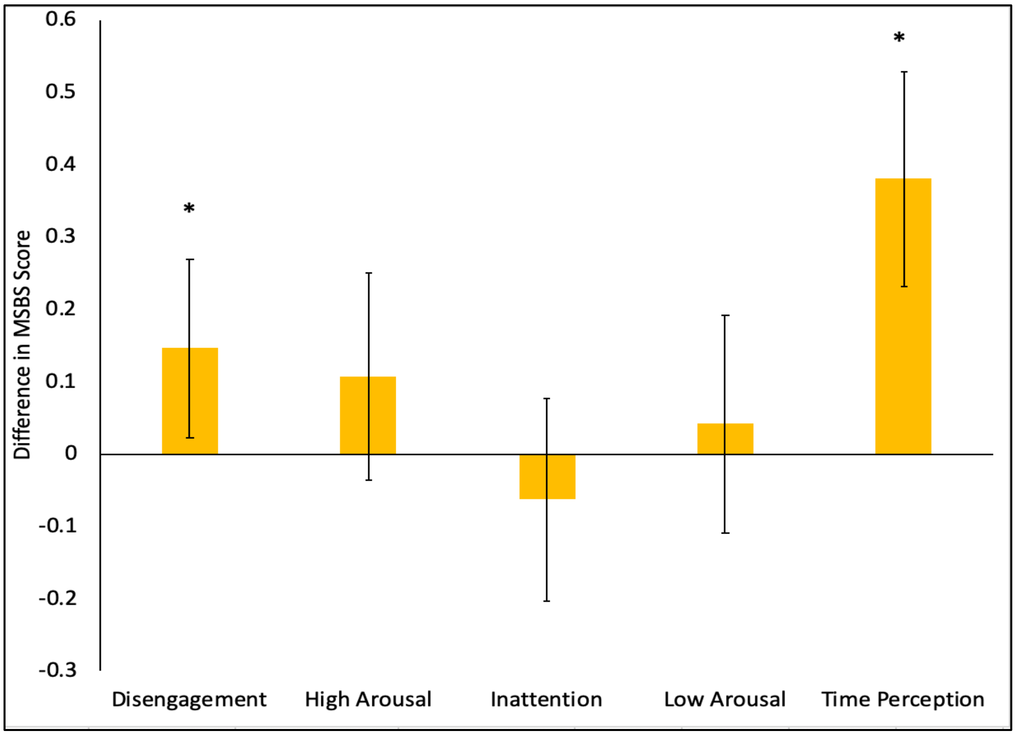

Figure 6 shows the difference in MSBS scores (average post scores – average pre scores). Disengagement and time perception subscales are the only two subscales that showed a significant difference (marked with asterisk) between pre and post MSBS scores after the attentional blink was performed.

Discussion

Attentional Blink

There was a significant difference between the attentional blink test trials and the control trials, which is evidence of attentional failures (see Figure 3A). This provides evidence for when participants were asked to ignore the white letter, they were able to more accurately report that the X was present compared to when participants were asked to report both the white letter and if the X was present (see both Figure 3B and 4). This is evidence that when participants were asked to retain information shown within 500 milliseconds of a previous target, they had difficulty reporting what was shown. This replicates the findings of the original attentional blink study done by Broadbent and Broadbent (1987), providing evidence for the attentional blink paradigm being replicable and is an accurate representation of attentional failures.

This further supports the attentional blink paradigm as defined by Shapiro et al. (1997) and shows that the attentional blink was evident in my study. The attentional blink was used to cause attentional failures for participants, allowing us to build on the hypothesis presented by Hunter and Eastwood (2018) that attentional failures influence state boredom to test my hypothesis that the attentional blink causes a change in state boredom.

State Boredom

There was a significant difference between the MSBS scores prior to completing the attentional blink and the MSBS scores after completion for only two of the subscales: disengagement and time perception (see Figure 5). Inattention, high arousal, and low arousal did not show significant differences between pre and post scores, which was not hypothesized. Inattention MSBS scores were higher prior to completing the attentional blink paradigm than they were after (see Figure 6).

Although the scores did not significantly change for all of the subscales, the change for disengagement and time perception is evidence that a change in state boredom did occur. The results of attention causing state boredom are consistent with Hunter and Eastwood (2018). Our study showed evidence of a change in state boredom after an attentionally demanding task was completed for 2 of the 5 subscales. Although it was not for all 5 of the subscales, further studies may be done to provide explanation for why these subscales changed and not others.

Dankert and Allman (2005) suggest that a slower passage of time may also lead to boredom, and if an activity feels like it is lasting longer than it is, the feeling of boredom may increase. The difference in time perception is understandable because the attentional blink paradigm was used to bore participants and purposefully make participants lose track of time around them. This may cause participants to take longer than they expect to complete the task, skewing the perception of time going by (Danckert and Allman, 2005). The difference between pre and post scores was the highest for time perception (see Figure 6), suggesting that time perception and boredom are connected and should be looked at more closely in future research.

Disengagement is defined as “a longing to engage in an unspecified satisfying activity” (Baratta & Spence, 2018; p.478). Since disengagement scores increased after completing the attentional blink, it suggests that the attentional blink paradigm was not a satisfying activity for participants and that their desire to be doing another activity increased.

Damrad-Frye and Laird (1989) explain that inattention is caused by participants not understanding the connection between the attentional distraction or failure and the task at hand. This was not present in my study, as the task was meant to consume the attention of the participants and exhaust their mind in order to stimulate attentional failures. There was no evidence of unexplained distractions for participants in my study, possibly explaining why inattention did not significantly change.

Jefferies et al. (2008) study how a participant’s emotion can affect their accuracy when completing visual attention tasks. They determine that sadness, associated with low arousal, led participants to be more accurate in their performance. They also determine that anxiety, associated with high arousal, showed the lowest levels of performance. Finally, happy states led to an intermediate performance. This is important to think about when comparing attention to boredom. If participants were anxious, which is a symptom of boredom (Hunter and Eastwood 2018), their accuracy may not reflect a strong attentional blink but a strong state boredom. Conversely, if a participant was sad during the experiment, the participant may have shown a strong attentional blink and not a strong change in state boredom, as sadness is also a symptom of boredom (Hunter and Eastwood 2018). This also may explain why these subscales did not significantly change, since we did not test what each participant's emotion was prior to starting the study and both could have shown a strong attentional blink success or failure without a change in state boredom.

Limitations and Future Research

This study was conducted in the middle of the 2020-2021 COVID-19 global pandemic when most people were required to transfer to at home learning and work with social distancing measures, making general socialization levels much lower than normal. The study was also conducted in an at-home setting, so we could not control participant actions and distractions while completing the study. We modified our methods so that the study could be accessed on any type of computer in order to allow access to as many participants as possible, instead of only designing the program to run on a computer in a laboratory. If this study is repeated outside of a laboratory setting, participants should be instructed to take the study in a quiet environment with limited number of distractions around them.

A study conducted by Driot-Volet et al. (2020) analyzed boredom and time perception during the COVID-19 pandemic and found that as boredom increased, participants experienced a slower passage of time when comparing participants' feelings prior to the pandemic to their feelings during the pandemic. This is significant to consider because if boredom levels are significantly higher during the pandemic compared to average levels pre-pandemic, changes in state boredom may not be as significant since the baseline is considerably higher during the pandemic. These findings also may influence the time perception findings if the pandemic is causing time to be perceived as going by slower. This study shows that baseline boredom is higher than normal, so the change in state boredom may not be as high compared to a more normal baseline.

Future research should be done by repeating this experiment when socializing levels are back to the average level for people when the pandemic is over. This will allow an accurate representation of the study to see if the average low levels of stimulations participants get during the day in the pandemic impacted baseline boredom levels that were reported by participants.

The study should also be done in a laboratory or controlled setting to limit the number of distractors for participants to ensure that the attentional blink is the factor that is causing the change in boredom. If participants completed the study in a setting where there were distractions such as a television in the background or other people walking around them, it could impact the accuracy of the participant. If a distraction took their attention away from the study, they could miss the X in the stream of letters or falsely report the white letter, which impacts their hit rate. This study should also have participants report their emotions prior to the experiment beginning in order to investigate the low and high arousal confounding factors further. Finally, stimulation of unexplained distractions should also be added to accurately study the inattention subscale.

Conclusion

Overall, there was a very strong attentional blink shown and there were changes in state boredom for the disengagement and time perception subscales. This supports my hypothesis that state boredom will increase after completion of the attentional blink. My results provide evidence for state boredom changing when attentional failures occur, but further research needs to be done to confirm these results.

Appendix A

Multidimensional State Boredom Scale

Instructions

Please respond to each question indicating how you feel right now about yourself and your life, even if it is different from how you usually feel. Use the following choices: 1 = *Strongly disagree*; 2 = *Disagree*; 3 = *Somewhat disagree*; 4 = *Neutral*; 5 = *Somewhat agree*; 6 = *Agree*; and 7 = *Strongly agree*.

Questions

1. Time is passing by slower than usual.
2. I am stuck in a situation that I feel is irrelevant.
3. I am easily distracted.
4. I am lonely.
5. Everything seems to be irritating me right now.
6. I wish time would go by faster.
7. Everything seems repetitive and routine to me.
8. I feel down.
9. I seem to be forced to do things that have no value to me.
10. I feel bored.
11. Time is dragging on.
12. I am more moody than usual.
13. I am indecisive or unsure of what to do next.
14. I feel agitated.
15. I feel empty.
16. It is difficult to focus my attention.
17. I want to do something fun, but nothing appeals to me.
18. Time is moving very slowly.
19. I wish I was doing something more exciting.
20. My attention span is shorter than usual.
21. I am impatient right now.
22. I am wasting time that would be better spent on something else.
23. My mind is wandering.
24. I want something to happen but I'm not sure what.
25. I feel cut off from the rest of the world.
26. Right now it seems like time is passing slowly.
27. I am annoyed with the people around me.
28. I feel like I'm sitting around waiting for some- thing to happen.
29. It seems like there's no one around for me to talk to.

Scoring

MSBS Total Score: sum of all 29 items
Disengagement subscale: Items 2, 7, 9, 10, 13, 17, 19, 22, 24, 28
High Arousal subscale: Items 5, 12, 14, 21, 27
Inattention subscale: Items 3, 16, 20, 23
Low Arousal subscale: Items 4, 8, 15, 25, 29
Time Perception subscale: Items 1, 6, 11, 18, 26

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