

Using an Electroencephalogram for Deception Detection

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### Abstract

This study will explore the differences in brain wave activity while a person is either telling the truth or being deceptive. We will monitor a participant's brain wave activities while they first respond truthfully and then falsely to questions in regards to a mock theft scenario. The brain wave for the person telling the truth will be less active than that of when the person is lying.

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The art of lying is prevalent in all facets of society. Whether it's a simple white lie, or to avoid criminal prosecution, people will lie on a daily basis. All the way back to early civilizations, man has tried different methods of detecting deception. For decades, coercive interrogation, and the polygraph have been the primary means of lie detection. However the accuracy of both methods has been in question. After the discovery of brain waves, conventional lie detecting is considered obsolete and it has been argued that one could determine deception by measuring brain activity.

Coercive interrogation, or torture, is defined as inflicting pain or suffering while trying to obtain information or a confession (Bellamy, 2006). In our society now, however, torture is collectively frowned upon. The ethicality of inflicting harm on another person is considered barbaric by today's standards. Ethics aside, the information gained from torture isn't always accurate. There are just as many cases of obtaining true confessions as there are false confessions when torture is used as an interrogation method (Bellamy, 2006). Essentially, a person, innocent or not, will admit to anything to escape physical pain.

The early 1920's saw the advent of the polygraph, a device used to measure the changes in respiratory, cardiovascular and sweat gland activity (Grubin, & Madsen, 2005). For decades, the polygraph has been the primary tool used in lie detection. However, the accuracy rate ranges from 70 to 90 percent, and can be easily beaten by sociopaths, or anyone that can easily suppress their emotions (Hansen, 2009). Questions over a person's ability to "beat" the polygraph, the rate of false positives for innocent subjects and basic theoretical support cause

the polygraph to fall short of the needs of law enforcement and national security (Happel, 2005).

Due to the controversy with both torture and the polygraph, new, more effective ways of detecting deception are being sought. While researching mental disorders, Hans Berger developed the electroencephalogram (EEG), a device that records the flow of electrical charge in the brain (Zifkin, & Avanzini, 2009). Today, psychologists have taken the EEG one step further and are now using it in deception experiments (Kubo, & Nittono, 2009). What scientists believe is that one particular type of brain wave can be used to determine deception. When exposed by a familiar stimulus, the P300 wave, as it is known, is shown to spike milliseconds after exposure (Hansen, 2009). Knowing this, when asked about facts pertaining to a specific incident, a suspect or witness should elicit a response to the facts (Kubo, & Nittono, 2009).

The newest method that experts believe could help in deception detection is functional magnetic resonance imaging (fMRI). The fMRI, first used in 1990, uses magnetic fields to measure changes of blood flow in a particular region of the body (Filler, 2010). Scientists believe that when a person is being deceptive, there will be a noticeable change in blood flow in the brain. Essentially, there will be a greater amount of blood flow in a person being deceptive. First, the person will acknowledge the truthful response, but then need to formulate the lie causing the brain to be more active (Kerr, Binnie, & Aoki, 2008). Preliminary tests support this theory, showing that when a person is contemplating and/or being deceptive, there are changes in blood flow patterns (Marks, Adineh, & Gupta, 2006). However, the size of the fMRI may hurt the practicality of using the device (Filler, 2010).

For the nature of this experiment, we will be focusing on the usage of the EEG in deception detection. Preliminary experiments have tested the EEG in deception detection. Kubo and Nittono (2009) instructed subjects to choose a playing card and when questioned, they were instructed to either lie or be truthful about the chosen card. What they found was a larger spike in the P300 wave when the subject was instructed to conceal which card they had chosen. Another test by Krusemark, Campbell, and Clementz (2008) goes as far as to show that there is a spike in the P300 wave when a person is appealing to a self-serving behavior. Basically, an EEG can test not only facts surrounding a specific situation, but also when a person is just trying to paint themselves in a better light.

The findings of these experiments have been promising in testing the validity of using an EEG in deception detection. However, more tests still need to be run to further add to the credibility of the EEG. Knowing the brain is more active when formulating a lie, we can hypothesize that an EEG will show more brain activity in a person lying than in a person telling the truth.

## **Method**

### **Participant**

I will study one volunteer from my PSY 110 class. This person may be either male or female and between the ages of 18 and 60.

### **Materials and Apparatus**

To test the participant's brain wave activity, I will be using the Biopac MP40 with a built in EEG device. One desk and one chair will be used to seat the participant while they are being

questioned. Pen and paper will be used to record the participant's responses. Finally, two one dollar, two dollar and five dollar bills, and one ten dollar bill will be used in the mock crime and questioning portion.

### **Procedure**

Prior to the experiment, the participant will first be briefed on the nature of the research being done and the participant will also give his or her consent to the experiment. This experiment will be similar to that of Kubo and Nittono's (2009) experiment. To begin, the experimenter will instruct the participant to take a one dollar, two dollar, or five dollar bill when the experimenter is not present. After the participant takes the bill, the subject will be connected to the EEG through the Biopac MP40. The experimenter will also have one of each, a one dollar, two dollar, five dollar and ten dollar bill. The participants will be instructed to answer truthfully as they are shown each bill and asked to identify it as the bill that was taken. These first set of questions will serve as the control for the experiment. Next, the participants will again be shown the same bills, but this time, they will be instructed to lie about which bill was taken.

### **Method of Analysis**

The results to the truthfully answered questions and the questions where they participant was instructed to lie will then be compared. The comparison of these results should show a greater spike in the P300 wave when the participant is being deceptive as to when they are telling the truth. If these results are shown as accurate, then the EEG will have been tested as a viable method of detecting deception.

## References

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