The Effect of Overt Head Movements on Memory Retention of Valenced Items

Andrew Scutt

Department of Psychology, University of Toronto

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Dr. Christine Burton

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Abstract

Swallow & Jiang (2010)'s research suggests that divided attention results in enhanced encoding for target pictures compared to distractor pictures, a form of dual coding: when studying a picture, a visual code (the image itself) and a verbal code (the description of the image) are stored. This paper tries to determine if and to which extent this revelation also applies to verbal coding. This goal was accomplished by following Swallow & Jiang (2010)'s experimental methodology but using words, not pictures (verbal coding) and undergraduate students from Ontario as participants. In this experiment, the amount of attention available and the colour of the dots were the independent variables. The number of correctly recognized words was the dependent variable. In terms of results, I discovered that divided attention (lower amounts of attention available) has a lesser effect on verbal coding when encoding target items than dual coding. Importantly, this discovery implies that verbal coding is more dependent on the amount of attention available than dual coding.

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Despite 81% of high school students admitting to multi-tasking when doing their homework, as stated by a survey of 145 000 United States students (*Challenge Success-Stanford Surveys of School Experiences*, 2018), divided attention, a derivative of multitasking, is not effectual as it decreases the amount of attention available for all tasks. This poor allocation of attention results in the attentional filter being overloaded, not selecting relevant information, and negatively disrupting the encoding of memories (F. I. M., R., M., & N. D., 1996). Importantly, the study of divided attention can bring insight into many debates on legality. For example, research has demonstrated that driving while talking on a cell phone impairs the encoding of memories similar to driving while intoxicated (Strayer, Drews, & Crouch, 2006). Therefore, texting while driving should be illegal.

Nonetheless, under a dual-task paradigm (two tasks being performed simultaneously) where one of the tasks is tracking a specific component of a stimulus, divided attention heightens the encoding of that stimulus (Swallow & Jiang, 2010). For example, Swallow and Jiang (2010) conducted an experiment that measured the effect of divided attention compared to full attention on image retrieval. The authors randomly assigned the participants into a full-attention group and a divided-attention group. The divided attention group had to remember a sequence of pictures with a white or black square in the center. In addition, this group had to monitor the colours of the squares by pressing a space bar whenever they saw a white square (target) instead of a black square (distractor). Conversely, subjects in the full attention group only had to remember the images and disregard the squares. Using a four-choice recognition task to test memory, the divided attention group had, on average, better recollection for images that had a white square than pictures with a black square, $t(34) = 15.82$, $p < 0.001$. These findings reflected the attentional boost effect: when, during the concurrent execution of two tasks, a transient increase in attention to one task enhances the performance in another task. However, the effect was relative: for pictures with a white square, both groups had an equal picture memory, and, for pictures with a black square, the divided attention group had a worse picture memory than the full attention section. The full-attention group had an equal memory for images with white or black squares. Importantly, this study demonstrated that divided attention (a lower amount of attention available) enhanced the encoding of target pictures in comparison to distractor pictures. In addition, major components of this research's procedure will be reproduced in this paper's experiment.

The study above described the effect of divided attention on encoding pictures (dual coding): when you retain a picture, you store a visual code (the image itself) and a verbal code (the description of the image) (Clark & Paivio, 1991). Crucially, this study fails to determine how divided attention affects verbal coding. Therefore, researching divided attention in regard to verbal coding would be monumental as it would determine the amount of attention available's influence on verbal coding.

As such, the purpose of this study is to investigate the effect of the amount of attention on verbal coding relative to dual coding for target items under a dual-task paradigm where one of the tasks is tracking a specific component of a stimulus. This study will attempt to fill this gap in knowledge by following Swallow and Jiang (2010)'s experimental approach but replacing pictures (dual coding) with words (verbal coding). This process assumes that words cannot be visually coded. I predict that a lower amount of attention available (divided attention) will have a diminished effect on the encoding of words relative to pictures as, in light of Clark and Paivio (1991)'s dual coding concept, studying words involves one stream of coding (verbal coding) whilst studying pictures involves two coding systems (visual coding and verbal coding), shallowing the possible encoding depth.

Method

Participants

The participants were 37 undergraduate students from a large post-secondary institution in Ontario, Canada: 22 women and 15 men. I sampled students who happened to be in the lecture room. From the 36 out of 37 participants who responded, the mean age of these subjects was 21.1 years (SD = 3.62, range: 18–35). The mean number of years in university was

2.30 (*SD* = 1.05, range: 1–4). All participants were fluent in English. Participants were rewarded with a participation credit for completing the experiment.

Design

The amount of attention available and the colour of the dots were the independent variables of this study. The number of correctly recognized words was the dependent variable. I randomly assigned the participants into one of the two groups based on their seating position in the classroom: a full-attention group (20) and a divided-attention group (17). The study used a mixed-subject design. The amount of attention available was a between-subjects manipulation due to the amount of attention allocated to distinct parts of the presented stimuli being different between the two groups. The colour of the dots was a within-subjects manipulation as both groups saw the colour of the dots.

Materials

Participants in both groups were presented with all-uppercase 60-word-dot pairs for a duration of 500 milliseconds each to control the encoding time, 10 were presented with red dots (target), and 50 were presented with green dots (distractor) on a large projector screen. In terms of controlled variables, the list of words was composed of mostly nouns and some verbs. These words were not semantically similar to avoid the source monitoring error. In addition, the placement of the words with red or green dots was random to avoid participants being more attentive to placement, not colour. Each word and dot appeared simultaneously at the center of the screen, with a vertical distance of approximately five centimeters between them without any interruptions.

Following this list, I administered 20 10-second-long four-choice recognition questions on the same projector screen where 10 words were paired with red dots and another 10 words were paired with green dots. These prompts, reflective of timed cued recall, were used to gauge the participants' explicit memory of the words. Participants had to respond using their own electronic devices on an online platform called *TopHat*.

Procedure

In a large lecture room, participants in the full-attention group, unknown to the divided-attention group, were instructed to read each presented word out loud and remember them in anticipation of a memory test via a prompt on the screen. In the same room and briefly afterwards, participants in the divided attention group were instructed the same. However, unknown to the full-attention group, the prompt also instructed them to make a checkmark on a sheet of paper whenever they saw a red dot, requiring participants to pay close attention to the words. Following these instructions, the participants were presented with the list of words as per the materials section. Immediately afterwards, participants were prompted with the 20 questions as per the materials section.

Results

The divided attention group correctly recognized, on average, 5.05 words paired with green dots (SD = 2.09). The full attention group correctly recognized, on average, 6.18 words paired with green dots (SD = 2.01). An independent samples t-test was conducted to investigate the effect of attention on the recognition of non-target (green) words between subjects. I found no significant difference in memory for words paired with green dots between the two attention groups, $t(35) = -1.66$, $p = 0.11$. The divided attention group correctly recognized, on average, 6.85 words paired with red dots (SD = 2.01). The full attention group recognized, on average, 6.29 words paired with red dots (SD = 1.83). An independent samples t-test was conducted to investigate the effect of attention on the recognition of target (red) words between subjects. I found no significant difference in memory for words paired with red dots between the two attention groups, $t(35) = 0.87$, $p = 0.39$. A paired-samples t-test was conducted to investigate the effect of dot colour on the recognition of words for the full-attention group within subjects. I found no significant difference in memory for words with red dots compared to words with green dots for the full-attention group, $t(16) = 0.33$, $p = 0.74$. A paired-samples t-test was conducted to investigate the effect of dot colour on the recognition of words for the divided-attention group within subjects. I found a significant difference in memory for words with red dots versus words with green dots for the divided-attention group, $t(19) = 3.85$, $p = 0.001$.

Discussion

The purpose of this experiment was to determine how a lower amount of attention available would affect verbal coding relative to dual coding for target items. My hypothesis is supported by Swallow and Jiang (2010)'s divided attention group having a greater significant difference in memory for target pictures than my divided attention group's memory retention for target words. This claim is evidenced by the significant discrepancy between my paired-sample-t-test on the effect of colour on word recognition for the divided attention group and Swallow and Jiang (2010)'s paired-sample-t-test on the effect of colour on item picture recognition for the divided attention group. This greater relative difference posits that lower amounts of attention have had a greater positive effect on dual coding, creating a larger discrepancy between the recognition of target and distractor images. In contrast, lesser attentional resources have had a diminished negative effect on verbal coding, creating a smaller discrepancy between the recognition of target and distractor words. This revelation implies that verbal coding is more dependent on the amount of attention available than dual coding. In addition, the information above indicates that the attentional boost effect was replicated as evidenced by the aforementioned significant discrepancies. In reference to Swallow and Jiang (2010)'s study, both full-attention groups had an equal memory for images/words with a target than a distractor, suggesting that higher amounts of attention equalize the encoding of distractor and target items regardless of coding type. All four attention groups had an equal memory for target items, signifying that the attentional boost effect provided by divided attention does not result in overall heightened retention of target items regardless of coding type. However, Swallow and Jiang (2010)'s divided attention group had a worse picture memory for distractor pictures than the full attention group whilst there were no significant differences in memory for distractor words between my attention groups. This discrepancy may be due to dual coding paired requiring more cognitive resources than verbal coding, resulting in a lower amount of encoded distractor pictures relative to distractor words.

The level of the emotional attachment to words may have skewed the data as emotionally attached words, such as police and explode, tend to be remembered better

(Kensinger, & Corkin, 2003). This effect can be limited by using non-emotional words, such as input, and keyboard. However, the emotional connotations are culture-dependent, making it difficult to monitor this limitation. The primacy and recency effect may have affected the data by words near the start and the end being remembered better (Glanzer & Cunitz, 1966). This effect can be limited by implementing a time buffer of 30 seconds after the words have been encoded.

In terms of future directions, other studies have shown that divided attention during encoding affects implicit memory less negatively than explicit memory for long-term memory systems (Spataro, Cestari, & Rossi-Arnaud, 2011). These studies hint at the prospect of divided attention having an utterly positive effect on encoding implicit memories. Nevertheless, the studies above have failed to examine the specific positive effects of divided attention on implicit memories. Therefore, researching divided attention in the context of implicit memory would be monumental as it may lead to the discovery of an absolute positive effect on encoding. This goal may be achieved by assessing participants' implicit memory using lexical decision tasks instead of a four-choice recognition task.

In conclusion, a lower amount of attention available has a lesser effect on verbal coding than dual coding for target items: lesser attentional resources have a diminished negative effect on verbal coding, creating a smaller discrepancy between the recognition of target and distractor words. Therefore, whenever you are only encoding information verbally, such as words, make sure that you are attentive!

References

Clark, J. H., & Paivio, A. (1991). Dual coding theory and education. *Educational Psychology Review*, *3*(3), 149–210. https://doi.org/10.1007/bf01320076

Craik, F. I. M., Govoni, R., Naveh-Benjamin, M., & Anderson, N. D. (1996). The effects of divided attention on encoding and retrieval processes in human memory. *Journal of Experimental Psychology: General*, *125*(2), 159–180. https://doi.org/10.1037/0096-3445.125.2.159

Glanzer, M. (1966). Encoding in the perceptual (visual) serial position effect. *Journal of Verbal Learning and Verbal Behavior*. https://doi.org/10.1016/s0022-5371(66)80112-3

Kensinger, E. A., & Corkin, S. (2003). Memory enhancement for emotional words: Are emotional words more vividly remembered than neutral words? *Memory & Cognition*, *31*(8), 1169–1180. https://doi.org/10.3758/bf03195800

Mulligan, N. W., & Brown, A. (2003). Attention and implicit memory. In *Advances in consciousness research* (pp. 297–334). John Benjamins Publishing Company. https://doi.org/10.1075/aicr.48.16mul

Spataro, P., Cestari, V., & Rossi-Arnaud, C. (2011). The relationship between divided attention and implicit memory: A meta-analysis. *Acta Psychologica*, *136*(3), 329–339. https://doi.org/10.1016/j.actpsy.2010.12.007

Stanford challenge success 2018 survey. (2018, October). Stanford Education. Retrieved June 5, 2023, from https://ed.stanford.edu/sites/default/files/challenge_success_white_paper_on_college_admissions_10.1.2018-reduced.pdf

Strayer, D. L., Drews, F. A., & Crouch, D. J. (2006). A comparison of the cell phone driver and the drunk driver. *Human Factors*, *48*(2), 381–391.

Swallow, K. M., & Jiang, Y. V. (2010). The Attentional Boost Effect: Transient increases in attention to one task enhance performance in a second task. *Cognition*, *115*(1), 118–132. https://doi.org/10.1016/j.cognition.2009.12.003