Liar Liar, Pants on Fire! A Physiological Study of Deception

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Abstract

From 2002 to 2005, the United States Department of Justice utilized the polygraph test 49,000 times. While not typically permissible in court, the results of a polygraph test can impact everything from individual employment opportunities to national security issues and thus, it is important to understand the advantages and limitations of the polygraph test. This experiment examined the ease of which a college-aged individual can thwart a polygraph test by manipulating his or her rate of respiration by controlling breathing or by increasing his or her body temperature though the use of heat packs and insulating clothing. Results were obtained by measuring heart rate, galvanic skin response (GSR) and rate of respiration using the iWorx Program. The data collected from the two experimental groups was compared to a control group where the participants were not provided with any strategies to beat the polygraph test. The analysis of respiration and GSR data of the control group showed no significant difference between truthful and untruthful responses measured by iWorx. Analysis of the heart rate data showed a significant difference between the truthful and untruthful responses from the control group, while it showed no significant difference for the experimental groups. Due to these results, the manipulations of respiration rate and body temperature were unable to be confirmed as effective methods to beat a polygraph. Further experimentation with larger sample sizes, more sensitive equipment and different methods of analysis might provide more conclusive findings.

Introduction

From 2002 to 2005, the United States Department of Justice utilized the polygraph test 49,000 times. The use of the test ranged from making pre-employment decisions and personnel security decisions to counterintelligence and counterterrorism investigations.[1] While the results of the polygraph test are typically not permissible in court, the results of polygraph tests clearly impact both individual employment opportunities as well as

national security precautions. Thus, it is important to understand the advantages and limits of the polygraph test.

A polygraph measures heart rate, respiration and Galvanic Skin Response (GSR). These physiological measurements are largely controlled by the sympathetic branch of the autonomic nervous system. When an environmental stressor is experienced the fight-or-flight response is induced and catecholamines are released from the adrenal gland to stimulate an appropriate physiological response. Theoretically, the heart rate, respiration, and GSR response of the individual should increase when they are lying as compared to when they are telling the truth, because the sympathetic nervous system is not consciously controlled. A main assumption of the polygraph test is that changes in emotional state will elicit a change in autonomic response.[2]

A baseline is obtained by asking an individual questions that are intended to provoke a typical autonomic response for the particular participant. These questions should be general enough that the administrator of the test can easily determine if the person is lying ("Are you human?", "Have you ever lied to someone?"). By creating a baseline measurement of normal autonomic activity, deviations in physiologic response during the test can be used to indicate when an individual is not being truthful.

Heart rate is defined as the number of beats per unit time, which is typically recorded as beats per minute (bpm). When a stressor is encountered, the cardiac output increases from around one gallon per minute to up to five gallons per minute.[3] Although SNS control of heart rate is largely involuntary, speculations have been made that there may be ways to affect your own heart rate.[4,5]

One technique that may influence heart rate is the conscious control of respiration. Respiration rate is defined as the number of breaths an individual takes in a given time period. The increased blood flow induced by a sympathetic response leads to an increased respiratory rate to maintain the O_2 and CO_2 equilibrium throughout the body.[6] This function is controlled in the medulla, which evaluates the amount of O_2 consumed and CO_2 produced by the tissues with the amount of O_2 intake and CO_2 expulsion of the lungs.[7]

Galvanic Skin Response measures the changes in conductance produced by sweat glands, particularly in the palms and the soles of the feet. These sweat glands act as "variable resistors" whose resistance can be measured when a small electrical impulse of known voltage is sent through the skin of the subject. As the sweat ducts in the palms fill with sweat their resistance decreases eliciting a spike in the conductance reading. The amount of sweat in the gland is a response to the novelty, intensity and emotional significance of environmental stimuli and is triggered when the sympathetic branch of the autonomic nervous system releases acetylcholine onto the pathways that increases the amount of sweat in the sweat glands. If a subject is lying, the GSR response should increase as his or her sweat glands fill, decreasing the resistance. It is important to keep in mind that random natural spikes in resistance occur one to three times per minute (Figure 1).[8]

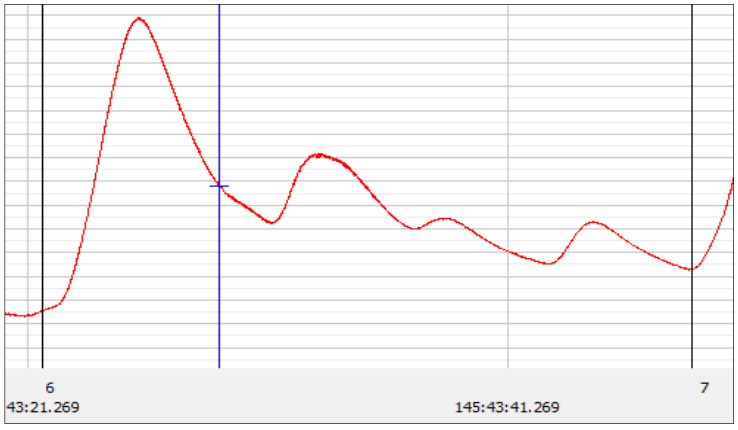


Figure 1. Example of a GSR trace showing natural and stress induced spikes. The peak to the left of the blue line shows a GSR response due to lying. To the right of the blue line, the trace displays the natural variations that occur during a GSR measurement.

In order to gain an appreciation as to the efficacy of the 'lie-detector' test, we have decided to explore how easily the polygraph can be beaten when individuals are provided with information about the test prior to administration of the polygraph. This is an area of research that has not been previously pursued and there is a lack of relevant literature regarding polygraphs tests and techniques to beat them. This study examines if it is possible for an individual to beat a polygraph test and tell a lie without displaying the expected physiological indicators when he/she is informed of the physiological responses that are assessed during a polygraph test and is provided with strategies to control these responses prior to undergoing the test.

Material and Methods

Fifteen individuals currently enrolled at the University of Wisconsin-Madison voluntarily participated in the project. Each reported he or she had no prior experience with polygraph examinations.

Each participant was presented with the fictitious situation that he or she had stolen money from an unoccupied office in the building; however no one had witnessed him or her commit the crime (see Appendix A). The participant was then given a twenty-dollar bill to keep in his/her pocket that represented the stolen money. The individual was instructed to deny any involvement and claim he or she had no knowledge of the situation during a polygraph test. Furthermore, he or she was instructed to provide truthful responses to all other questions unrelated to the burglary posed during the test. The control group received no further instruction and was immediately tested. The other three groups were provided with possible techniques to attempt to thwart the polygraph

machine. The first group was instructed to concentrate on breathing in order to maintain a constant respiration rate throughout the entire exam. The second group of participants was given heat packs to raise their body temperature and increase sweat production.

The polygraph administrator was blinded to the experimental method. Each individual was asked the same set of 22 questions with five pertaining to the stolen money (see Appendix B). The test was performed in a small, windowless room with minimal distractions and noise.

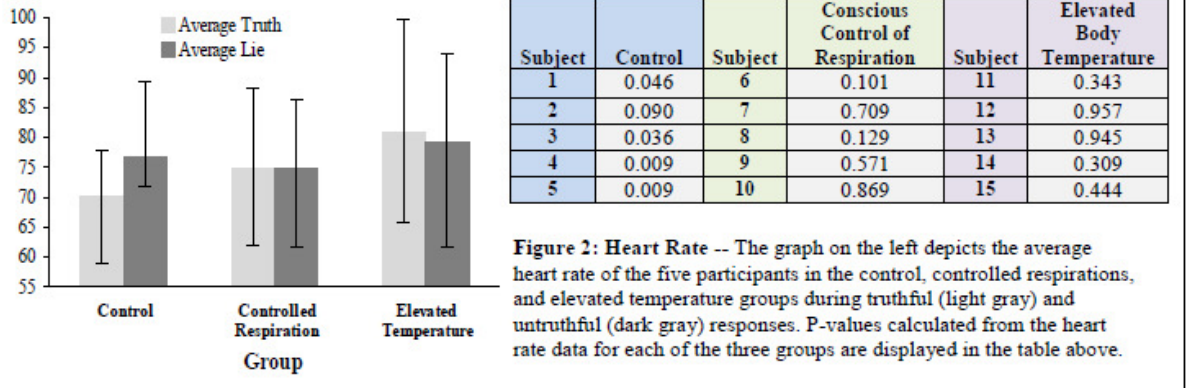
The three physiological factors used by the polygraph machine were galvanic skin conductance (GSR), respirations, and heart rate. A GSR-200 Galvanic skin response amplifier (iWorx Systems Inc., Dover, NH) was used to measure the skin conductance. A RM-204 respiration monitor and C-AAMI-504 ECG electrodes (iWorx) were also used to monitor respirations and heart rate, respectively. Two ECG electrodes were positioned on each side of the participant's chest, just beneath the collarbone. A reference electrode was placed on the right ankle. Data was collected using the IWX/214 data acquisition unit (iWorx) and was formatted and analyzed using LabScribe (iWorx). Equipment setup and calibration are thoroughly described in literature provided by iWorx Systems and will not be discussed here.[8]

Analysis was performed on the responses to questions 3, 5, 11, 12, and 21 for which the subjects were instructed to be truthful and the responses to questions 6, 9, 14, 19, and 22 for which the subject was instructed to lie. As each individual had a different physiological response time for each question, the analysis window was standardized by measuring each physiological factor (heart rate, respirations, and GSR) from the time a question was asked until the GSR recording stabilized at a constant value. Heart rate was

determined using the number of beats that occurred within this time period and the number of inhalations within this window was used to calculate respiratory rate. The area under the curve of respiration was measured to obtain the depth of respiration for each subject. Peak GSR height was calculated using the maximum voltage deviation from the baseline value. The area under the GSR curve was also measured. (See Appendix C for example data traces). Averages and standard deviations were calculated for each individual. Truthful responses were compared to the untruthful responses using a paired t-test. Statistical significance was set at the level of 0.05.

Results

The average heart rate values for truthful and untruthful responses of the control group, controlled respirations group, and elevated temperature group are depicted in Figure 2. Individual p-values comparing truthful versus untruthful responses for heart rate are also shown. For supplementary data see Appendix D, part a.

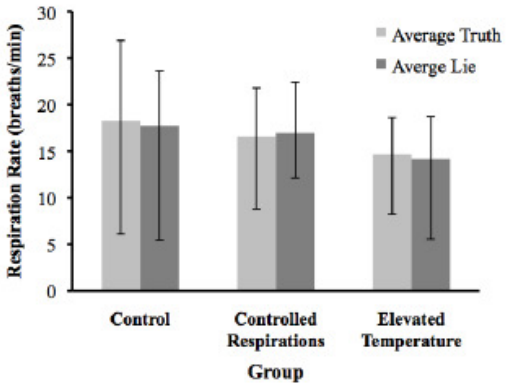


Subject	Control	Subject	Conscious Control of Respiration	Subject	Elevated Body Temperature
1	0.046	6	0.101	11	0.343
2	0.090	7	0.709	12	0.957
3	0.036	8	0.129	13	0.945
4	0.009	9	0.571	14	0.309
5	0.009	10	0.869	15	0.444

Figure 2: Heart Rate -- The graph on the left depicts the average heart rate of the five participants in the control, controlled respirations, and elevated temperature groups during truthful (light gray) and untruthful (dark gray) responses. P-values calculated from the heart rate data for each of the three groups are displayed in the table above.

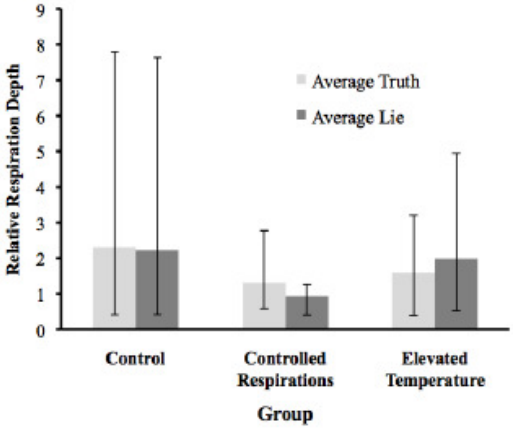
Data for respiration rate and respiration depth was also obtained for truthful and untruthful responses of the control group, controlled respirations group, and elevated

temperature group. The respiration rate data and respective p-values are shown in Figure 3. The respiration depth data and respective p-values are depicted in Figure 4. For supplementary data see Appendix D, parts b and c.



Subject	Control	Subject	Conscious Control of Respiration	Subject	Elevated Body Temperature
1	0.187	6	0.207	11	0.382
2	0.676	7	0.273	12	0.556
3	0.447	8	0.073	13	0.753
4	0.264	9	0.886	14	0.539
5	0.252	10	0.592	15	0.146

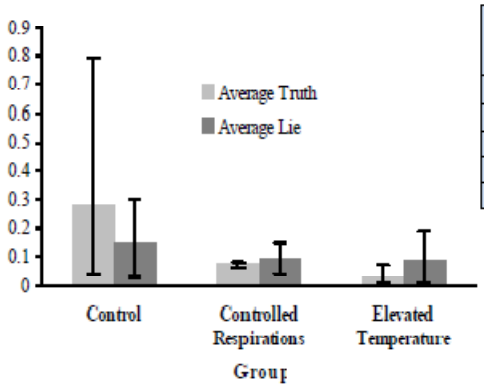
Figure 3: Respiration Rate -- The graph on the left depicts the average respiration rate of the five participants in the control, controlled respirations, and elevated temperature groups during truthful (light gray) and untruthful (dark gray) responses. P-values calculated from the respiration rate data for each of the three groups are displayed in the table above.



Subject	Control	Subject	Conscious Control of Respiration	Subject	Elevated Body Temperature
1	0.3381	6	0.8197	11	0.9538
2	0.5260	7	0.4408	12	0.6947
3	0.5260	8	0.0483	13	0.7772
4	0.9311	9	0.4652	14	0.2659
5	0.1498	10	0.4363	15	0.8331

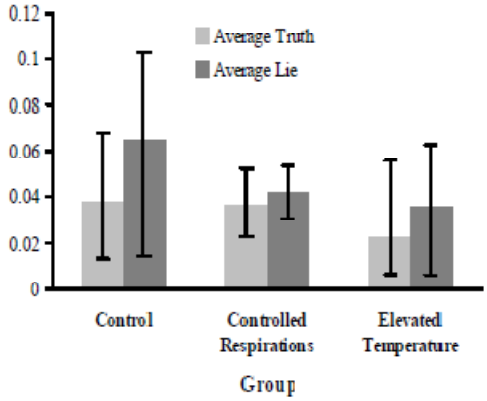
Figure 4: Respiration Depth -- The graph on the left depicts the average respiration depth of the five participants in the control, controlled respirations, and elevated temperature groups during truthful (light gray) and untruthful (dark gray) responses. P-values calculated from the respiration depth data for each of the three groups are displayed in the table above.

Data for maximum GSR deviation from baseline and GSR area under the curve was also obtained for each experimental group. The maximum GSR deviation from baseline and respective p-values are depicted in Figure 5. The GSR area under the curve data and respective p-values are depicted in Figure 6. For supplementary data see Appendix D, parts d and e.



Subject	Control	Subject	Conscious Control of Respiration	Subject	Elevated Body Temperature
1	-	6	-	11	0.290
2	0.026	7	-	12	0.256
3	0.157	8	0.125	13	0.167
4	0.304	9	0.282	14	0.854
5	0.380	10	0.152	15	0.152

Figure 5: GSR Max Peak -- The graph on the left depicts the average GSR max peak of the five participants in the control, controlled respirations, and elevated temperature groups during truthful (light gray) and untruthful (dark gray) responses. P-values calculated from the GSR max peak data for each of the three groups are displayed in the table above. Some GSR data was excluded for participants 1 and 2 due to method error during data collection.



Subject	Control	Subject	Conscious Control of Respiration	Subject	Elevated Body Temperature
1	0.2533	6	0.0076	11	0.0858
2	0.1883	7	0.0296	12	0.8226
3	0.6635	8	0.1129	13	0.7861
4	0.7602	9	0.0356	14	0.8767
5	0.3157	10	0.4223	15	0.0561

Figure 6: GSR Area Under the Curve -- The graph on the left depicts the average GSR area under the curve of the five participants in the control, controlled respirations, and elevated temperature groups during truthful (light gray) and untruthful (dark gray) responses. P-values calculated from the GSR area under the curve data for each of the three groups are displayed in the table above.

Discussion

If it were possible to beat a lie detector test, we would have expected to find that the p-values for our control group in all physiological measurements were significant (<0.05) because lying is stressful. On the other hand, the variable groups (elevated temperature and controlled respirations) would show p-values with no significance because the stress of lying is masked by the experimental maneuver. Significance indicates that we saw a marked difference in the measured variable when the subject was lying as compared to when the subject was telling the truth. We hypothesized that in the control group, when a participant was lying, the maximum deviation of GSR from the baseline value would be

larger than if the participant was being truthful. We also hypothesized that their average heart rate and rate of respiration would increase if they were lying; their depth of respiration would thus be decreased due to increased frequency of respirations. If the manipulation of these variables using breathing control and heat pads was a successful way to beat the lie detector test, we would expect the p-values of these two data sets to be insignificant.

For the control group, heart rate provided a consistent measurement to determine if the subject was telling the truth. There was a regular and significant increase in heart rate when the participant provided an untruthful response. This displays the sympathetic response of each subject to the stress presented by lying. Catecholamines, such as adrenaline, are released during this stress response and increased the heart rate. While four of the five p-values in this group were below 0.05, the remaining value for subject 2 was 0.0901. However, for this individual, the GSR was not allowed to return to baseline before the next question was asked, which affected the analysis window in which the heart rate was determined. Using these data, the iWorx system effectively distinguished the heart rate during an untruthful response from that obtained during a truthful response 95% of the time.

In the group that controlled respirations, heart rate was not significantly different between truthful and untruthful responses. By controlling breathing rate, participants were able to maintain a consistent heart rate, even when telling a lie. The p-values for these individuals were all greater than 0.10, indicating the iWorx system was unable to distinguish between a truth and a lie when the person was controlling his/her respirations.

While consciously slowing one's heart rate is more involved than merely controlling respiration rate, by concentrating on breathing the subject can influence the stimulation of the parasympathetic nervous system, which helps to minimize the effects of the sympathetic nervous system when presented with a stressor.

With the group that was given heat packs to raise their body temperature, there was no significant difference in heart rate between truthful and untruthful responses. The p-values were all greater than 0.30, meaning the heart rates were very similar for each response type. When the subject was given heat packs to increase their body temperature, the iWorx system was unable to be used effectively to discern when an individual was lying. Vasodilation is an important thermoregulation mechanism of the body to decrease body temperature. When the vessels dilate, the heart beats faster in an attempt to maintain blood pressure. Given the data, using heat packs affected the resting heart rate enough to mask the effect of the sympathetic response while lying.

Our data analysis of the respiration and GSR measurements did not confirm our hypothesis. Overall, p-values for all three participant groups were not significant, meaning it was not possible for us to tell the difference between the truth and a lie based on either respiration or GSR data. No p-values within the respiration data set were significant. Within the GSR data set, only two p-values were significant (Control Subject #2: $p = 0.0263$ and Heat Subject #15: $p = 0.0276$).

No significant findings were obtained regarding alterations in respiration frequency or depth while lying. Thus, no conclusive results can be drawn as to the effectiveness of controlling rate of respiration in order to beat a polygraph test. The insignificant p-values

of the control group indicate that even when respiration was not consciously controlled, it was not a good indication of whether or not a participant was lying.

No conclusive results were obtained from the GSR data. Not only did we find no significance when analyzing maximum GSR peak, we also found no significance when analyzing area under the GSR curve. This measurement was intended to determine if the GSR took longer to reach baseline when someone was lying. It is difficult to draw definitive conclusions from the GSR data because there is a lot of variation in GSR spikes not only from participant to participant, but also within individual responses to the questions asked of each participant. This might be eliminated if a larger sample size of questions and/or a larger sample of participants were analyzed. It is also difficult to say whether or not our GSR measurements were an accurate representation of truth versus lies because GSR spikes also occur naturally (refer to Figure 1), and it is often challenging to differentiate a natural spike in GSR from a spike caused by a physiological response to lying. It would be beneficial to investigate if there are other ways this data can be analyzed that may give rise to different results.

A selected amount of GSR data was excluded due to experimenter error. When carrying out the first four trials, the interviewer did not allow sufficient time after each question for the GSR measurement to return to baseline. Thus, it was not possible to obtain an accurate analysis of GSR data for these participants because there was no baseline value to compare to the peak height. GSR data for the first three participants was completely excluded. For the fourth participant, GSR data was able to be analyzed for six questions; however, the other four questions could not be analyzed because the measurement did not

return to baseline. All data for the remaining participants was able to be utilized because ample time was allowed for the GSR to return to baseline between each question.

There are several factors regarding the experimental subject group that affect the ability of the results obtained to be generalized. The results are subject to selection bias due to the non-random recruitment of participants. All participants were college students between ages the ages of eighteen and twenty-three. This absence of considerable demographic variation amongst our participants limits the extent to which the results can be generalized to the entire population. In addition, the number of participants interviewed was fewer than anticipated due to time constraints; the overall sample size consisted of fifteen participants. A larger sample size would give more statistically relevant results and decrease variation seen within the data. The consequence of selection bias and a limited sample size is that the results may not be indicative of the population as a whole. These issues decrease the external validity of the experiment.

Various experimental procedures used also limit the internal validity of the results. In some instances the participant was a friend or acquaintance of the interviewer. A personal relationship with the interviewer could potentially have a calming or distressing effect on the physiological state of the participant. The existence of a relationship between interviewer and interviewee would then give rise to inconsistent data when compared to the absence of any relationship. Therefore, the data obtained from these participants may be skewed. In addition, two of the researchers conducted interviews with participants rather than one as was originally planned. The inconsistency in the individual asking the

questions could also lead to biased results due to differences amongst the interviewers and the way the interviews were conducted.

Measures were taken to ensure minimal distraction of the participant during testing. No one was present in the room during the questioning aside from the interviewer and participant. The interviewer was prevented from knowing the experimental condition of each individual; the execution of a blind experiment works to limit unconscious bias on behalf of the interviewer.

In order to increase the validity of the results obtained, this experimental procedure could be repeated with some alterations. In order to reduce selection bias, participants would be randomly chosen. Ideally, the subject group would consist of a large number of participants with significant variability in demographic background. Using the same interviewer for the testing of each participant would provide more consistency as well. If the experiment were repeated, a greater time investment would be made in choosing the appropriate software to ensure efficient and accurate data collection and analysis. The iWorx software required substantial effort in integrating the GSR, ECG, and respiration measurements. Software specifically designed for collecting and analyzing polygraph measurements would be more suited to the scope of this experiment. We also experienced difficulty with the leads measuring GSR on multiple occasions. The traces appeared "noisy" making them unreadable and unusable as data. (See Figure 7) An additional proposition for further research is to test the same hypothesis using additional physiological measurements. We could also take measurements of blood pressure throughout the

interview to investigate whether changes in blood pressure can serve as an indication of lying.

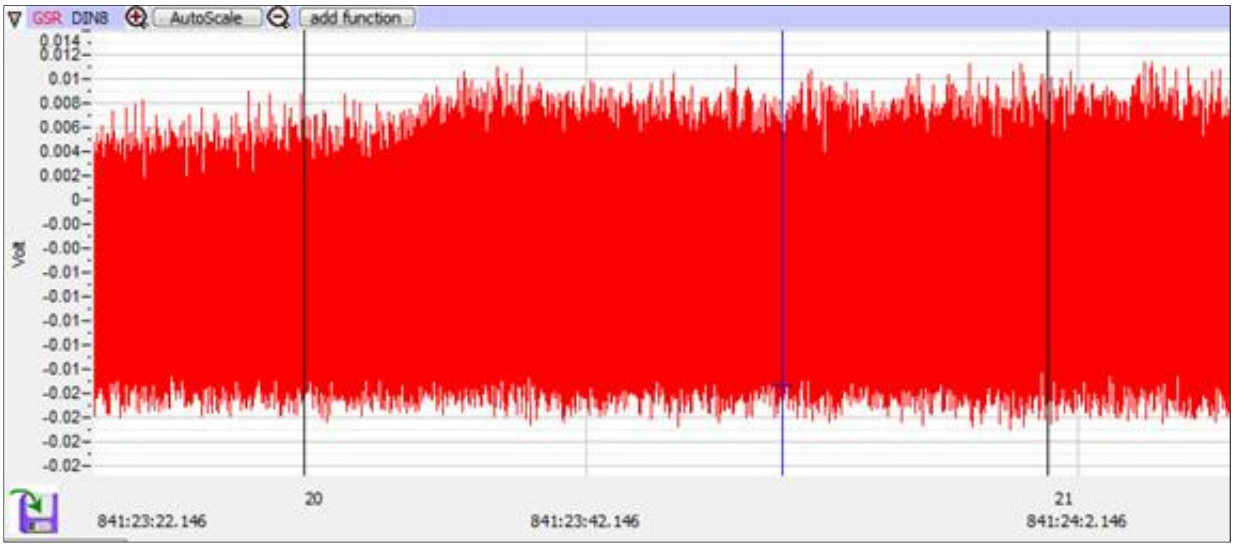


Figure 7. Example of poor GSR data.

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Appendix

A. Prompts for Test Subjects

Prompt for Control and Test subjects

You have stolen money from the empty office (go grab money out of drawer). No one saw you enter or leave the office, and they have no physical proof that you were there. Unfortunately, due to your badass reputation, the cops have called you in for questioning and a lie detector test. Your lawyer advises you to deny any involvement and claim you have no knowledge of the situation, but to answer all other question truthfully. Respond to the questions by saying either "Yes" or "No." Attempt to sit as still as possible, because if you appear fidgety the police will assume you are not being truthful and assume your guilt.

Additional prompt for test subjects undergoing heat increase

You must attempt to "beat" the test or else you face jail time. The lie detector directly involves the measurement of your perspiration. In order to attempt to thwart the measurement, you will use heat pads placed on your core and layering of clothing to increase your sweat production. This should increase the conductance measured by the galvanic skin response monitor, hiding your physiological response when lying.

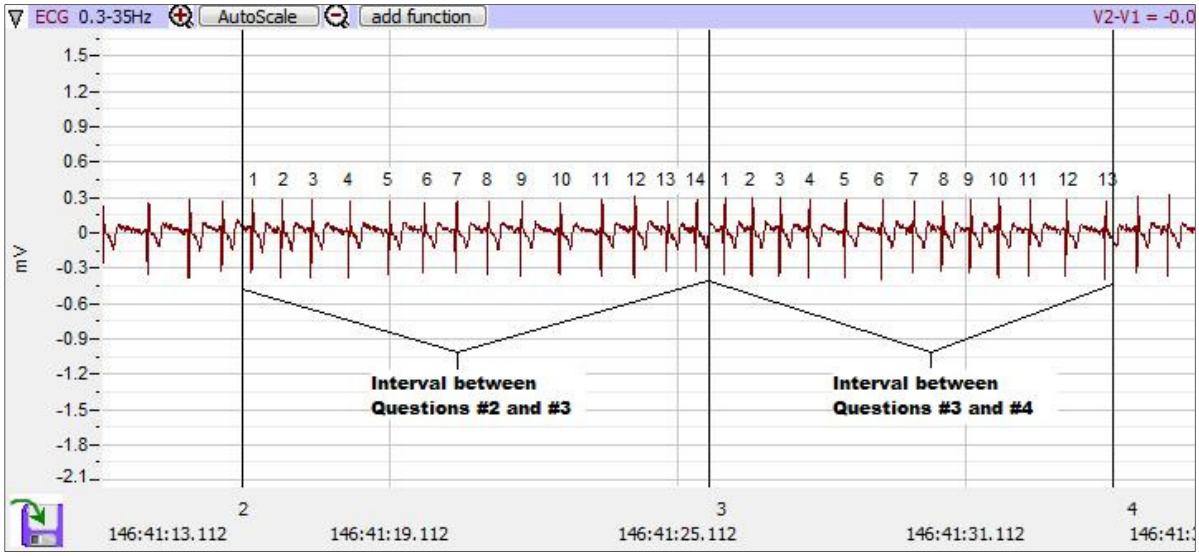
Additional prompt for test subjects using respiration control

You must attempt to "beat" the test or else you face jail time. The lie detector directly involves the measurement of your respiration and heart rate. In order to attempt to thwart the measurement, you will use the given technique. This should increase the measurement, hiding your physiological response when lying.

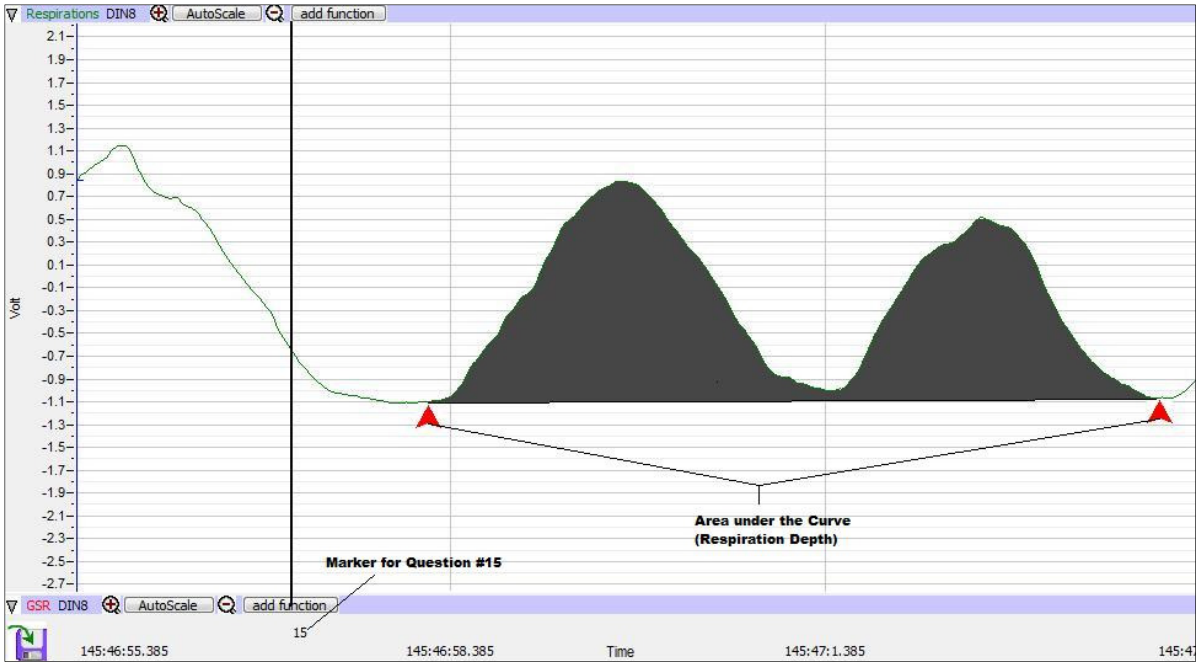
B. Question list

1. Is your name _____ ?
2. Is your major biology?
3. Have you ever told a lie?
4. Are you male/female?
5. Are you a student at UW-Madison?
6. **Did you steal the money?**
7. Do you have class on Friday?
8. Do you live in the residence halls?
9. **If you stole the money, do you have it with you?**
10. Is your hair color_____?
11. Have you ever taken food from your roommate without asking?
12. Do you have a dog?
13. Do you have an exam this week?
14. **If you stole the money, was a five dollar bill?**
15. Is it March?
16. Is your favorite season spring?
17. Do you like ice cream?
18. Do you exercise regularly?
19. **If you stole the money, was it a 20 dollar bill?**
20. Are you a packers fan?
21. Do you have a bicycle in Madison?
22. **If you stole the money, did you take it out of the drawer?**

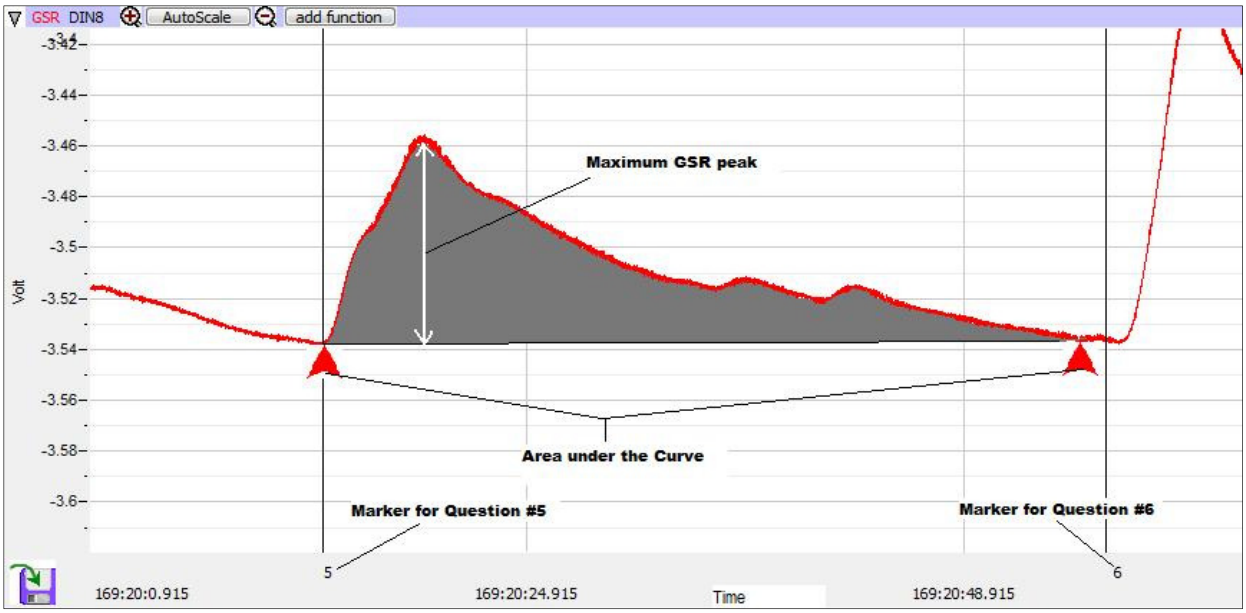
C. Example Data Trace Figures



a. Heart rate was determined by analyzing data obtained from the ECG. The number of heart beats in each time interval was multiplied by 60 seconds, then divided by the length of the time interval (in seconds) to give heart rate in bpm for each particular time interval.



b. Respiration depth was determined by measuring area under the curve. The bottom of the first respiration after the respective question marker was used as the starting point. The end point was the bottom of the last respiration before the next question marker.

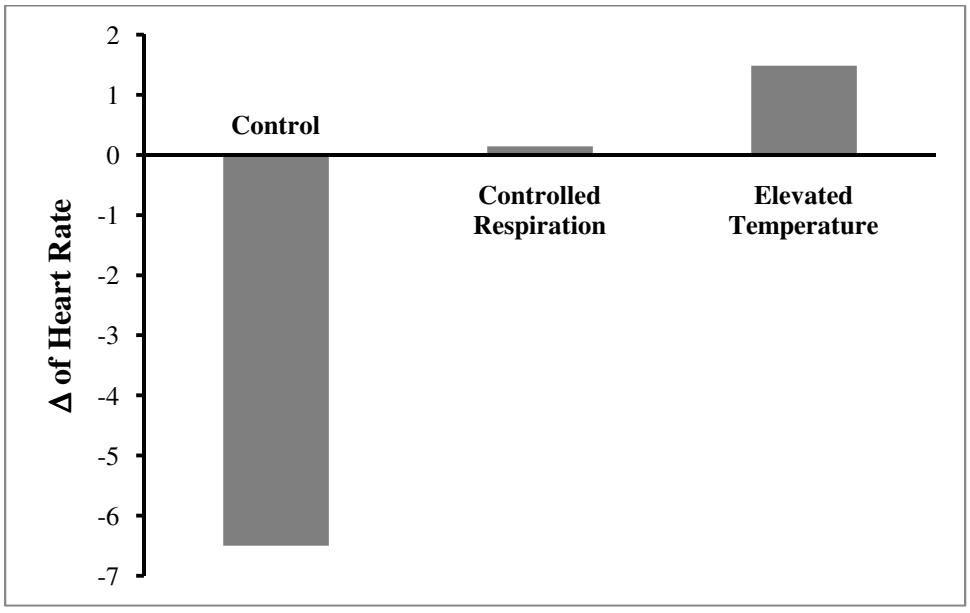


c. Maximum GSR peak was determined by measuring the height of the largest peak in each question interval. Area under the curve was also determined. The starting point was taken at the point the question was asked; the end point taken at the closest approximation of the point that the GSR leveled off.

D. **Supplementary Figures.** Average Truth and Lie values for **a.** heart rate, **b.** respiration rate, **c.** respiration depth, **d.** GSR maximum peak height, and **e.** GSR area under the curve are shown in the following tables along with standard deviations. The graph below each table represents the difference between the group average measurement for truthful responses and untruthful responses (i.e. Average truth – Average Lie).

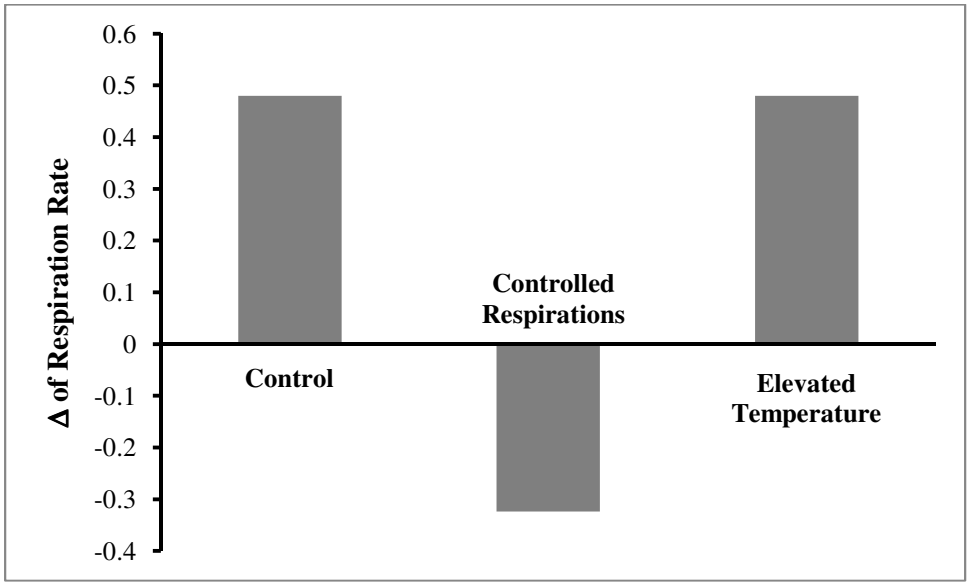
a. Heart Rate Data (beats/min)

Response	Subject	Control	Subject	Conscious Control of Respiration	Subject	Elevated Body Temperature
Truth	**1**	65.4 ± 6.2	**6**	70.0 ± 6.1	**11**	87.1 ± 3.0
Lie		72.9 ± 1.2		75.1 ± 1.2		84.2 ± 3.3
Truth	**2**	81.6 ± 4.8	**7**	62.7 ± 2.2	**12**	61.8 ± 2.3
Lie		89.3 ± 3.1		61.6 ± 1.9		61.7 ± 1.8
Truth	**3**	75.2 ± 1.5	**8**	79.6 ± 5.2	**13**	84.4 ± 2.9
Lie		77.8 ± 1.5		76.2 ± 6.2		84.5 ± 3.4
Truth	**4**	62.6 ± 2.6	**9**	87.9 ± 4.1	**14**	74.7 ± 1.6
Lie		71.8 ± 2.9		86.3 ± 4.6		72.0 ± 4.1
Truth	**5**	66.3 ± 1.1	**10**	74.2 ± 2.8	**15**	95.9 ± 3.9
Lie		71.8 ± 1.9		74.5 ± 2.1		94.1 ± 2.4



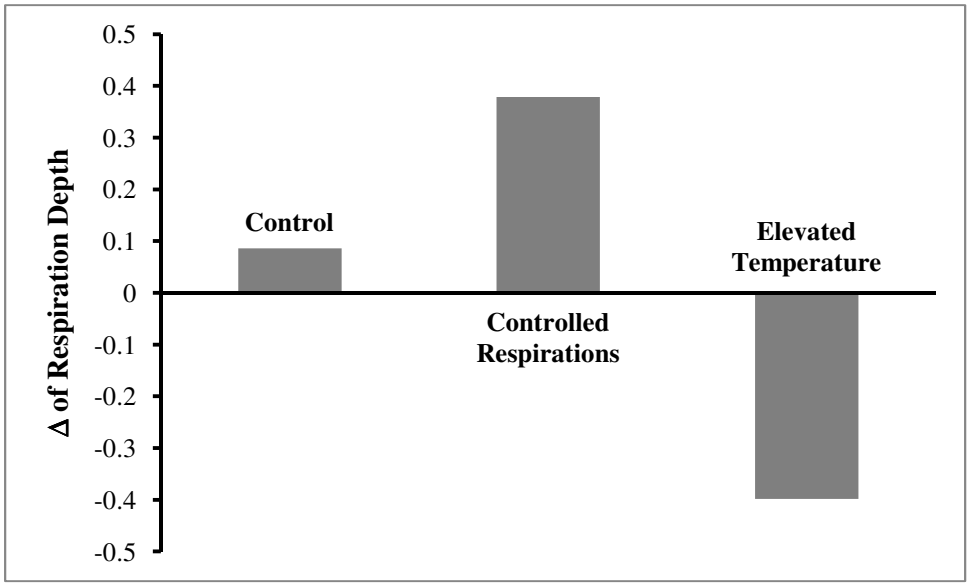
b. Respiration Rate (breaths/min)

Response	Subject	Control	Subject	Conscious Control of Respiration	Subject	Elevated Body Temperature
Truth	**1**	26.9 ± 1.1	**6**	21.1 ± 4.9	**11**	11.6 ± 2.7
Lie		23.6 ± 4.6		17.0 ± 4.0		10.2 ± 1.5
Truth	**2**	19.4 ± 6.7	**7**	17.3 ± 2.9	**12**	18.6 ± 1.5
Lie		17.8 ± 3.1		18.8 ± 1.6		18.0 ± 0.9
Truth	**3**	18.0 ± 2.1	**8**	8.78 ± 1.9	**13**	18.4 ± 2.7
Lie		19.2 ± 1.6		12.1 ± 1.8		18.7 ± 1.7
Truth	**4**	6.1 ± 1.1	**9**	14.0 ± 3.3	**14**	16.4 ± 3.3
Lie		5.4 ± 0.8		14.3 ± 3.8		18.4 ± 3.7
Truth	**5**	20.7 ± 4.7	**10**	21.8 ± 2.2	**15**	8.2 ± 3.7
Lie		22.7 ± 1.6		22.4 ± 1.2		5.5 ± 1.8



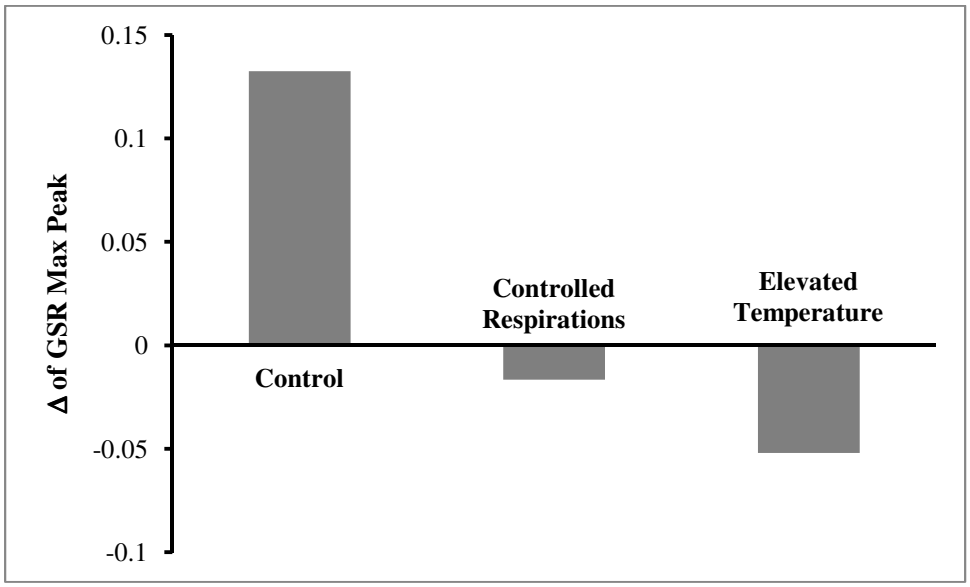
c. Relative Respiration Depth

Response	Subject	Control	Subject	Conscious Control of Respiration	Subject	Elevated Body Temperature
Truth	**1**	0.4658 ± 0.2210	**6**	1.0073± 0.4219	**11**	3.2441± 1.5967
Lie		0.6311 ± 0.2423		1.0528± 0.0745		3.2975± 0.5966
Truth	**2**	1.1475± 0.5299	**7**	0.6748± 0.3039	**12**	0.5112± 0.2268
Lie		0.8941± 0.5361		0.8090± 0.1933		0.4823± 0.2104
Truth	**3**	1.4578± 0.3888	**8**	2.7702± 1.3002	**13**	0.5874± 0.5429
Lie		1.5141±0.3350		1.2643± 0.2459		0.6832± 0.3272
Truth	**4**	7.8041± 3.2151	**9**	1.5089± 1.0293	**14**	0.3969± 0.1432
Lie		7.6458± 2.9463		1.1090± 0.5772		0.5155± 0.2731
Truth	**5**	0.6566± 0.2167	**10**	0.5743± 0.2147	**15**	3.2003± 1.6063
Lie		0.4155± 0.1222		0.4075± 0.3010		4.9526± 1.1506



d. Maximum GSR deviation from baseline (volts)

Response	Subject	Control	Subject	Conscious Control of Respiration	Subject	Elevated Body Temperature
Truth	**1**	-	**6**	-	**11**	0.02 ± 0.01
Lie		-		-		0.03 ± 0.004
Truth	**2**	0.04 ± 0.01	**7**	-	**12**	0.05 ± 0.01
Lie		0.16 ± 0.11		-		0.06 ± 0.02
Truth	**3**	0.23 ± 0.08	**8**	0.08 ± 0.04	**13**	0.01 ± 0.02
Lie		0.30 ± 0.05		0.15 ± 0.06		0.13 ± 0.05
Truth	**4**	0.06 ± 0.06	**9**	0.06 ± 0.03	**14**	0.01 ± 0.01
Lie		0.03 ± 0.01		0.08 ± 0.01		0.01 ± 0.01
Truth	**5**	0.79 ± 1.54	**10**	0.08 ± 0.06	**15**	0.07 ± 0.03
Lie		0.10 ± 0.04		0.04 ± 0.04		0.19 ± 0.06



e. GSR Area Under Curve

Response	Subject	Control	Subject	Conscious Control of Respiration	Subject	Elevated Body Temperature
Truth	**1**	0.0460 ± 0.0245	**6**	0.0376 ± 0.0115	**11**	0.0086 ± 0.0031
Lie		0.0743 ± 0.0103		0.0487 ± 0.0173		0.0130 ± 0.0025
Truth	**2**	0.0166 ± 0.0088	**7**	0.0525 ± 0.0005	**12**	0.0164 ± 0.0073
Lie		0.0557 ± 0.0235		0.0309 ± 0.0118		0.0160 ± 0.0041
Truth	**3**	0.0687 ± 0.0209	**8**	0.0377 ± 0.0140	**13**	0.0558 ± 0.0142
Lie		0.0763 ±0.0162		0.0536 ± 0.0242		0.0489 ± 0.0264
Truth	**4**	0.0134 ± 0.0025	**9**	0.0227 ± 0.0142	**14**	0.0064 ± 0.0025
Lie		0.0142 ± 0.0029		0.0384 ± 0.0050		0.0061 ± 0.0021
Truth	**5**	0.0420 ± 0.0103	**10**	0.0314 ± 0.0222	**15**	0.0249 ± 0.0103
Lie		0.1031 ± 0.1355		0.0372 ± 0.0092		0.0631 ± 0.0234