

# **Correlation between Physical Activity and Stress Response in Polygraph Tests**

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**Address:** 1300 University Ave., Madison, WI 53706

**Key words:** GSR, EDA, activity, heart rate, polygraph test, exercise  
Total words: 3,797

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## **Abstract**

This study investigated whether active individuals would be able to better cheat a polygraph test by virtue of a more controlled heart and respiration rate and a lower stress response. The subjects were asked 25 questions, nine of which were control questions, and the remaining were more intrusive, personal questions. The stress response to each question was measured as the participant's skin response (EDA), heart rate (ECG), and respiration rate. After recording the truthful answers to the questions previously asked via a questionnaire, the participants were separated into active and non-active groups based on their average minutes of exercise per week. The physiological responses to each question were compared to the subject's baseline to find the magnitude of the response, and this data was then normalized. The mean of the normalized data for the respective groups were compared using unpaired t-tests. Although not statistically significant, the mean responses for lies were generally higher than the mean responses for truths. The data showed no conclusive or significant results, indicating that we can not, at this time, show that more physically active individuals are better able to cheat a polygraph test than more sedentary individuals.

## **Introduction**

There has long been controversy surrounding the accuracy of polygraph tests. Critics of this technology feel no legitimate evidence has been found that prove there is a link between dishonesty and physiological responses (American Psychological Association, 2004). In contrast, the American Polygraph Association (APA) claims that the polygraph tests performed by their members are accurate more than 90 percent of the time (American Polygraph Association, 2011). In turning to scientific studies for answers, few conclusive results have been found regarding the validity of polygraph tests. In a 2003 National Academy of Sciences (NAS) report on deception, results showed that between 85 to 89 percent of data collected by polygraphs is indeed accurate. Although this seems to convey that polygraphs are more useful than some think, the NAS also concluded the margin of error was too high for the data to be considered valid. With such inconclusive and conflicting evidence, many are questioning why polygraphs are being used at all.

The original polygraph was developed in 1921 by Dr. John Larson, whose interest had been captured by an article detailing the effects of lying on heart rate and blood pressure. When he developed his first model of the future polygraph machine, it measured blood pressure, pulse and respiratory rate on soot-blackened paper. While the original polygraph was large, crude and cumbersome, it measured the same physiological indicators of stress that are measured with modern day polygraph machines. Since then, polygraph technology has been markedly advanced: ink lines are produced continuously on chart paper and examiners are appropriately trained in questioning and interpreting data (Fisher, 2008). Its uses have also expanded greatly, and what began as a criminal investigation tool has now been used in medical analysis and marketing research among other applications (Grimes, 2007).

The polygraph test measures several physiological changes that are associated with the stress response. It usually measures cardiovascular activity and respiration and is coupled with a

measurement of the galvanic skin response. The basis of such tests is that a guilty individual will be fearful of detection and will thus have a stress response when trying to get away with a lie or when presented with relevant information pertaining to a crime committed. The test begins by gathering baseline physiological measurements since most subjects, innocent or guilty, are likely to be anxious or nervous while taking the test. Control questions are presented with the relevant questions, and sometimes include a question in which the subject is told to lie (e.g. *Is today Wednesday?*) at which point the examiner says that they were able to detect the lie.

The interview style is an important component of the test. One of the most widely used polygraph tests in forensic settings is the control/comparison question test (CQT), which consists of an interrogation and sometimes ends with the examiner trying to get a confession from the subject. This method has been criticized because the physiological responses to the fear of detection and the fear of false detection are indistinguishable. In addition, some people are able to cheat the test through various countermeasures, such as enhancing the response to the control question by lightly biting the tongue or doing mental arithmetic. Other interview methods exist, but CQT still remains the most widely used (Iacono, 2008).

As previously stated, the most common physiological responses to a polygraph test include an increase in respirations and heart rate, both of which can be affected as a result of regular exercise training. A rigorous training schedule can also lead to physiological adaptations such as a lower resting heart rate and a slower breathing rate. Studies have found that with endurance training, the parasympathetic activity of the autonomic nervous system increases, leading to a decrease in the sympathetic response. As a result of these autonomic changes, a lower resting heart rate, is common in athletes who train regularly (Carter *et al.*, 2003). Endurance training also increases the stroke volume (volume of blood pumped per beat) and allows more blood to return to the heart. This increase in volume in the left ventricle, causes its walls to stretch and diameter to increase. With larger internal diameter and increased wall thickness, less effort is required to pump blood and resting heart rate decreases (CDC, 1996). Additionally, physical fitness was shown to be strongly associated with vagal modulation, a cranial nerve associated with lowering heart rate (Goldsmith *et al.*, 1997).

In addition to cardiac adaptations, the respiratory system adapts with regular endurance training. Better physical fitness and regular exercise schedules strengthen muscles involved in respiration such as the diaphragm, intercostal muscles, rhomboids, and sternocleidomastoids (Holloszy, 1984). This increase in muscle leads to greater pulmonary efficiency, an increased stroke volume, and a lower respiratory rate at rest. This allows for more oxygen flow throughout the body (Oxford United Youth & Community Sports Trust, unpublished material). Maximal oxygen uptake, or  $VO_2\text{max}$ , also increases with training, allowing an athlete to use more oxygen while exerting less effort. Overall, exercise causes a smaller disturbance in homeostasis if muscles are trained (Illinois Wesleyan University, unpublished material).

Do physically active individuals have decreased physiological responses during a polygraph test as compared to sedentary individuals? Is it possible that regular physical activity could give someone an advantage in polygraph testing by allowing subjects to better conceal

physiological changes? In a 12 month study, it was shown that regular exercise reduces psychological responses to perceived stress and anxiety (Health Psychol, 1993). Because exercise can have an effect on long term psychological stress, such as a subject's baseline stress level, it is possible that it could have similar effects on short term stress responses. Since the polygraph is based on heart rate, respiratory rate, and skin conductance, physically active people may exhibit lower responses in a polygraph test because of exercise's influence on an individual's baseline heart and respiration rate and the body's stress response.

If physically active individuals have a lower stress response than their respective sedentary individuals, it can be anticipated that the dishonest responses in sedentary individuals will exhibit a higher mean change in heart rate and respiration rate than the dishonest active individuals when placed in a stressful situation. Therefore it was predicted that the physically active individuals will exhibit a lower physiological stress response than the respective sedentary individuals while answering dishonest polygraph test questions. By measuring heart rate, GSR, and respiration rate, the physiological differences between the physically active and sedentary people due to dishonesty should be apparent if physically active individuals do indeed respond less severely to the stress of lying (Scheirer, 2014).

## **Materials and Methods**

The study subjects had their heart rate, respiration rate and galvanic skin response monitored during a modified version of the BIOPAC® (Goleta, CA) Polygraph Procedure in conjunction with the BIOPAC® (Goleta, CA) Analog to Digital Converter Model MP36 and the computer program Biopac Student Lab 4.0 (Goleta, CA). Electrodermal Activity (EDA) was measured by a BIOPAC® (Goleta, CA) EDA Finger Electrode (SS3LA) with Electrode gel (GEL101). Respiration rate was measured using a BIOPAC® (Goleta, CA) Simple sensor with respiration transducer and heart rate was measured using a BIOPAC® Electrocardiogram. For the purpose of this study, physically active individuals were defined as individuals who engaged in moderate physical activity for at least 150 minutes per week, which is the suggested amount of exercise recommended by the Center for Disease Control and Prevention (2011). Sedentary, or non-active, individuals were defined as individuals who engage in less than 150 minutes of physical activity per week. The total sample size for this study was twenty-four individuals including fourteen in the non-active group and ten in the active group.

In order to ensure proper functioning of the equipment and explore physiological responses during the interview, a trial experiment was performed on a group member. A stress response was elicited from the group member and then their responses were allowed to fall back to baseline. A positive control was obtained (Figure 2) to demonstrate that interview questions would elicit a response on which data could be collected. The increased physiological response served as a positive control, showing what a response to a stressful situation would look like on the BIOPAC (Goleta, Ca) machine (Panel A).

All participants were assigned a random ID number that consisted of a mixture of ten digits and letters for concealment of the subject's identity and responses. Each subject was asked

the same twenty-five questions during the polygraph test (see Appendix A). A three person team was used to question the subjects: one lab member verbally conducted the questionnaire; another member managed the Biopac Student Lab 4.0 (Goleta, CA) software by keying when questions were asked and when answers were given and monitoring the subject's physiological responses; and the last member in the interview room recorded the participant's question responses in a Microsoft Excel spreadsheet. For the interview, each subject was first asked to answer a series of five low-stress control questions. The first four questions were used to get the participant used to the polygraph test, as they often started off with a higher baseline response for all three variables and their baseline slowly decreased throughout the rest of the interview. The minimum values for question #5 and the other control questions after were used as a baseline to find the magnitude of the variables for each question of interest following. By establishing a new baseline every five questions, it was possible to compensate for the slow change in physiological baseline response throughout the test. The questions of interest were chosen due to their prying nature and were intended to make the subject feel reluctant to answer truthfully. The participant was informed that if they felt uncomfortable with a question, they may lie about it while taking the polygraph test with the goal being that each subject would lie with regard to at least a few questions. After each question was answered, the member, working the software, signaled to the interviewer when the subject's physiological response returned near his/her baseline so that the next question could be asked.

Following the polygraph test, each participant filled out a confidential written questionnaire that included their assigned ID number, the amount of physical activity the participant engages in on a weekly basis, and the truthful responses to each of the previously asked questions. The participants were instructed to fill out the survey using only their ID number in order to protect each one's identity so that they would be more willing to provide truthful responses. After participants had taken the polygraph test and filled out their individual survey, the answers given during the polygraph were compared to the answers listed by each participant. The discrepancies in answers were then compared to physiological responses throughout the individual's polygraph test in order to examine differences between baseline physiological measurements and physiological measurements taken while the participant was lying.

In order to perform data analysis, peak GSR, peak heart rate, and peak respiration rate for each participant were recorded for each test question in Microsoft Excel (Figure 15). For the control questions, the minimum value was recorded and used as a baseline reference in which to compare the test question responses to. For each variable, the minimum of the most recent control question was subtracted from the maximum value for each question of interest to find the magnitude of the subject's physiological response for each question of interest. This allowed us to take into account how the subject's baseline physiological response changed throughout the interview. To normalize the data, the magnitude of each question was compared to the average value of all questions of interest to get a normalized value using the formula:  $\frac{\text{magnitude} - \text{average}}{\text{average}}$ .

With this formula, the normalized data with a more positive number indicated a larger magnitude

response (more likely to indicate a lie) and the normalized data with a more negative number indicated a smaller magnitude response (more likely to indicate a truthful response or someone successfully cheating the test).

While conducting the data analysis, it was decided to exclude questions #21 and #24. Question #21, “Do you find me attractive?” became our positive control, because every subject had a large response whether they answered yes or no, and whether they lied or told the truth. This question was included in the normalization calculations, but was taken out before finding the mean of the normalized values and subsequent t-tests. Question #24, “Have you answered all of the preceding questions truthfully?” was thrown out because subjects were confused on the questionnaire as to whether to answer in the context of the interview responses or the questionnaire responses. As this problem was apparent early in the data collection process, it was not included in the normalization of values or in later statistical tests.

After normalizing the data, questions were then grouped into truths and lies for both active and non-active participants for each variable (GSR, heart rate, respiration rate). Unpaired t-tests were performed to determine the significance of differences in responses to each variable for both groups. The t-tests performed included the following comparisons: the truth versus the lie responses of the active group; the truth versus the lie responses of the non-active group; the truth responses of the active group versus the truth responses of the non-active group; the lie responses of the active group versus the lie responses of the non-active group. Our hypothesis was tested through the comparison of active participant’s responses to lying and non-active participant’s responses to lying. p-values were then interpreted based on a 0.05  $\alpha$ -value, meaning a p-value of less than 0.05 would be considered significant and imply a difference between groups.

## **Results**

The mean values of the normalized data and corresponding p-values are shown in Tables 1 and 2 respectively. No statistically significant differences between truth and lies were found for either active or non-active groups. Although not statistically significant, the mean values of the normalized data for each data group displayed a trend in which the mean for lying had a higher value than the mean for telling the truth in all data groups except the non-active heart rate and active respiration rate data groups. Thus, trends generally suggested that subjects had a higher magnitude response when lying than while telling the truth in both athletic and non-athletic groups.

Statistically significant differences in skin response, respiration rate, and heart rate between active and non-active groups in response to lies were not found. In contrast, judging by the mean of the normalized values for each group (Table 1) the non-athletic group was generally better overall at cheating the polygraph test, which was contrary to our original hypothesis, but these trends were also not statistically significant. Significant differences between groups in response to truths also were not found. These results do not support the hypothesis investigated.

StatPlus® (AnalystSoft Inc.) statistical analysis software was used to make histograms to display the normalized data for each data group that can be found in Figures 3-14. A curve for a

normal distribution is overlaid on each histogram.

## **Discussion**

The hypothesis that active participants would elicit less of a physiological response to lies than sedentary participants was rejected. There was no significant difference between the responses of active participants and non-active participants when lying or telling the truth. Studies have shown that regular exercise can lower a person's resting heart rate, blood pressure, respiratory rate and overall stress response (Carter *et al.*, 2003, Health Psychol, 1993). However, a person's stress response to a specific stimuli, such as telling a lie, may not directly correlate to average physical activity level.

As significant evidence was not found to support the hypothesis, it is important to consider that while a regular exercise regimen undoubtedly has physiological effects, it is possible that the changes may occur in the form of a lower resting rate and not necessarily in a more specific high stress situation. It is also possible that in contrast with the reduced resting rate, the reduction in physiological stress response as a result of regular physical activity could be miniscule and not significant. Overall, this particular study did not support a difference in physiological changes for a lie response, supporting nonbias in polygraph test subjects with regards to their physical activity. Further studies investigating the physiological responses of active and non-active subjects could be done to further explore the differences exercise can induce in the way bodies respond to certain stimuli.

In a forensic setting, where guilty subjects have a vested interest in lying convincingly, the inability to do so under such stressful circumstances results in unwanted consequences. Such an environment was difficult to recreate in a lab setting where there were no significant consequences. This administration of the test in a classroom by fellow classmates may have depressed the physiological stress response that would have been elicited in a more high-stress situation.

Throughout their questioning, each participant had the option to lie or tell the truth. Some of the questions were more invasive than others and participants were encouraged to lie on those that made them feel uncomfortable answering truthfully. This option to tell the truth or lie was problematic for two reasons. First, there was a high amount of variation in what each person determined uncomfortable. While analyzing data, it was found that some participants were not made uncomfortable by the more invasive questions and therefore, did not feel the need to lie during their testing. This led to some subjects voluntarily answering all questions truthfully and thus, making their data unusable because a stress response from lying was never obtained. Secondly, by encouraging participants to lie, they may have felt less pressured throughout the test to be truthful. This relief from feeling obligated to tell the truth may have further lowered the physiological stress response.

The questions themselves also posed a problem. Depending on the person, a question that was perceived as invasive could elicit a strong physiological response regardless of whether it was a truthful or untruthful response, such as in question #21 for nearly every subject. When these questions were asked, deciding on an answer itself was stressful. Unfortunately, a stress

response from a lie was indistinguishable from a stress response due to anxiety and discomfort. Therefore, responses to lies could not be separated from responses to overall unease, possibly misrepresenting the impact of lying in the data collected and analyzed. Additionally, the stress response to a question that was answered truthfully was sometimes significantly higher than baseline values even though the subject had not lied. This was again due to the nervousness created by the more prying questions and most likely altered the values obtained for truthful answers, skewing the data before it was analyzed.

Another consideration is the accuracy of the polygraph test in general. Our data suggests that polygraph tests are not accurate at assessing truthful and untruthful responses. It is possible that if using a more reliable polygraph test, the data could have been more precise. Additionally, the equipment used to collect data was not completely accurate. The electrodes and sensors seemed to be sensitive to motion by the participant. For example, if a subject laughed during the test, their respiration rate would spike uncontrollably and the data was difficult to read. If the electrodes were not placed in the correct place on an individual, it is possible that data could have been affected as well.

In order to further expand upon the results of this study in the future, it would be helpful to include more subjects to get more statistically reliable data. Each subject took an extended amount of time to connect to the BIOPAC® (Goleta, CA) equipment, be questioned, disconnect, and fill out the post-test survey. This process limited the number of subjects that could be tested within the given time frame. More subjects would help to minimize the high amount of variation between the physiological stress responses between subjects and would also help in identifying outliers in the data. The limited amount of subjects in this study allowed for a single subject's data to impact the data of its respective group (athletic vs. non-athletic) significantly. If an individual's impact can be minimized, the statistical analysis will be more wholly representative of standard physiological stress responses to lying in active and non-active groups.

In examining the numbers of truths and lies told over all questions and subjects, there was an overwhelming number of truths compared to the number of lies told. While this was expected, the high disparity between the two led to a larger, more representative sample for the physiological stress response elicited by telling the truth and a smaller, less representative sample for the physiological stress response elicited by lying. A proper comparison between the groups was then not possible because of the gross imbalance. By increasing the number of subjects in the study and by devising more probing questions, the number of lies told would greatly increase and the values for the lying group would stabilize. This more representative sample of responses induced by lying could then be more appropriately and accurately compared to the sample of responses induced by telling the truth.

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### **Acknowledgements**

We would like to thank the University of Wisconsin-Madison Department of Physiology for the use of laboratory facilities and equipment as well as department faculty including Dr. Andrew Lokuta, teaching assistants, and peer learning volunteers for their guidance and support. We would also like to thank the subjects for their cooperation and willingness to participate. This study was funded by a research and education grant supporting the Physiology 435 course at the University of Wisconsin-Madison.

## Tables

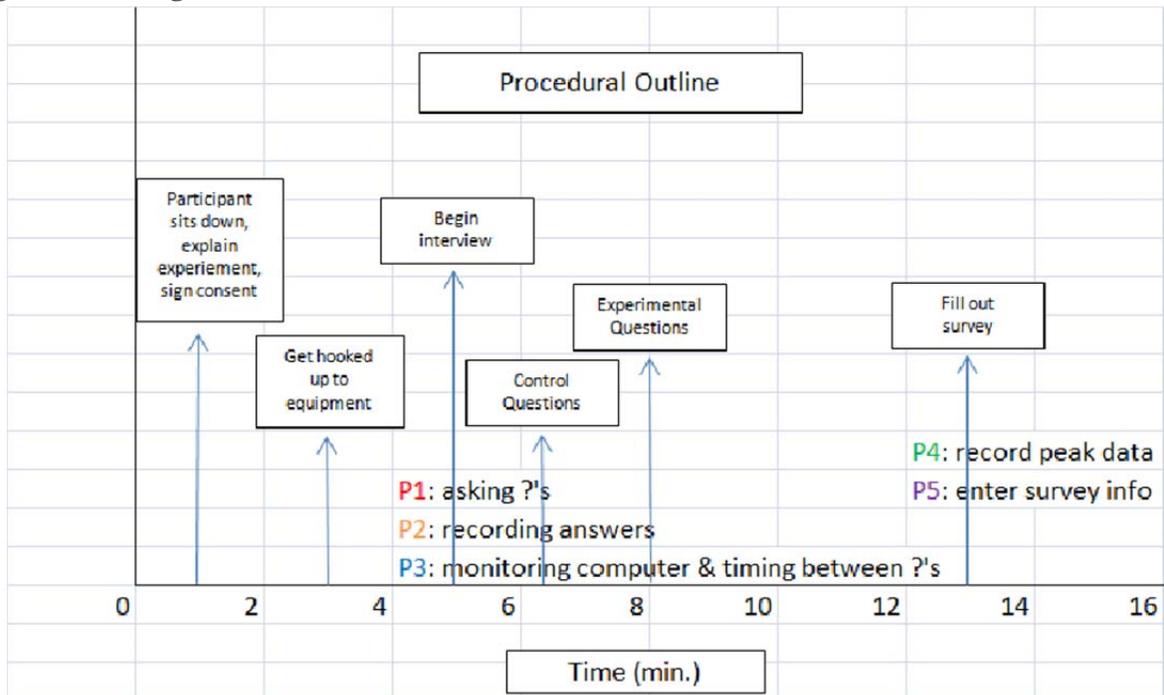
	active, truth	active, lie	non-active, truth	non-active, lie
GSR	-0.10744	0.07563	-0.12975	0.04201
Resp. Rate	-0.00529	-0.00845	-0.12975	0.03397
Heart Rate	-0.08877	0.04113	-0.0086	-0.05326

**Table 1.** Mean of normalized values for each group.

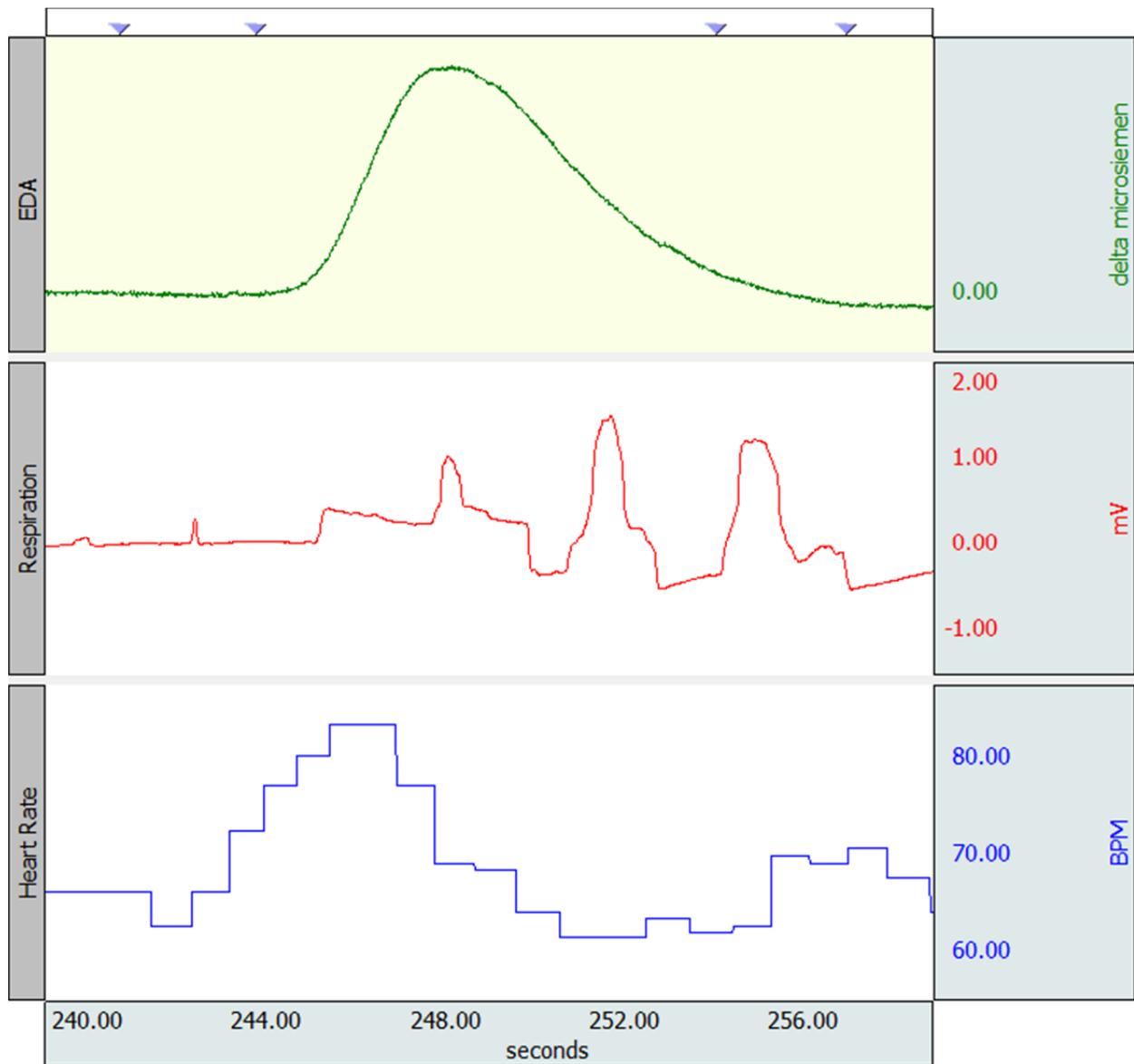
	active truth vs active lie	non-active truth vs non-active lie	active truth vs non-active truth	active lie vs non-active lie
GSR	0.08834	0.10168	0.78312	0.75704
Resp. Rate	0.92609	0.20902	0.88676	0.25764
Heart Rate	0.15613	0.39095	0.10772	0.26958

**Table 2.** p-values from t-test of group vs group.

## Figures and Legends



**Figure 1.** Procedural outline of the experiment displaying what will occur at what time throughout an approximate 15 minute participation session for each individual tested. The experimenters (P1-P5) and their respective responsibilities are indicated as well.



**Figure 2.** An example of a response to a question being asked during an interview. The peak in EDA is shown in green, respiration is in red, and heart rate is documented in blue. This is an example of a positive control, showing that when using this equipment a physiological response will be produced in response to a question being asked.

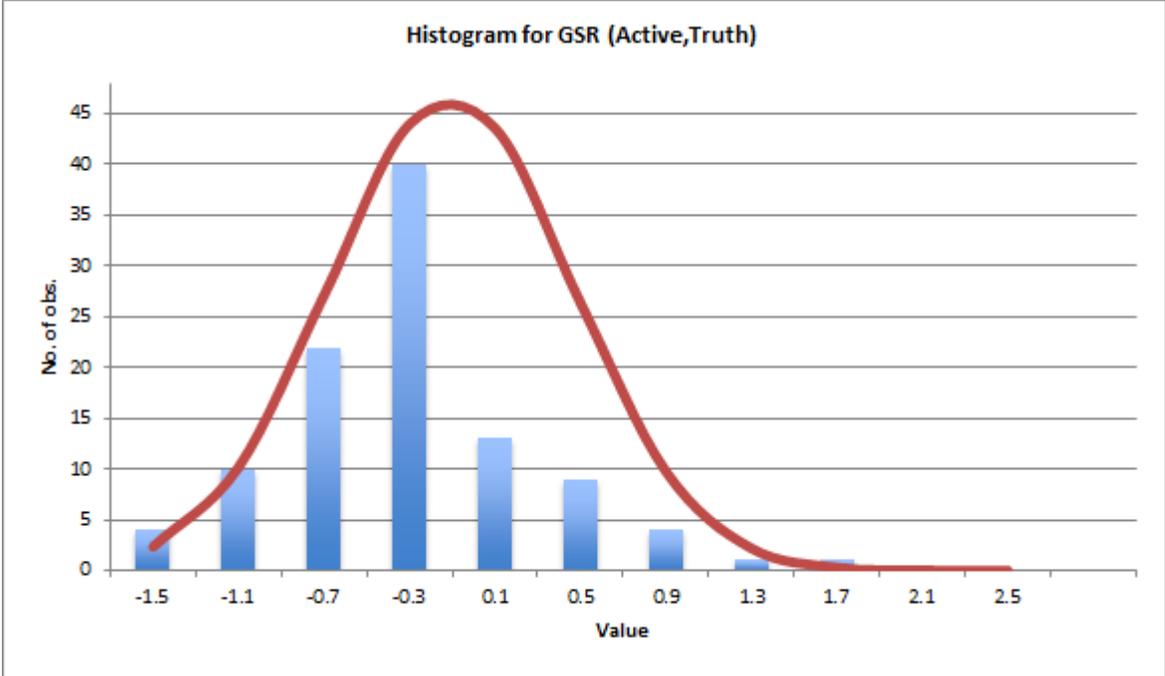


Figure 3. GSR responses for active participants on truthful responses. Mean: -0.1074, s: 0.5696

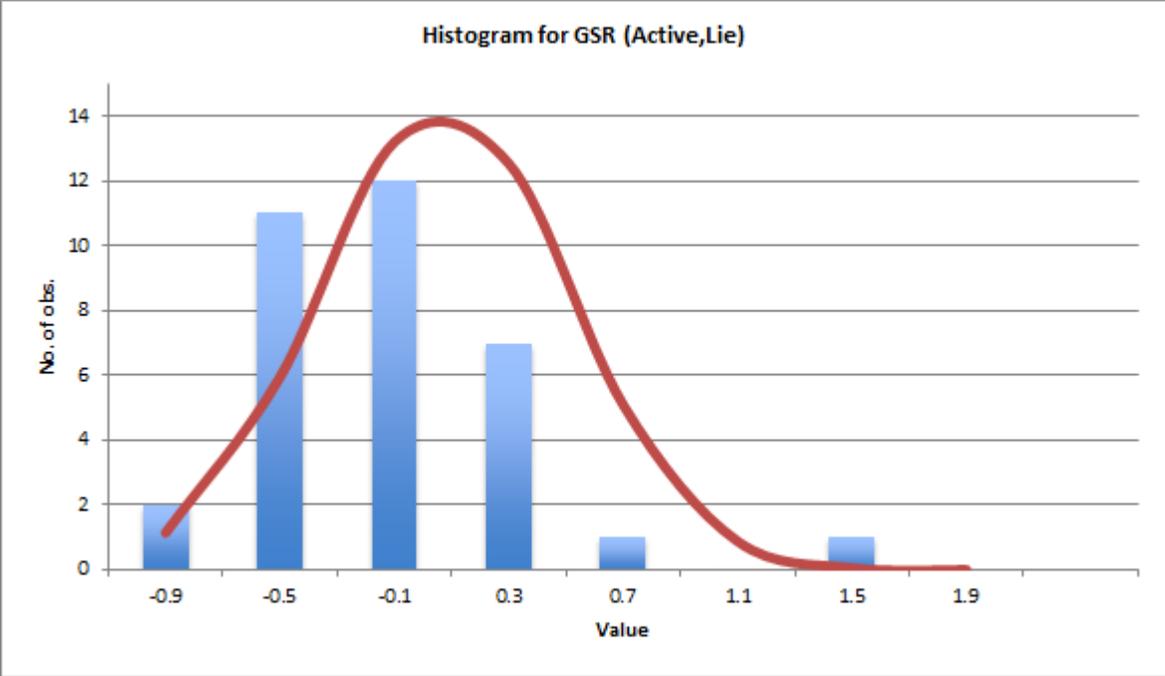
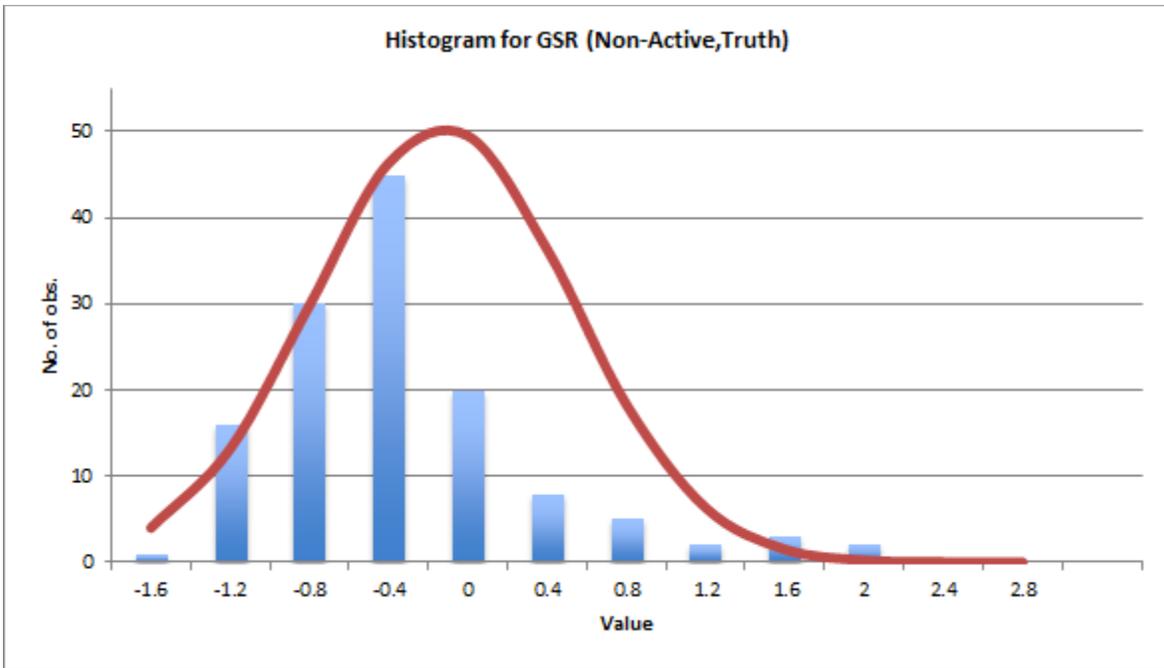
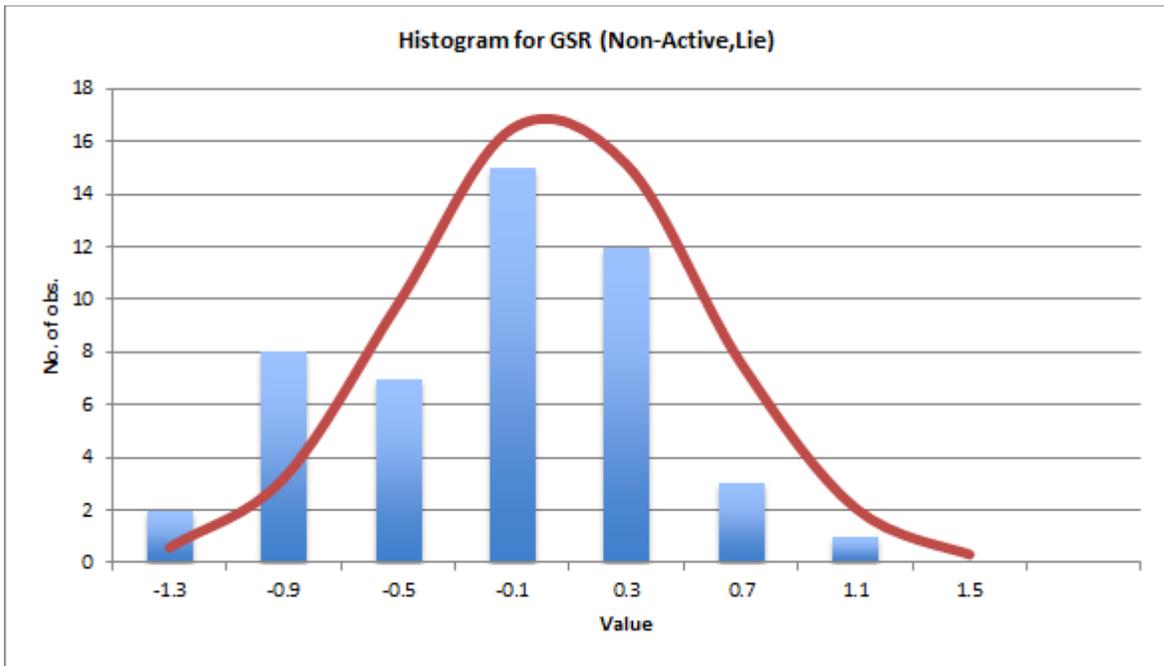


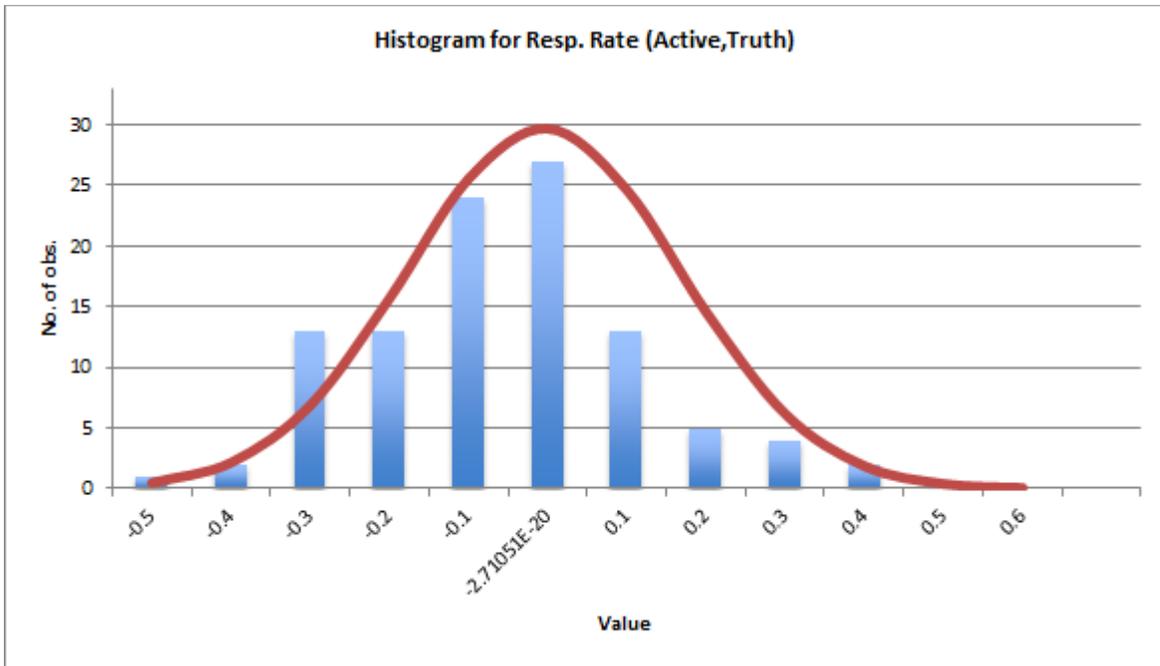
Figure 4. GSR responses for active participants on lie responses. Mean: 0.07563, s: 0.4342



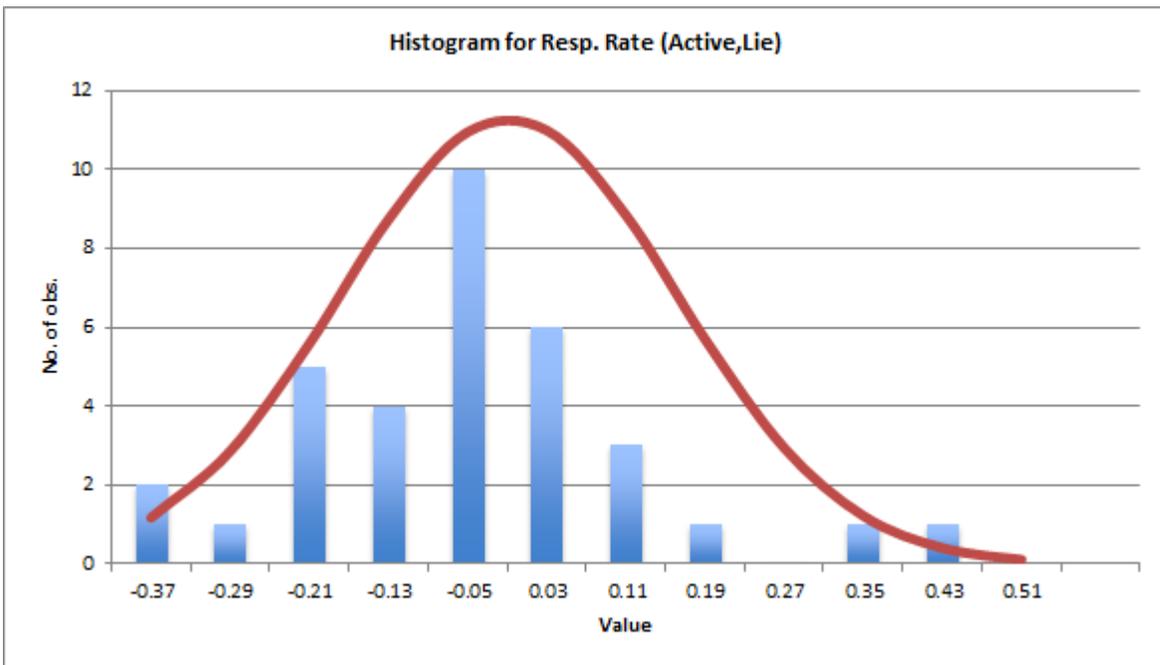
**Figure 5.** GSR responses for non-active participants on truthful responses. Mean: -0.1298, s: 0.6529



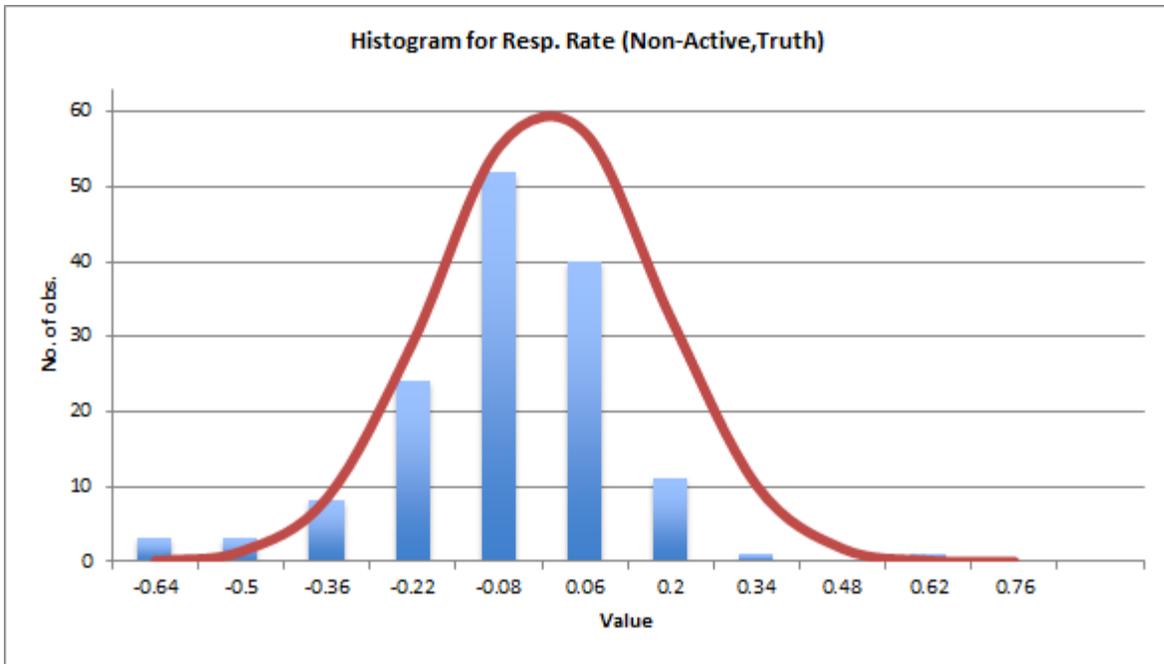
**Figure 6.** GSR responses for non-active participants on lie responses. Mean: 0.0420, s: 0.5147



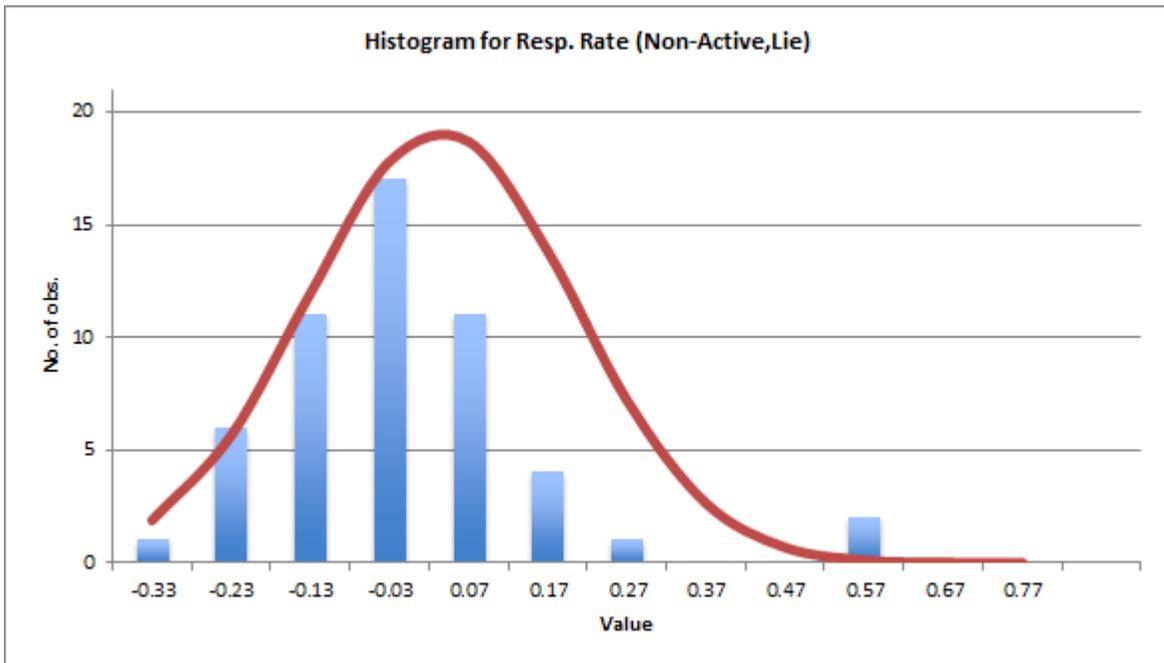
**Figure 7.** Respiratory rate responses for active participants on truthful responses. Mean: -0.0053, s: 0.1722



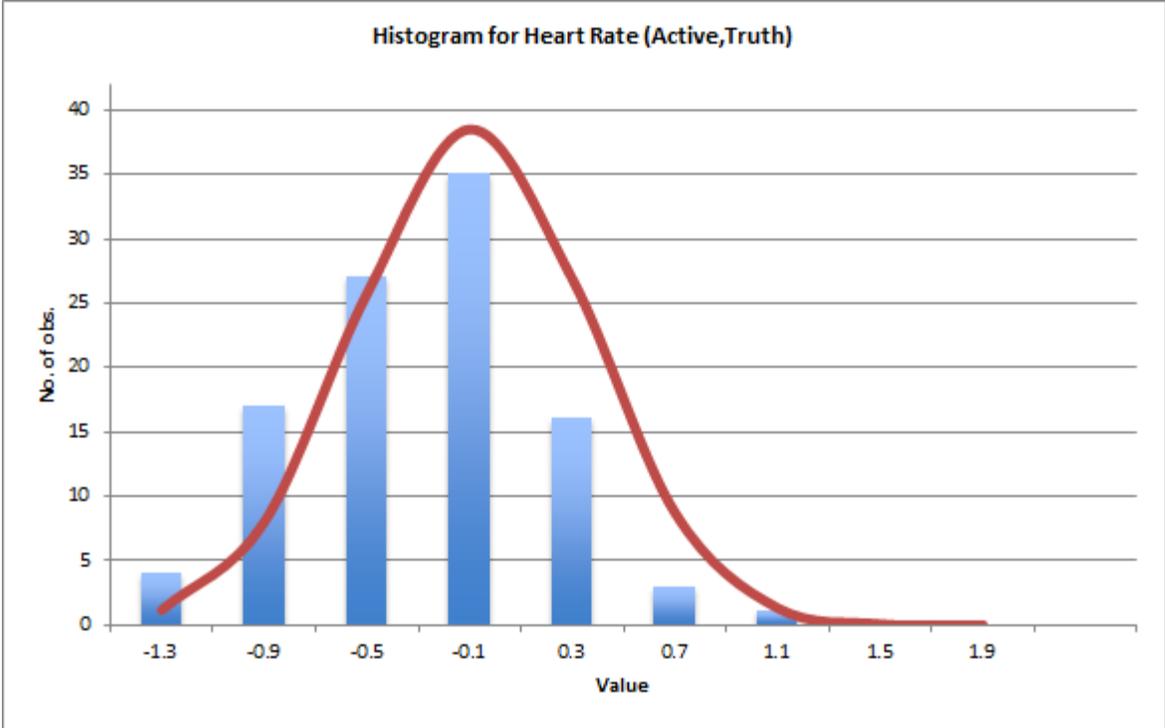
**Figure 8.** Respiratory rate responses for active participants on lie responses. Mean: -0.0085, s: 0.1699



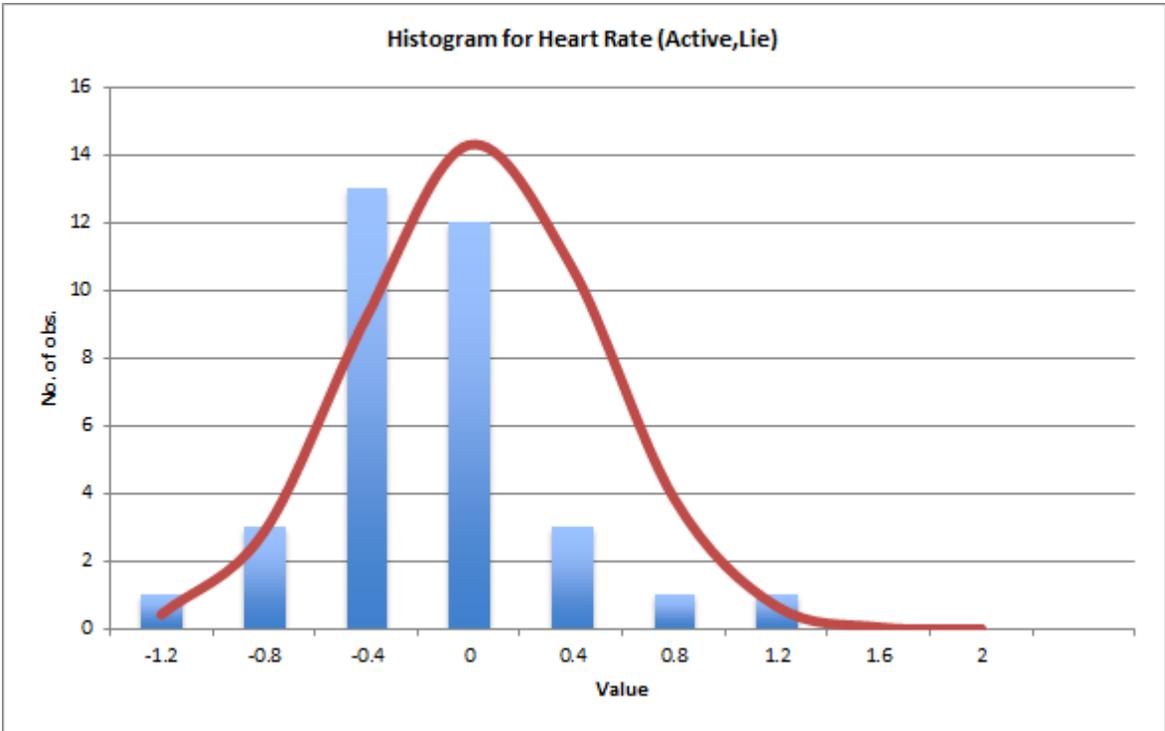
**Figure 9.** Respiratory rate responses for non-active participants on truthful responses. Mean: -0.0020, s: 0.1807



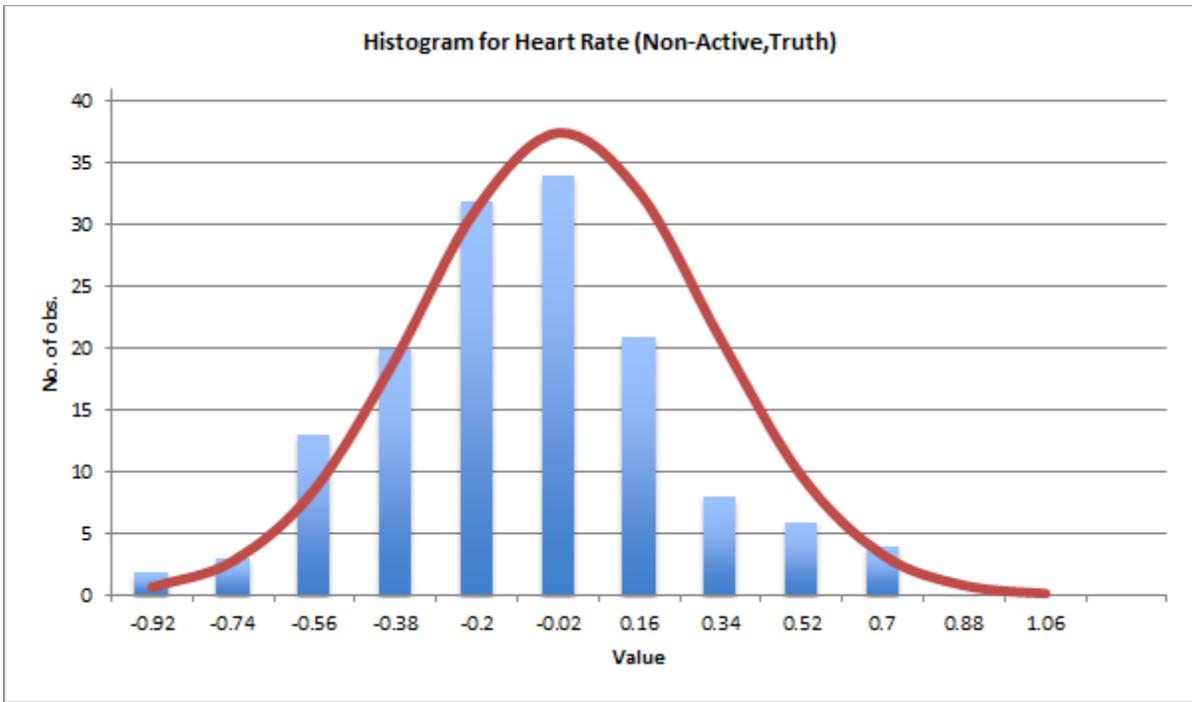
**Figure 10.** Respiratory rate responses for non-active participants on lie responses. Mean: 0.0340, s: 0.1691



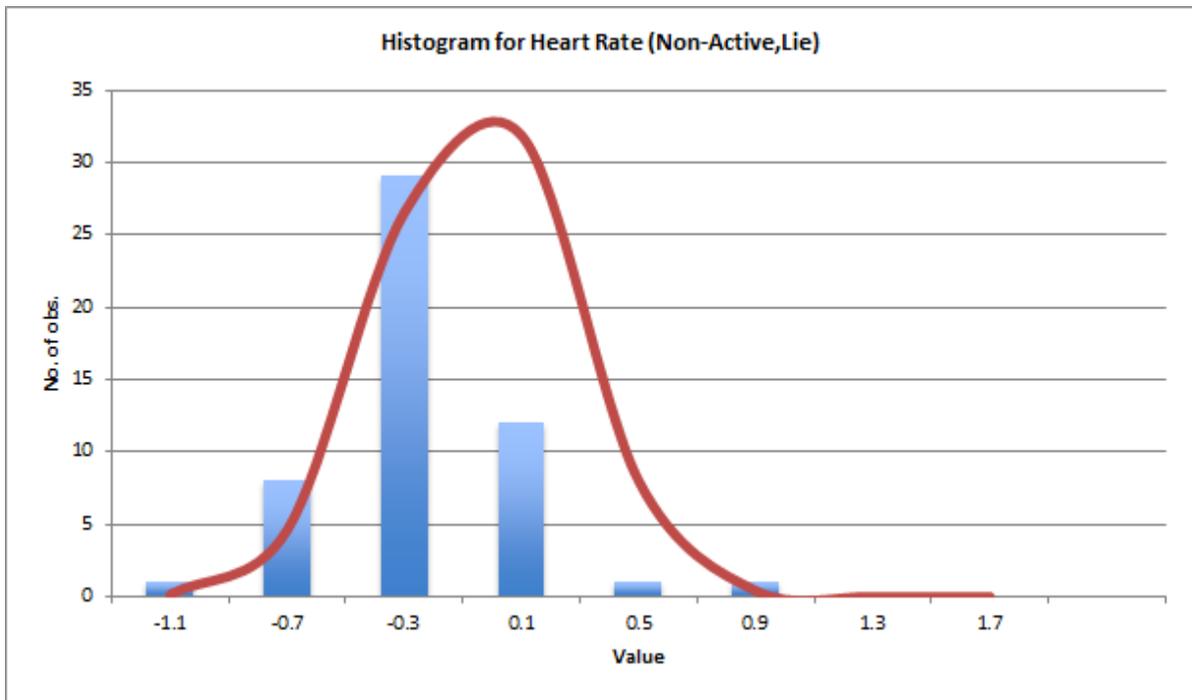
**Figure 11.** Heart rate responses for active participants on truthful responses. Mean: -0.0888, s: 0.4580



**Figure 12.** Heart rate responses for active participants on lie responses. Mean: 0.0411, s: 0.4682



**Figure 13.** Heart rate responses for non-active participants on truthful responses. Mean: -0.0086, s: 0.3210



**Figure 14.** Heart rate responses for non-active participants on lie responses. Mean: -0.0533, s: 0.3199

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Subject ID#: 2HKZ3D7AKV	Question #	Peak Galvanic Skin Response	GSR Magnitude	Normalized GSR	Respir. Rate	Normalized Respir. Rate	Peak Heart Rate	Heart Rate Magnitude	Normalized Heart Rate	Yes/No Interview	Yes/No Questionnaire	Truth/Lie
2	Group (Athletic vs Non-Athletic): 3 hours; Athletic		0.5298			0.333		75.95		-0.074427481	Y	Y	
3	Control: Are you sitting down?	1	0.3949			0.3282		74.07			Y	Y	
4	Control: Are you a student at UW Madison?	2	0.166	Grey=		0.2528		74.07	Grey=		Y	Y	
5	Control: Are you currently in the state of Wisconsin?	3	0.2454	minimum		0.3521		76.92	minimum		Y	Y	
6	Control: Do you regularly attend lecture for this class?	4	0.0635	-0.08972		0.3456		71.43	61.86		Y	Y	
7	Control: Do you regularly attend lab for this class?	5	0.4736	0.56332	0.519201726	0.3079	-0.10207057	70.59	8.73	-0.074427481	N	N	T
8	Would you say you pick your nose often?	6	0.3198	0.40952	0.104422869	0.4127	0.203557889	72.29	10.43	0.105810008	N	N	T
9	Have you ever cheated on a test (college or high school)?	7	0.4712	0.56092	0.512729234	0.2967	-0.13473316	67.42	5.56	-0.410517388	N	Y	L
10	Have you ever cheated on your boyfriend/girlfriend?	8	0.1648	0.25452	-0.313592233	0.3774	0.100612423	69.77	7.91	-0.161365564	N	N	T
11	When riding a bike, do you wear a helmet?	9	0.0647	-0.1062		0.2882		67.42	57.69		Y	Y	
12	Control: Do you have any more classes today?	10	0.2795	0.3857	0.040183387	0.3654	0.065616798	74.07	16.38	0.736641221	Y	Y	T
13	Have you ever consumed alcohol underage?	11	0.2936	0.3998	0.078209277	0.2463	-0.28171479	71.43	13.74	0.456743003	N	N	T
14	Do you have any information that could lead to an arrest of any kind?	12	0.2631	0.3693	-0.004045307	0.3155	-0.07990668	69.77	12.08	0.280746395	N	Y	L
15	Have you ever consumed illegal drugs?(not including drinking alcohol or smoking)	13	0.2942	0.4004	0.0798274	0.4043	0.179060951	69.77	12.08	0.280746395	N	N	T
16	Have you ever been sexually attracted to an instructor?	14	-0.03417	-0.1196		0.3326		72.29	63.83		N	N	
17	Control: Are you graduating this year?	15	0.16113	0.28073	-0.242907228	0.3388	-0.01195684	71.43	7.6	-0.1942324	N	Y	L
18	If applying for a job, would you withhold any information about your illegal drug history?	16	0.0708	0.1904	-0.486515642	0.3638	0.060950714	72.29	8.46	-0.103053435	Y	Y	T
19	Have you ever lied to someone who trusted you?	17	0.282	0.4016	0.083063646	0.3788	0.104695246	68.18	4.35	-0.538804071	N	N	T
20	Have you ever been terminated from a job for any reason?	18	0.1495	0.2691	-0.274271845	0.2439	-0.28871391	73.17	9.34	-0.009754029	Y	Y	T
21	Did you earn an "A" on the last exam that you took?	19	0.06713	-0.09155		0.3695		74.07	63.83		Y	Y	
22	Control: Would you say science is your favorite subject in school?	20	0.5426	0.63415	0.710221143	0.3974	0.158938466	75.95	12.12	0.284987277	Y	N	L
23	Do you find me attractive? (your examiner)	21	0.06896	0.16051	-0.567125135	0.3064	-0.10644503	70.59	6.76	-0.283290925	Y	Y	T
24	Have you ever cursed in the presence of a child?	22	0.1904	0.28195	-0.239617044	0.3886	0.133275007	69.77	5.94	-0.370229008	Y	Y	T
25	If you saw someone drop money would you return it to them?	23	0.3986					74.07			Y	N	
26	Have you answered all of the preceding questions truthfully?	24	0.01586					68.97			N	N	
27	Control: Are you wearing red today?	25											
28	*We threw out question #24 and didn't need values from #1-4 or #25 for the analysis	25	Average Mag:	0.3707947		0.3429267			9.432				

Figure 15. Example of excel spreadsheet used to collect and normalize data.

### Appendix A: Questions administered during Polygraph Test (\* denotes control question)

1. Are you now sitting down?\*
2. Are you a student at UW Madison?\*
3. Are you currently in the state of Wisconsin?\*
4. Do you regularly attend lecture for this class?\*
5. Do you regularly attend lab for this class?\*
6. Would you say you pick your nose often?
7. Have you ever cheated on a test (college or high school)?
8. Have you ever cheated on your boyfriend/girlfriend?
9. When riding a bike, do you wear a helmet?
10. Do you have any more classes today?\*
11. Have you ever consumed alcohol underage?
12. Do you have any information that could lead to an arrest of any kind?
13. Have you ever consumed illegal drugs, not including drinking alcohol or smoking under age?
14. Have you ever been sexually attracted to an instructor?
15. Are you graduating this year?\*
16. If applying for a job, would you withhold any information about your illegal drug history?
17. Have you ever lied to someone who trusted you?
18. Have you ever been terminated from a job for any reason?
19. Did you earn an "A" on the last exam that you took?
20. Would you say science is your favorite subject in school?\*
21. Do you find me attractive? (your examiner) → data not used
22. Have you ever cursed in the presence of a child?

23. If you saw a stranger accidentally drop a 20 dollar bill would you try to return it to them?
24. Have you answered all of the preceding questions truthfully?
25. Are you wearing red today?\*