Abstract

Previous studies have reported a positive relationship between doodling and working attention and memory processes (Andrade, 2009; Boggs et al., 2017; Kercood & Banda, 2012). The present study aims to investigate why this positive dual-

Introduction

As time progresses during a classroom lecture, students are likely to daydream and mind wander instead of effectively processing the presented information. Past research has demonstrated that doodling while simultaneously monitoring an auditory message results in better attention towards and memory of information presented in the message (Andrade, 2009; Boggs et al., 2017; Kercood & Banda, 2012). The purpose of this experiment was to further investigate the beneficial effects doodling on attention and memory, as it is especially unique compared to typical occurrences involving dual-task performances. Generally, past research has demonstrated that performing two tasks simultaneously (relative to performing either task one at a time) results in either an impairment in task performance, or no effect on task performance (Strayer & Johnston, 2001). Interestingly, the doodling effect is the one of the few, if not only, existing findings where a dual-task activity results in the improvement of performance.

A concept that potentially explains the effectiveness of dual

A concep

This balance of stimulation and attention is also mentioned by researchers Suneeta Kercood and Devender Banda, whose study focused on the effects of additional physical activity on learning performance (2012). In their experiment, they studied four students between the ages of 10 and 12, two of which were diagnosed with attention problems. A single subject alternating treatments design was used that required participants listen to a short story followed by a multiple choice assessment in each condition. Each participant experienced four conditions: (a) the baseline condition, where they simply listened to the short story, (b) an intervention-doodling condition where they freely doodled while listening to the short story, (c) an intervention-exercise ball condition where they sat on a bouncy exercise ball and listened to the short story, and (d) a reversal condition where they repeated the baseline condition and merely listened to the short story. It was observed that all four students scored higher and showed improved performance accuracy during both of the intervention conditions (doodling and exercise ball), compared to their assessment scores for both the baseline and reversal conditions.

Keercod and Banda (2012) suggest their findings could be related to a theory they mention known as the Optimal Stimulation Theory. Similar to the daydream reduction hypothesis, this theory suggests that physical activity, like doodling, whilst processing information can be beneficial because it allows individuals to achieve an optimal stimulatory state that could be described as homeostasis. If one reaches the state they require, but do not exceed it, it is likely for them to actively attend to the task and reduce distractions such as mind wandering or daydreaming.

Current Research Goal

The hypothesis that structured doodling improves attention and memory via reduction of daydreaming has not yet been empirically tested as no prior study has assessed the effects of doodling on attention and memory under a condition where individuals are prevented from day-

extending it via the addition of a second manipulation that is intended to completely prevent the

possibility that participants day-dream while monitoring the message. Specifically, in addition to randomly assigning participants to doodle or not while monitoring the message, participants were further randomly assigned to verbally shadow or not shadow the message as it was presented in real-time. This shadowing technique required that participants repeat the auditory information aloud, word-for-word as they were listening to the exposed message. By adding this component, it was assumed that shadowing would use a substantial amount of cognitive resources, enough to eliminate the possibility for the participant to day dream.

With the additional shadowing component, a 2x2 between-subjects factorial design was created consisting of four conditions. All participants were asked to monitor a message, similar to the experiment reported by Andrade (2009) . The first group doodled but did not shadow, the second both doodled and shadowed, the third shadowed but did not doodle, and the final group as the control neither doodled nor shadowed.

If the daydreaming reduction hypothesis were correct, the data would reveal that the daydream-

system and in return received course credit.

Materials

The task administered before the experiment was intended to bore participants so that they may be more likely to daydream. A program, similar to one used by van Tilburg and Igou (2012), played on the computer screen for ten minutes. Each trial flashed a series of 5 to 15 squares; lined in a row sized at 2.5 cm^2 and spaced at 2 mm apart. At the end of each trial the participants to respond using their keyboard.

The mock telephone message played for participants lasted 5 minutes, and contained a similar script to the one used in Andrade (2009). The only difference in the script was a change in places mentioned as they were changed to American cities rather than cities in the United Kingdom (Andrade 2009). The recorder spoke in a reasonably monotone voice and at a slower pace so that participants in the shadowing conditions would be able to perform appropriately. The audio file was played at a comfortable listening volume through headphones. Throughout the script were 8 names of people attending the party, 8 place names, and the names of 3 people and a cat who could not attend (along with much unrelated information).

Participants selected to be in the doodling conditions used a pencil to shade shapes printed on white computer paper. The shapes were sized to be approximately 1 cm in diameter, and were printed by 10 shapes per row, each row alternating between squares and circles. A 4.5 cm wide margin was made available on the left side of the paper, to allow doodling participants to effectively monitor and note any of the targeted information. Those in the non-doodling conditions received a lined piece of paper to write down any of the targeted information.

Procedure

In consideration of replicating Andrade (2009) as closely as possible, participants first completed an unrelated task before focusing on the analyzed portion of the experiment. The unrelated task involved administering participants the program that requires them to make estimations about the visual stimulation. Before the program played researchers instructed the

flashes the program will ask you to make an estimated guess about the amount of squares you previously saw. Do your best to estimate correctly; however, errors do not significantly count

After finishing the boredom task, participants were told the follow

play you a tape. I want you to pretend that the speaker is a friend who has telephoned you to

headphones, while doing so please shade in the printed shapes. It does not matter how neatly or

Participants in the control group did not receive any further instruction as they neither doodled nor shadowed, but merely listened to the auditory message and wrote down any of the targeted information on their lined piece of paper.

All participants listened to the recording, and at its completion researchers collected their paper, and engaged the participant in conversation for 1 minute, including an apology for

The two independent variables being studied were doodling and shadowing, each consisting of two conditions: doodling and non doodling, and shadowing and non shadowing, respectively. This formation resulted in a 2x2 between-subjects factorial design consisting of four groups. After data collection, three two-way ANOVAs were conducted to test the effects that doodling and shadowing have on message-monitoring and message-memory. If the daydream-reduction hypothesis were correct, the results would have shown a doodling-shadowing interaction that indicated doodling improved performance compared to non-doodling under conditions of non-shadowing, further, it would have also indicated that both doodling and non-doodling conditions performed equally under shadowing conditions.

Results

Three two-way ANOVAs were conducted in the interest of analyzing the effects of doodling (doodling, non-doodling) and shadowing (shadowing, non-shadowing) on a measure of attention, a measure of memory for target names, and a measure of memory for places. All three measures were calculated as a number of correct responses minus number of incorrect responses.

Effects on Attention (Table1). First, a main effect of shadowing on attention was found, $F(1, 91) = 8.594$, $p < .05$; participants who shadowed ($M= 6.98$, $SD = 1.05$) scored significantly lower on the attention task than those who did not shadow ($M= 7.54$, $SD= .80$). This indicates that shadowing significantly impairs attention. Further, the main effect of doodling on attention was not significant, $F(1, 91) = 2.032$, $p > .05$. There was non-significant interaction between doodling and shadowing with respect to their effects on the attention measure, $F(1, 91) = .101$, $p > .05$.

Table 1

Means and Standard Deviations on the Measure of Attention Score

Shadow Condition	Doodle Condition	*M*	*SD*	*N*
Non-shadow	Doodle	7.40	1.00	24
	Non-doodle			

Table 3

Means and Standard Deviations on the Measure of Places Memory Score

Shadow Condition	Doodle Condition	*M*	*SD*	*N*
Non-shadow	Doodle	1.80	1.38	24
	Non-doodle	1.50	1.38	24
Shadow	Doodle	2.04	1.40	24
	Non-doodle	1.83	1.27	23

Discussion

The purpose of this study was to investigate pre-existing evidence that supported doodling having a positive effect on working attention and memory (Andrade, 2009; Boggs et al., 2017; Kercood & Banda, 2012). This study specifically aimed to explore why the observed relationship between doodling and learning performance exists through close replication of Andrade (2009). With the addition of the shadowing variable, the daydream reduction hypothesis memory and attention is due to doodlings ability to reduce daydreaming.

If the daydream reduction hypothesis were correct, the data would have revealed that the conditions designed to promote daydream reduction (the doodling, shadowing, and combination conditions) would all perform equally better than the control condition. However, this was not the case and so the daydream reduction hypothesis remains unproven.

The only significant relationship found between the three ANOVA analyses existed between shadowing and attention; a relationship observed to go in a negative direction. It was initially anticipated that participants selected to be in the shadowing conditions would use enough cognitive processes to reduce daydreaming, while maintaining the ability to focus on the target information. However, data analysis suggests that participants could possibly have been

overwhelmed by the unfamiliar instruction to shadow information, consequently affecting their performance negatively (Morey & Cowen, 2004). This suggestion can be supported by comments of multiple participants at the conclusion of the experiment, who claimed that their focus was more on shadowing correctly rather than the target information.

An alternative method that could promote daydream reduction more effectively would be to substitute shadowing with finger tapping, as previous studies have found a positive relationship between finger tapping and improved memory and attention (Rabinowitz & Lavner, 2014). Theoretically, this task would provide enough stimulation to reduce daydreaming and would be less cognitively taxing than shadowing.

Interestingly, there were no significant findings between doodling on attention and memory processes; previously observed results showing the positive effects of doodling on learning performance were not replicated (Andrade, 2009; Boggs et al., 2017; Kercood & Banda, 2012).