Caffeine’s Effect on Certain Visual Sensory Input

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Abstract

This study will explore caffeine’s effect on the rate of eye movement while reading. To measure rate of eye movement, one must examine rate of saccades, or small movements of the eye that occur when a person reads, looks at a scene or searches for an object. Since caffeine is a stimulant drug, the rate of saccades should increase while reading occurs. An individual will be asked to read two paragraphs, one while not on caffeine and one after ingestion of about 160 mg of caffeine. Two EOGs will be taken while the participant performs the reading tasks and comparison of the 2 EOG recordings will show how caffeine affected the rate of eye movement.
Caffeine’s Effect on Certain Visual Sensory Input

Caffeine is one of the most popular drugs used in the world today and caffeine consumption is widely associated with increased energy and mental alertness. People’s reaction times tend to improve with the presence of caffeine (Cheney, 1936). Caffeine in doses as small as 12.5 milligrams even creates better reaction times than placebos (Smit & Rogers, 2000). Even caffeinated gum has been shown to improve mood and performance efficiency (Smith, 2009). While the drug stimulates the alertness of an individual, an interesting question is if the improved cognitive function stems exclusively from an increase in brain activity or if certain sensory systems also contribute to this phenomenon. For example, in a task such as reading a book, it is beneficial to determine if the rate of eye movement increases with the amount of caffeine because it helps us to further understand the effects of caffeine on the body.

While caffeine may stimulate reaction times, some studies have shown that it generally decreases comprehension and recall. One study even went so far as to claim that caffeine may induce psychosis in otherwise psychiatrically healthy people (Hedges, Woon, & Hoopes, 2009). According to another study, caffeinated individuals scored consistently lower on the AVLT (Auditory-Verbal Learning Test), a test of memory (Terry & Phifer, 1986). This goes against common assumptions that caffeine increases your memory and improves your mood.

In order to study eye movement, background and techniques for studying the eye need to be examined. According to Rayner (1998), saccades are eye movements continually made when we read, look at a scene or search for an object. In between saccades, our eyes experience fixations, where they remain relatively still for a fixed period of time. These fixations tend to last differing amounts of time, depending on what task our eyes are trying to accomplish.
Rayner states that the average fixation interval for silent reading is 225 milliseconds, while the average fixation interval for oral reading is 275 milliseconds.

Additional research on saccades has been conducted by other studies. Apparently, during a saccade, at least one form of cognitive activity called mental rotation is stopped. If mental rotation, which is the ability to rotate an object in your mind, ceases to function during a saccade, possibly other mental processes also halt (Irwin & Carlson-Radvansky, 1996). If this was the case, then an increase in eye movement would take the brain longer to comprehend a reading. According to Irwin, the saccades are very good at picking up visual stimuli, which explains why people’s reaction times could be quicker after ingestion of caffeine.

Current research in the field does not really touch on eye movement after caffeine ingestion, but it does seem to further support the idea that it takes people on caffeine longer to comprehend and recall material. One study measured the amount of lines read in a certain time period and found that caffeine was associated with a higher average of lines read for impulsive individuals, but the drug was also associated with a lower average of lines read for less impulsive individuals. (Anderson & Revelle, 1982). Another study concluded that caffeine led to longer reading times overall for specific stories (MacPherson et al., 1996). Apparently, while caffeine does affect certain people differently, it generally seems to slow down the reading process.

One study actually did look at eye movement to detect various stimuli in participants’ visual field. The test results did not indicate increased visual activity while under the influence of caffeine, however the team stated that this was probably due to a data-limited process that resulted from the high-complexity of the experiment (Ruijter, Lorist, & Snel, 1999).

Based on the studies of reading times and the in-depth study on saccades, I believe that caffeine does increase eye movement, which in turn slows down comprehension of reading
materials as your brain temporarily halts every time your eyes move. The increased reaction times are explained by the ease with which visual stimuli are picked up by saccades. Since the saccades, or eye movements, are more frequent while on caffeine, your eyes will detect stimuli in the environment better, thus improving reaction times. My thesis for this research project, however, only covers that people have a higher rate of side-to-side eye movement when reading a book after consuming at least 15 milligrams of caffeine.

My hypothesis for this experiment is: If an individual consumes at least 15 milligrams of caffeine and reads a book, they will experience an increase in the rate of saccades relative to when they were not on caffeine.

Method

Participant

One individual from a general psychology class at Broome Community College will be studied. The individual will be between 18 and 30 years of age.

Materials and Apparatus

One desk and one chair will be used to seat the test participant, while one Biopac MP40 device (with a built-in EOG monitor) will be used to record the test results. A computer will also be required for the MP40 device to work properly. Two paragraphs from the book “Language Development from Birth to Three,” a 1270L book on the Lexile scale, will be provided for reading material. The 1270L measurement is consistent with a twelfth grade reading level, to ensure the reading material is not too easy and not too difficult for the participant to read. Finally, one energy drink (about 160 mg. of caffeine) will be provided for test participant consumption.

Procedures
Before commencing the experiment, I will explain to the test participant the nature of my test and obtain consent from the participant to test him or her. After approval, the participant will be instructed to sit at the desk and chair provided while being hooked up to the Biopac MP40 device. The device will then be connected to a computer and the participant will be given one of the two paragraphs as reading material. The participant will be instructed to read the passage at their normal pace, while the MP40 device monitors their saccades. Afterwards, the individual will be given an energy drink to consume within ten minutes. After consumption, the test participant will be given a second paragraph to read and the MP40 device will record their saccades.

Method of Analysis

After the experiment, the two saccade recordings taken will be compared to see which recording had the higher rate of saccades. The second recording should have the higher rate, which should show that caffeine did increase the rate of saccades while reading. Some possible error could be introduced into the test if the two paragraphs are not perfectly equal based on reading levels and length.
References


