

Thermoregulatory Responses to Lying Based on Age and Temperature

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ABSTRACT

The main goal that was trying to be achieved throughout the course of this project was to determine if a subject is lying, based on the body temperature of an individual. This can also be known as the thermoregulatory responses in the metopic suture and the apex region between male and females. When law enforcement tries to determine whether a subject is lying, they could be able to figure it out based on the subject's facial temperature increasing or decreasing. The two points, forehead and nose, were chosen because there is a location in the brain called the insula, which is located deep within the lateral sulcus of the brain, which shows a difference in temperature when a lie is told. Insula activates brown adipose tissue to release heat, causing this phenomenon to occur. Ten subjects were used. Thirty questions were posed to each subject, and they were permitted to tell either the truth or a lie. After every question, the forehead and nose temperatures were taken. The results showed that when male and females lie, their temperature increases. The explanation for this is the area in the brain called the insula, which is more active in females and people over the ages of eighteen. For high insular activity to happen, it means the brain is trying hard to perform a complex task.

Introduction

Thermoregulatory responses to lying based on age and sex is the best way to find if someone is lying. In more simple terms, the difference in the temperature between the forehead and nose point. The reason this topic was chosen is because more reliable sources need to be made to identify if someone is lying. The polygraph tests are not 100% accurate ("Does The Polygraph "Lie Detector" Work?"). If we had a way to figure out if someone is lying, then it would be used more frequently, and be more reliable.

The temperature change was looked at for a few main reasons: in one study by Panasiti, et. al., in which they found that temperature change does occur, around the facial region when someone lies. Second is that a person can not change the temperature of the body. The temperature change can show a difference in both female and male, and even in age. If a heartbeat were to be looked at, like the polygraph test does, there would not be a difference. If the temperature were to be looked at, there would be a difference (Panasiti et al., 2016). The purpose of this experiment is to find improvements to the technology that is used for investigations today.

Materials and Methods

An infrared sensor was used to determine the temperature change in each subject's skin. Temperatures were taken at the forehead and nose. 30 questions were made to ask the participants, which they could reply to with an honest answer or a lie, based on what they decided. Questions were found online or made up. Different types of questions were asked, some emotional ones, some involving the subject becoming angry, and some questions that are easily answered, such as the experiment's name. The questions were mixed up to try and get the insula

of the brain to work, then to stop working, and then work again, etcetera. The questions were mixed up, sometimes an emotional question was asked and then an easy question with little emotion attached to the answer. The temperature was immediately checked after each question. After writing down the temperature on a piece of paper with a pen or pencil, the rest of the questions were asked.

Once all of the questions have been answered, participants were asked to honestly answer if they had lied or told the truth on each question. After figuring out if they lied or told the truth on the questions, the temperatures between the nose and the forehead were subtracted. Initial and final temperatures were subtracted to determine range.

For the question parts, a document was created full of 30 questions with 6 levels, and 5 questions in each level. Each level got harder, as in more difficult questions to answer that made the subject think. Lined pieces of paper and a pen were used to record the data found from the subject. To look at their temperature, an infrared sensor on Amazon for fifteen dollars was purchased. Only two batteries were used to power the sensor. For this experiment, the questions were asked of 10 people, 5 females and 5 males. Five were 18 and older while 5 were 18 and younger.

Actions were taken to prevent false results, such as making sure the subjects were not in direct sunlight. This is because it might affect the data, which would give faulty results due to heat from the sun. The sensor was put up towards their face in those two areas. All the questions asked were appropriate but would still bring emotional feelings up for the subjects, in the hopes that it would change results. The subjects were asked to take it seriously, because they might be fatuous with the answers to the questions. A question they get asked could be "What is the participant's age?" and receive a reply of "110". This is because if the subjects laughed, the data was going to become skewed and inaccurate.

The ANOVA Test was used to compare the temperature data for different groups. Due to having two different groups, the Anova Test was the one that was needed to supply the experiment with the best, most conclusive results. A comparison was needed for the two groups, which are both either decreasing or increasing in temperature, depending on answers.

Results

After asking all of the questions, the forehead temperature was subtracted from the nose temperature. On the x-axis of the graphs, is whether the participant told the truth or a lie. Then on the y-axis it is the temperature difference between the forehead and nose.

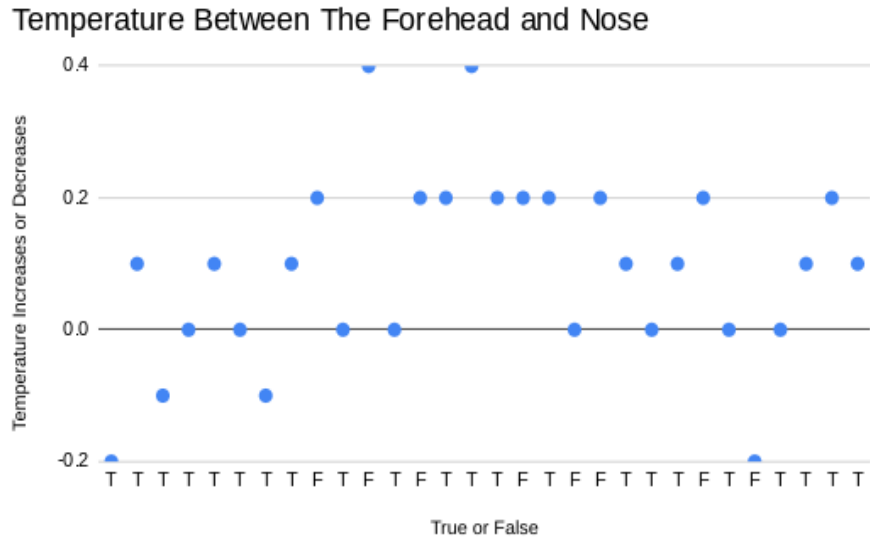


Figure 1. Female 14; pos. 0.2

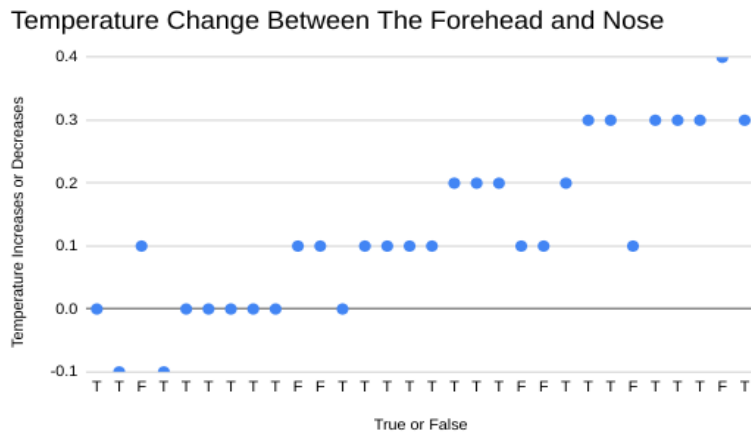


Figure 2. Female 49; pos. 0.2

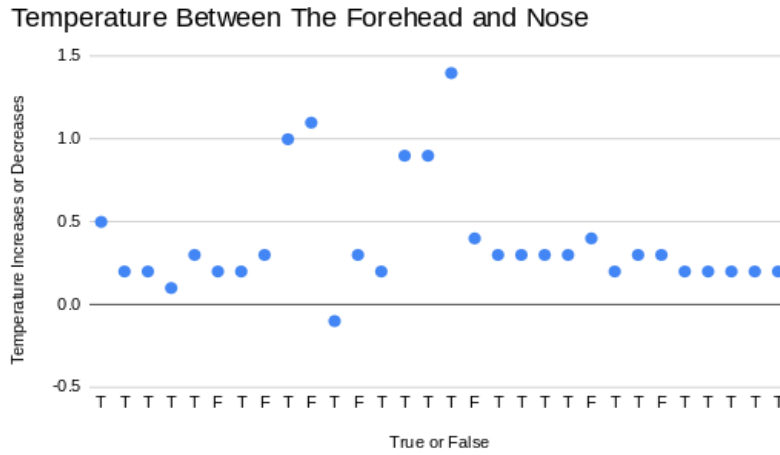


Figure 3. Female 18; pos. 0.3

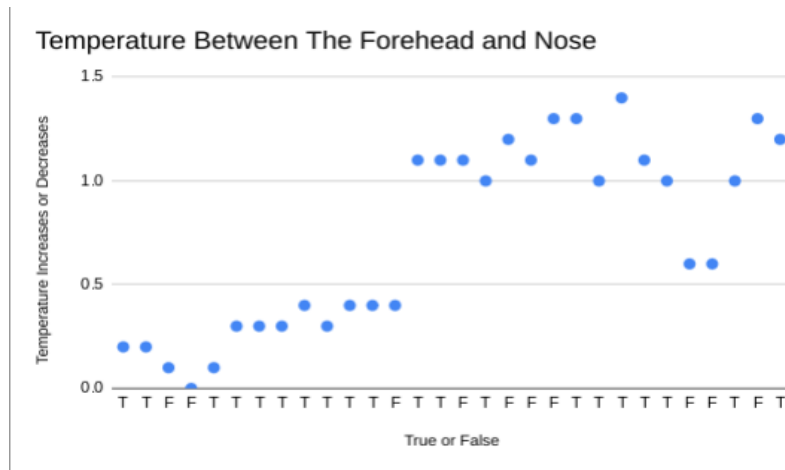


Figure 4. Female 41; pos. 0.3

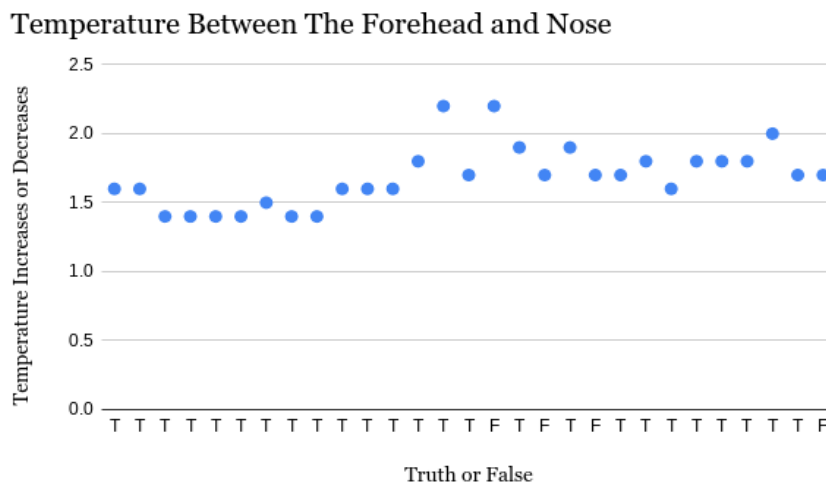


Figure 5. Female 16; pos. 1.6

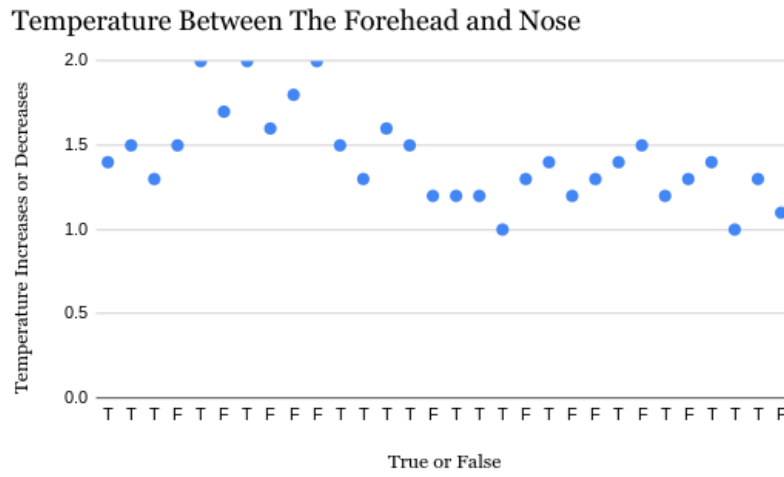


Figure 6. Male 16; pos. 1.5

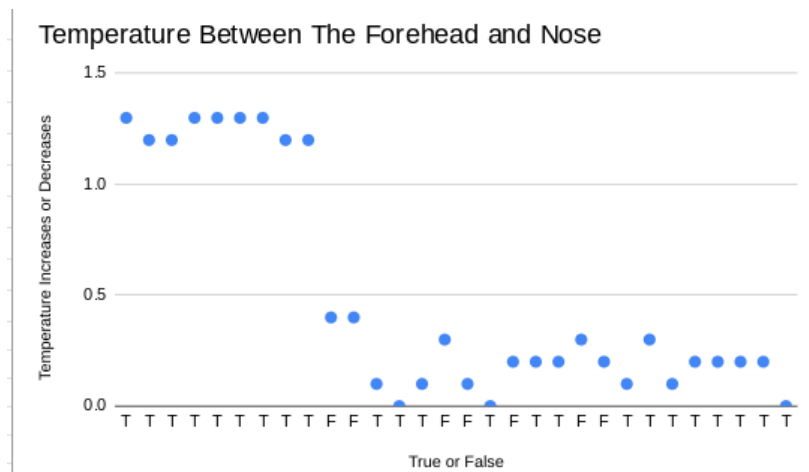


Figure 7. Male 16; pos. 3.0

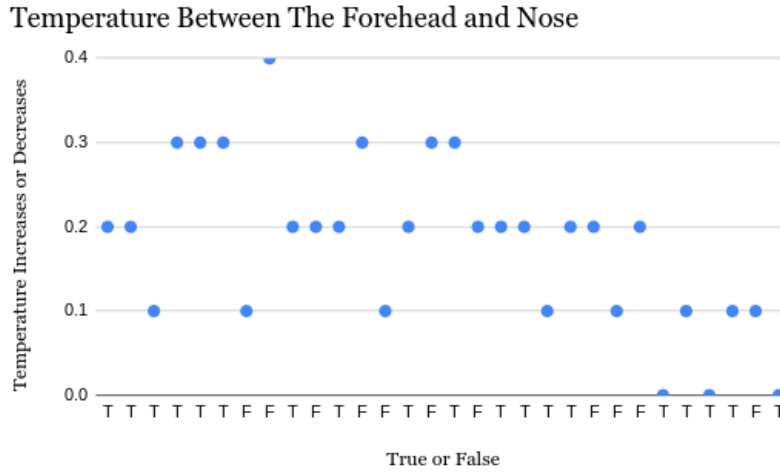


Figure 8. Male 47; pos. 2.0

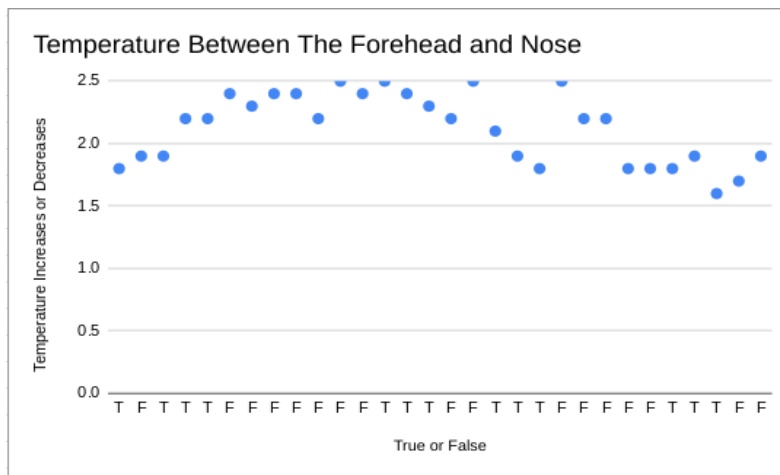


Figure 9. Male 18; pos. 1.7

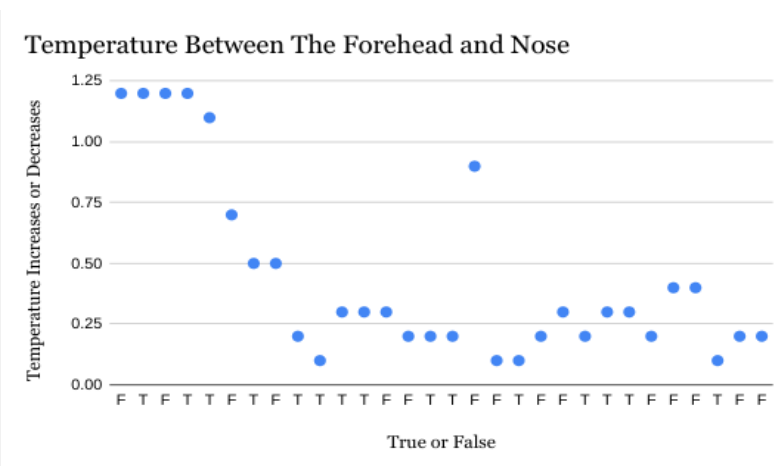


Figure 10. Male 13; pos. 0.2

There is a direct correlation to males having an increase in temperature when they lied, as when they were alone answering questions. The average difference from the nose to the forehead was positive 1.68. For the females, all had a positive increase in temperature. The female's average temperature was positive 0.52.

Females showed a lower response with temperature to the lying compared to males. However, for ages 18<, they had an average of positive 0.9. While people who were >18, had an average of 1.3.

Discussion

The hypothesis was rejected, but at a later date, the hypothesis would be the difference between the forehead and nose when someone lies. It was realized that the experiment would show more accurate results if the two points were subtracted from each other.

The reason there is a difference in body temperature when we lie, is that high insular activity happens. It means the body is trying hard to perform a difficult task, such as lying. Insula activates brown adipose tissue to release heat (Yin & Weber, 2019). After asking a few questions to both genders, it seems that females are the ones who hide lies well, as opposed to males who do not hide their lies very well. This means that females have more of a chance when they lie, because they try to hide the lie better (Verigin et al., 2019). People who were 18 years old or older had a less drastic change, showing that they will be able to lie better. It is not just lying that can be difficult to detect, but also being able to see the lie.

If the temperature is taken from someone who has been in the sun or in the cold, it might affect the results. This study is important because it can be more specific than a lie detector test. Law enforcement use the polygraph test to ask questions to subjects, but they do not have a 100% accuracy rate (Adelson 2004). A human's body temperature can not be changed on purpose, as it is uncontrollable.

Conclusion

Based on the study, the independent variable is to determine whether the age or gender of a subject can determine whether or not their face can change temperature, when they lie. The independent variable does influence the dependent variable because the temperature of the forehead and nose changes. The thermoregulatory responses showed that both males and females have a temperature change when they lie, due to insula activities in the nose and forehead regions. The polygraph tests that are being used now are not as accurate as they should be. Using temperature on a human, can help show if someone is lying. Deceptions can not always be as easy to find on someone's face. Seeing the responses in the face to lying is being studied more, as this realization has occurred. Males and females were shown to have a positive average temperature change between the forehead and nose. Ages 18< showed a lower temperature change. Though there did not seem to be a similarity between age groups, there was one found between siblings, who had developed at the same time.

Acknowledgments

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References

- Adelson, Rachel. (2004). Psychological sleuths--Detecting deception. *Monitor on Psychology*, 35(7).
<https://www.apa.org/monitor/julaug04/detecting>

- Verigin, B. L., Meijer, E. H., Bogaard, G., & Vrij, A. (2019). Lie prevalence, lie characteristics and strategies of self-reported good liars. *PLOS ONE*, 14 (12). DOI: 10.1371/journal.pone.0225566
- Does The Polygraph ‘Lie Detector’ Work? *Federal Services*, <https://www.cvsa1.com/polygraph.htm>
- Panasiti, M., Cardone, D., Pavone, E. et al. (2016). Thermal signatures of voluntary deception in ecological conditions. *Sci Rep.* 6, 35174. <https://doi.org/10.1038/srep35174>
- Yin, L., & Weber, B. (2019). I lie, why don't you: Neural mechanisms of individual differences in self-serving lying. *Human Brain Mapping*, 40(4), 1101–1113. <https://doi.org/10.1002/hbm.24432>