THE STUDY OF THE EFFECTS OF CAFFEINE ON THE HUMAN BODY

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Abstract:
Caffeine blocks Adenosine receptors, allowing dopamine to be produced, which creates adrenaline and allow energy levels to rise. In the experiments, volunteers will drink 120, 240, and 360ml of Pepsi Max and test different things used in daily life. The results showed that more caffeine helps boost performance in things necessary in human survival. People can use my results to see if the cons of caffeine out weigh the pros or not.

Introduction:
Caffeine is a routine part of daily life to the average human being. Caffeine in substances like coffee or 5-hour energy drinks help people stay awake and be more alert and energetic at work or late nights. Caffeine is one of the world most commonly used drug, other than alcohol, the average adult drinks over 50,000 mg of caffeine in a year! Caffeine is a potent and quick acting drug that gives coffee and cola there “kick” and helps boost energy and adrenaline levels much like sugar. Caffeine is an acceptable drug which is known to cause irregular ventilation and heart rate and become VERY addictive-so much so that if a regular coffee drinker didn’t have caffeine for a certain amount of time, they will suffer withdrawal symptoms. Caffeine is known to help boost humans both mentally and physically. Many studies have been performed on how caffeine affects the body or the brain. Adenosine is a brain chemical that helps stop the flow of dopamine, which makes adrenaline. Adrenaline is a natural stimulant released when a human is in much stress in order to prepare a human for exertion, so as a result when a lot of adenosine is released a person tends to become sleepy. Dopamine is a chemical made in the brain that releases pleasure, helps fine motor skills, and enhances the senses. Dopamine attaches to dopamine receptors in the brain, which sends the brain a message which gives the human a wave of pleasure, helps them focus on something hard, or allows them to experience an adrenaline rush.
Figure 1 shows the normal amounts of adenosine without caffeine.

When a human consumes caffeine, the caffeine blocks the receptors for adenosine, stopping the flow of adenosine. With the lack of adenosine, dopamine and adrenaline levels increase making the human more alert and motivated. Figure 2 shows how caffeine prevents the flow of
The problem with caffeine is that the more consumed, the more insensitive our body and brain becomes to our normal level of stimulants, making them sort of ignore those natural stimulants. Therefore, humans need more caffeine for more stimulants to be released and then feel normal again. But as a result of the consumption of caffeine to feel normal, the human body needs even more to feel normal again leaving the human more and more depressed, exhausted, and unable to cope with life. Caffeine in the human body reaches its peak at about 30-60 min. because it is broken down by the liver afterwards, but for about five hours the human would still have half the amount of the peak. For example, let’s say a person drank 200ml of caffeine, approximately the amount in a large cup of coffee, at 1:00pm. There would still be 100ml of caffeine in the body at 6:00pm. Since dopamine is necessary for sleep and caffeine uses up the dopamine in the human body, it becomes more difficult to sleep after consuming caffeine. Even if a human fell 

Figure 2- diagram of bodily functions after caffeine
asleep after consuming caffeine, it wouldn’t have an as deep or meaningful sleep, leaving the human more sleepy and exhausted in the morning. This usually leads it to consuming even more caffeine; creating a nasty cycle. Caffeine can also affect memory and is known to cause memory loss in older adults.

In a similar study to caffeine effects on the body, Pauline Pauwels experimented with spicy foods and their effects on the human body by conducting experiments that measured the change in heart rate in humans after consuming spicy foods, the change in body temperature, and how spicy foods dissolve. The results showed that there was a dramatic change in heart rate when tabasco sauce was consumed because the spiciness sends a pain message to the brain and the immediate response is a change in heart rate. There was a large increase in body temperature because the pain message sent to the brain responded with sweating which increased the body temperature, and fireballs dissolved very quickly because of its high sugar content and sugar absorbs water.

Materials and Method:

Materials: a timer, 3 volunteers, 1800ml of Pepsi Max, 45 cups, lung capacity probe, heart rate probe, hand dynamometer, 12 pages of 12 pictures, 12 sheets of blank paper, reaction time test from http://getyourwebsitewhere.com/jswb/rttest01.html, and a pencil.

In the first experiment 3 volunteers drank 120, 240, and 360 ml of Pepsi Max because of its high caffeine content and did a reaction time for each amount of caffeine. To do this 3 360ml cans of Pepsi Max were poured equally into 9 cups, 3 for each volunteer, so that each holds 120 ml, and the volunteers were able to drink one after the other equaling up to 120, 240, and 360. First the volunteers did a reaction time test with no Pepsi Max, then drank one cup of 120ml, waited 5 min. and did another reaction time test; the action is repeated for 240 and 360ml of Pepsi Max. The reaction times and the improvement were recorded.

In the second experiment, the 3 volunteers drank 120, 240, and 360ml of Pepsi max and used a lung capacity probe to find the volunteers’ lung capacity. The Pepsi Max was again poured into 3 cups for each volunteer so that each cup holds 120ml for the experiment. The volunteers drank no Pepsi Max and use the lung capacity probe, drank 120ml and waited 5 min. before using the lung capacity probe, then drank 240ml and waited 5 min. before using the probe, and drank
360ml of Pepsi Max and again waited 5 min. before using the probe. The lung capacity results were recorded as well as the improvement.

In the third experiment, 3 volunteers drank 120, 240, and 360ml of Pepsi max and had their heart rate taken by a heart rate probe. Again the Pepsi Max was poured into 9 cups like in experiment 1 and 2. First the volunteers had their heart rate taken without Pepsi Max, then had it taken after consuming 120ml of Pepsi Max and waiting 5 min.

In the fourth experiment, the volunteers drank 120, 240, and 360ml of Pepsi Max and had their strength recorded by using a hand dynamometer. The same method was used for Pepsi max distribution as the rest of the experiments. The volunteers drank no Pepsi Max and used the hand dynamometer, then drank 120ml, waited 5 min. and used the hand dynamometer; the same was done with 240 and 360ml of Pepsi Max.

**Results and Discussion:**

For the first experiment, the volunteers steadily improved. The normal reaction time was on average, about 0.295. After consuming 120ml of Pepsi Max, the improvement in reaction time was 0.45 sec., being on average; 0.25 sec. After consuming 240ml of Pepsi Max the volunteers improved 0.6 sec., being on average; 0.235 sec.. Lastly, after drinking 360ml of Pepsi Max the improvement was 0.75 sec.; making the reaction time 0.22 sec.; on average. This showed a trend of 0.15 sec. improvement in reaction time for every 120ml of Pepsi Max consumed, as shown in figure 3.
The results correlated with the more consumption Pepsi Max the more caffeine there is. Caffeine is known to help fine motor skills and allow the drinker to be more alert because more energy is coursing through their body. Since caffeine allows someone to be more alert and help fine motor skills, the volunteers saw and react to the symbol which appears randomly after the reaction time test is started, timing the time taken for the recipient to react to the symbol. The test involves a street light which turns green, being the symbol, and the recipient clicking on a button, as the reaction; the caffeine let the volunteers to see the image and click on it faster.

In the second experiment, the results weren’t as predictable. The average improvement of lung capacity after consuming 120ml of Pepsi Max was -3.1 liters per second. The average improvement in lung capacity after consuming 240ml of Pepsi Max was, on average; 0.27 liters per second. Lastly, after consuming 360ml of Pepsi Max, the average improvement was 2.59 liters per second; as shown in figure 4.
When reviewing the results, it seemed the first 120ml was a small amount and was able to flow through the body faster, and most of it was already broken down by the liver in the 5 min. between consuming the Pepsi Max and testing the lung capacity of the volunteers. But the caffeine was able to stop the flow of adenosine for a short period, depleting the dopamine and leaving the volunteer tired, meaning they breath fast shallow breaths which give short bursts of energy; kind of like after a human runs for a while. The 240ml of Pepsi Max stayed in the volunteers system longer, allowing more access to dopamine, increasing energy levels, leaving no need for the short and fast breaths as before; letting the volunteers breathe more deeply. The 360ml of Pepsi Max lingered even longer in the volunteers system, giving even more access to dopamine, and increasing energy levels more, giving no need for such an immediate source of energy, resorting to even deeper breaths that give large amounts of energy in longer time periods.

In the 3\textsuperscript{rd} experiment, the results were almost as constant as the first. The normal average heart rate was about 75 beats per min., after consuming 120ml of Pepsi Max the heart rate improved.
by -1 beat per min., making the average heart rate 74 beats per min. After consuming 240ml of Pepsi Max the volunteers’ heart rate improved by 11 beats per min., making it on average 86 beats per min. After the volunteers consumed 360ml of Pepsi Max their heart rate improved 21 beats per min., making it on average; 96 beats per min. as shown in figure 5.

To summarize the results, again the 120ml of Pepsi Max coursed through the body quicker, making most of it already broken down by the liver and leaving the volunteer tired. When someone is tired, the human body slows along with the heart rate, because it is preparing for sleep. But after the volunteers consumed more caffeine, it stayed longer in their systems and allowed more energy to flow, which speeds up the body as well as the heart rate.

In the 4th experiment, there was another almost constant pattern in the results. The normal average strength was about 120 newtons, when 120ml of Pepsi Max was consumed; there was an improvement of 24 newtons, making the average strength 144. When 240ml of Pepsi Max was consumed; the improvement was 27.1 newtons, making the strength on average; 147.1 newtons.
After 360ml of Pepsi Max was consumed, there was an improvement of 31.3 newtons, making the average strength 151.3 newtons; as shown in figure 6.

![Figure 6- improvement against amount of Pepsi Max](image)

The results for the 4th experiment were based on force is mass times acceleration, and caffeine speeds up the body even though the mass is staying the same, the acceleration is growing. This makes the force larger and thereby increasing the grip strength.

**Conclusion:**

The results all, over-all showed improvement in things necessary in human survival; such as reaction time, lung capacity, heart rate, and strength. The Data can help people see if caffeine’s cons are worth its perks and if they should drink it. The hypothesis was correct because it was predicted caffeine would help improve the things tested and the results showed that they did. A follow-up experiment would be to test these things after having volunteers wait different amounts of time after drinking the caffeine before doing the tests.

**Citations:**
Caffeine Reduces Time-of-Day Effects on Memory Performance in Older Adults


Lee Ryan, Colleen Hatfield and Melissa Hofstetter

Pauline Pauwels, the study of how spicy foods affect the body, Cary Academy, 2011

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