Employees' Perceptions About the Deterrence Effect of Polygraph Examination Against Security Compromises

Joshua L. Cook

Abstract

The polygraph screening examination is a technique commonly used to deter and detect potential national security crimes. Yet, critics argue that the technique is based on faulty assumptions. The purpose of this descriptive and exploratory research study was to determine whether there is a perceived deterrence effect related to the use of polygraph screenings examinations between groups. Paternoster and Simpson's as well as Vance and Siponen's rational choice models, and Bandura's social learning theory served as the theoretical foundation for this study. This study assessed groups' perceptions about adhering more closely to security regulations if a polygraph screening is required, changes in their behavior and attitude, and beliefs about polygraph screening deterrent effects. Data were obtained through a 15-minute researcher created survey with a cluster sample of 326 participants. Data were analyzed with a t-test to determine whether there was a statistically significant difference between the groups. A factor analysis was also conducted to determine underlying construct and reliability of the survey. Results indicated that there was a statistically significant difference ($p < .001$) between the groups, suggesting that participants perceive a deterrent effect associated with the use of polygraph screenings as well as a change of behavior and attitude if a polygraph screening can be randomly administered at work.

A number of federal agencies and members of the intelligence community use polygraph screening examinations to detect and deter national security crimes. The number of yearly screening examinations exceeds thousands, based on a study in 2003 (National Research Council, 2003). The National Research Council's (2003) report on polygraph screening examinations noted there is a limited body of research on the deterrence efficacy of screening examinations. Anecdotal evidence supports the use of polygraph screening examinations as a tool to protect national security (National Research Council, 2003). This descriptive and exploratory research study was conducted in order to explore the deterrence effect of polygraph screening examinations (The National Research Council defined deterrence as, "Keeping people who have done or may do certain undesired things out of sensitive positions and keeping people already in sensitive positions from doing undesired things." (p. 72) Different theories may impact how deterrence is effected as a result of screening examinations. The rational choice model of Paternoster and Simpson (1996) and Siponen (2012), and Bandura's social learning theory (1971, 1989) affect how deterrence within an organization is impacted as a result of screening.

Paternoster and Simpson's Rational Choice Model

The Paternoster-Simpson rational choice model of corporate crime is essentially a subjective expected utility theory (Paternoster & Simpson, 1996). Paternoster and Simpson (1996) reported that it is based on two assumptions: (a) "decisions to offend are made on a balancing of both the costs and benefits of offending and (b) what are important are the decision-maker's perceived or subjected expectations of reward and cost" (p. 553). Researchers related that the first assumption pertains to individuals being at least minimally rational agents and their conduct partly guided by the expected consequences of their behavior. In regard to the second assumption, an implication is that the critical agent of corporate crime is the individual. The researchers suggested that the decision to break a law is made by the individual; however, an individual is affected by the context of their employment and the nature of their crime. Hence, employees who commit corporate crimes are affected by the characteristics and imperatives of their business organization. Specifically, the decisions of employees are influenced by (a) the risks and benefits they perceive for themselves, (b) the risks and benefits they perceive

for their company, and (c) the presence or absence of offending inducements or restrictions within the specific context of the organization.

Vance and Siponen's Rational Choice Model

Vance and Siponen (2012) used Paternoster and Simpson's (1996) rational choice model to better understand the effect of expected benefits on Information Systems (information systems) security violations, Vance and Siponen reported that Rational Choice Theory (RCT) had not been used in the field of information systems. The researchers related that RCT explains an individual's decision to commit crimes as utilitarian calculations based on perceived benefits and both formal and informal sanctions. Therefore, RCT extends beyond deterrence theory by including individuals' perceptions of benefits of violations, informal sanctions, and espoused moral beliefs. They noted that RCT is commonly used to explain criminal behavior; however, it is general enough to cover all violations. Thus, Vance and Siponen noted that RCT is also applicable to the study of violations of organizational information systems security policies. The researchers also noted that RCT has been found to explain white-collar crimes better than street-level crimes. Due to this and because RCT has been found to be effective in the corporate context (e.g., Paternoster & Simpsons, 1996), Vance and Siponen related that they expected it to be a good fit for explaining intentional information systems security policy violations, which also includes a deliberate violation of organizational norms.

To better explain information systems security policy violations in situations where employees are aware of the information systems security policy, Vance and Siponen's (2012) theoretical model includes disincentives (sanctions) and incentives (perceived benefits) for violating information systems security policies.

Social Learning Theory

Bandura (1971, 1989) developed Social Learning Theory (SLT) in the 1960s, which was later changed to Social Cognitive Theory (SCT) in 1986 (Boston University School of Public Health, 2013). According to Boston University School of Public Health (2013), SLT posits that learning occurs in a social context with a three-way, dynamic and reciprocal interaction of the person, environment, and behavior. In this theory, focus is placed on social influence and external and internal social reinforcement. In SLT, consideration is placed on the unique way in which individuals acquire and maintain behavior, while considering the social environment in which individuals perform the behavior. The theory takes into account individuals' past experiences, which influences reinforcement, expectations, and expectancies. All of these factors shape whether individuals will engage in a specific behavior and the reasons for doing so. SLT's goal is to explain how individuals regulate their behavior through control and reinforcement to achieve goal-directed behavior that can be maintained over time (Boston University School of Public Health, 2013). Boston University School of Public Health (2013, para. 3) discussed six constructs of SLT: (a) reciprocal determinism, (b) behavioral capability, (c) observational learning, (d) reinforcements, (e) expectations, and (f) self-efficacy.

Methods

A descriptive and exploratory research design was used. This research design was appropriate as the goal of the research study was to determine whether there was a statistically significant difference between the polygraph-treatment and no polygraph-treatment groups' perceptions of the deterrence effect of polygraph screening examination. McNabb (2008) pointed out that descriptive studies, "Provide a description of an event or define a set of attitudes, opinions, or behaviors that are observed or measured at a given time and environment" (p. 97). Participants in the polygraph-treatment group were employees who worked in the intelligence field and were subjected to a polygraph screening examination as part of their work. Participants in the no polygraph-treatment group were individuals who have never experienced a polygraph screening or the experience was more than a year prior to the distribution of the survey.

The method of data collection was a survey. Data on the surveys were collected through a 5-point Likert-scale. A Likert scale is useful for data collection where I essentially

collected ordinal data, but needed to interpret them as though the data were interval or ratio level data. The scale's summative nature allows the individual perception of deterrent effects to be quantitatively displayed and compared to another group, and has been successfully used in past research on perceptions of deterrence (e.g., Nagin & Pogarsky, 2003).

The use of the Likert-scale format was needed in this study in order to determine self-reported behavior and attitude changes. The Likert-scale format allowed participants to express the likelihood of behavior and attitude change when exposed to a situation in which they are more likely to have violations of regulations detected through polygraph screening exams. Participants' perceptions were important in determining polygraph screening's deterrence effect against security compromises. Individuals with access to national security information and are employed in law enforcement and intelligence positions are briefed on a regular basis about their responsibilities in protecting national security and community standards, and the sanctions for failure to protect such information. Prior knowledge of potential sanctions increases deterrence since the rational actor can then consider risk versus gain (Nagin & Pogarsky, 2003). Nagin and Pogarsky (2003) noted that sanctions must be known in order for deterrence effects to be (observed) within the population. Likewise, there is an increased likelihood of deterring negative actions when sanctions exist. Most polygraph screening examinees are aware of restrictions placed on their access to sensitive information prior to their polygraph examination

Researchers have found that increasing the certainty of detection of undesirable behaviors can have a deterrent effect on individuals engaging in those behaviors (e.g., Nagin & Pepper, 2012; Nagin & Pogarsky, 2001; Nagin & Pogarsky, 2003; Paternoster et al., 1983a). These researchers used a self-report method in their studies and noted the necessity of anonymity in exchange for truthfulness when assessing potential negative behaviors and attitudes, such as willingness to commit a crime in both the presence and absence of punishment and authority figures (Nagin & Pepper, 2012; Nagin & Pogarsky, 2003; Nagin & Pogarsky, 2001; Paternoster et al., 1983a). Nagin and Pogarsky (2003) noted that summative scales or perceptual surveys allow participants to better express their concern for sanction of risks prior to offending.

Participants. The sample consisted of N = 326 volunteer participants, all of whom were U.S. citizens or legal resident aliens. Demographics were not collected due to a guarantee of anonymity. Originally, N = 372 individuals started the online survey, with 326 total completing the survey. There were 174 participants reported in the no polygraph-treatment group, and 152 reported in the polygraph-treatment group. The completion rate for both surveys was 88%.

Procedure. For the polygraph-treatment group, I recruited individuals who had completed a polygraph screening examination within the previous year. I gave a hard copy consent form with the link to the survey. The consent form outlined participants' anonymity in the study, as there would be no way to identify who completed the survey (see survey). Additionally, the consent form outlined that no compensation was offered for voluntary participation. For the no polygraph-treatment group, I recruited participants who did not require a polygraph screening examination as part of their job requirement or individuals who did not complete a polygraph screening within more than a year prior to the distribution of the survey. Individuals under 18 years of age and those not legal US residents or citizens were excluded from participating in the study.

All subjects were provided a consent form with the survey link. The consent form was also available on Survey Monkey. Implied consent was used; therefore, the study replied on implicit endorsement rather than signed endorsement as participants were informed on the consent form that completing the web link survey indicated their voluntary consent to take part in the study (see survey). The Survey Monkey account was set to ensure complete anonymity so that I could not identify individuals based on their responses. In order to ensure anonymity, no demographic information was collected.

Instrumentation. The instrumentation for this study was a 15-minute researcher developed questionnaire that was

used to obtain the perceptions of participants about the perceived deterrence effect related to the use of polygraph screenings (see survey). Researchers have used similar types of perception surveys in their investigation on deterrence (e.g., Nagin & Paternoster, 1991; Nagin & Pogarsky, 2001). The questionnaire was divided into two distinctly different sections. The first section identified the participant's group (polygraph-treatment or no polygraph-treatment), and included the informed consent information. No demographic or identifying data were collected except for participants' polygraph screening experiences and whether or not their job required a polygraph screening. The second section of the survey contained the scaled questions along with definitions, which ensured a degree of consistency for certain terms used in the questions. A 5-point Likert-scale format was used, ranging from 5 (strongly agree) to 1 (strongly disagree). Three items were reverse scored and 4 questions were included to detect answering bias in question responses and were not be evaluated in the final factor analysis. The questions were developed to determine a participant's self-reported likelihood of behavior and attitude change and perceptions of polygraph screening's deterrence effects. Some words in the survey were specific to national defense; therefore, I wrote definitions that would clarify how the terminology would apply to both the polygraph-treatment and no polygraph-treatment groups. In an effort to prevent confusion on word use, review of the definitions was mandatory prior to proceeding to the survey.

Variables. The operational variable was deterrence effect by means of self-reported perceptions of sanction risk to prior unlawful behavior or continuing acceptable behavior. The variable had two factors from which the questions on the questionnaire were derived: (a) admittance in a change of behavior and attitude and (b) belief of the effects of a change in the workplace security because of the use of the polygraph screening to ensure compliance. The creation of the questionnaire relied on the development of both factors once the factor analysis was completed.

The overall deterrence effect was determined by t-test evaluations of the factors that resulted from the exploratory factor analysis, the results of the combination of various survey questions that best answered the research questions, and comparison of both groups with all questions evaluated using a t-test with alpha set at .05. The scores were calculated by adding the sums of the answers from the Likert scale. Higher scores indicated an increased support for uses of the polygraph screening examination and self-reported change in behavior and attitude, which enhanced support of polygraph screening use.

Data Analysis Plan

Factor analysis. A factor analysis was conducted among the 30 polygraph questions. A Principal Component Analysis (PCA) was used. The PCA can be used to discover subsets of questionnaire questions that correlate with one another but are independent of another subset of correlated questions (Tabachnick & Fidell, 2012). It was assumed that three factors would be produced: (a) adherence to security regulations, (b) admittance to change of behavior and attitude if a polygraph screening examination is randomly required, and (c) belief that a polygraph screening is an effective deterrent against security compromises. The factors were assumed to have no correlation with each other; thus, an orthogonal rotation was used in the loading matrix (Tabachnick & Fidell, 2012). Items were considered strong loaders at .50 or better (Costello & Osborne, 2005).

The number of factors extracted from the PCA were determined by examining eigenvalues and the scree test. The number of factors used were those that have eigenvalues greater than 1.00 (Tabachnick & Fidell, 2012). In addition, the scree plot obtained was assessed for the slope of the decreasing eigenvalues. In addition, the Kaiser rule of eigenvalues greater than .70 for the communalities was assessed (Mertler & Vannatta, 2010).

G*Power 3.1.7 was used to assess the required sample size for an independent sample t-test. Using a medium effect size (Cohen's d = 0.50), a generally accepted power of .80 is recommended when doing a t-test for means (Sawyer, 1982); thus, a power level of 0.8 was used, and I used an alpha level of .05. For exploratory factor analysis in developing sur-

veys, Field (2009) recommended at least 300 samples. Thus, the sample size (N = 326) for the current study was found to be adequate.

To conduct the principal components analysis, the assumptions of sample size, normality, and absence of outliers were assessed. Univariate normality among the items is also important for the analysis to run properly. Univariate normality was assessed using skew. A z-score derived from skew and its standard error was used to assess for normality. For all z-scores greater than ±1.96, the variable was significantly skewed and considered for removal from the PCA (Tabachnick & Fidell, 2012). Outliers were assessed for, defined as values greater than 3.29 standard deviations from the mean.

Once the PCA was conducted and factors were determined, a Cronbach's alpha reliability test was conducted. George and Mallery's (2010) guidelines for reliability were used, where reliability greater than .90 is excellent, .80 is good, .70 is acceptable, .60 is questionable, and less than .60 is unacceptable. Once good reliability was found for all factors, the summation of the factors was done to create the factor scores.

Research Questions and Hypotheses

The research design in this study was driven by the following questions, each producing a respective null and alternative hypothesis:

Research Question 1. To what extent are there differences in the likelihood to adhere more closely to security regulations if a polygraph screening is required as a condition of employment by group (no polygraph-treatment vs. polygraph-treatment)?

H01: There will be no difference in the likelihood to adhere more closely to security regulations if a polygraph screening is required as a condition of employment by group (no polygraph-treatment vs. polygraph-treatment).

Ha1: There will be differences in the likelihood to adhere more closely to security regulations if a polygraph screening is required as a condition of employment by group (no polygraph-treatment vs. polygraph-treatment).

Research Question 2. To what extent are there differences in the changing of behavior and attitude if a polygraph screening can be randomly administered at work by group (no polygraph-treatment vs. polygraph-treatment)?

H02: There will be no differences in the changing of behavior and attitude if a polygraph screening can be randomly administered at work by group (no polygraph-treatment vs. polygraph-treatment).

Ha2: There will be differences in the changing of behavior and attitude if a polygraph screening can be randomly administered at work by group (no polygraph-treatment vs. polygraph-treatment).

Research Question 3. To what extent are there differences in the belief that a polygraph screening is an effective deterrent against security compromises by group (no polygraph-treatment vs. polygraph-treatment)?

H03: There will be no differences in the belief that a polygraph screening is an effective deterrent against security compromises by group (no polygraph-treatment vs. polygraph-treatment).

Ha3: There will be differences in the belief that a polygraph screening is an effective deterrent against security compromises by group (no polygraph-treatment vs. polygraph-treatment).

Results

Pilot study. The purpose of the pilot study was to determine the reliability of the questions on the survey, and the feasibility of implementing the data collection methodology. The methodology of collecting surveys was found to be sufficient for expanded use.

Descriptive Statistics

Originally, N = 372 participants started the online survey and N = 326 individuals completed the survey. There were 152 participants in the polygraph screening-treatment group and 174 participants in the no polygraph-treatment group. Thus, the completion rate for the surveys once a participant had

Table 1. Frequencies and Percentages for Nominal Variables

Frequencies and Percentages for Nominal Variables

Variables	n	%
Taken Screening polygraph in the Last Year		
No	174	53
Yes	152	47

Note. Due to rounding error, percentages may not add up to 100.

started was 88%. Frequencies and percentages for nominal variables are presented in Table 1. Demographics were not collected due to a guarantee of anonymity and demographics could have been used to identify likely volunteers.

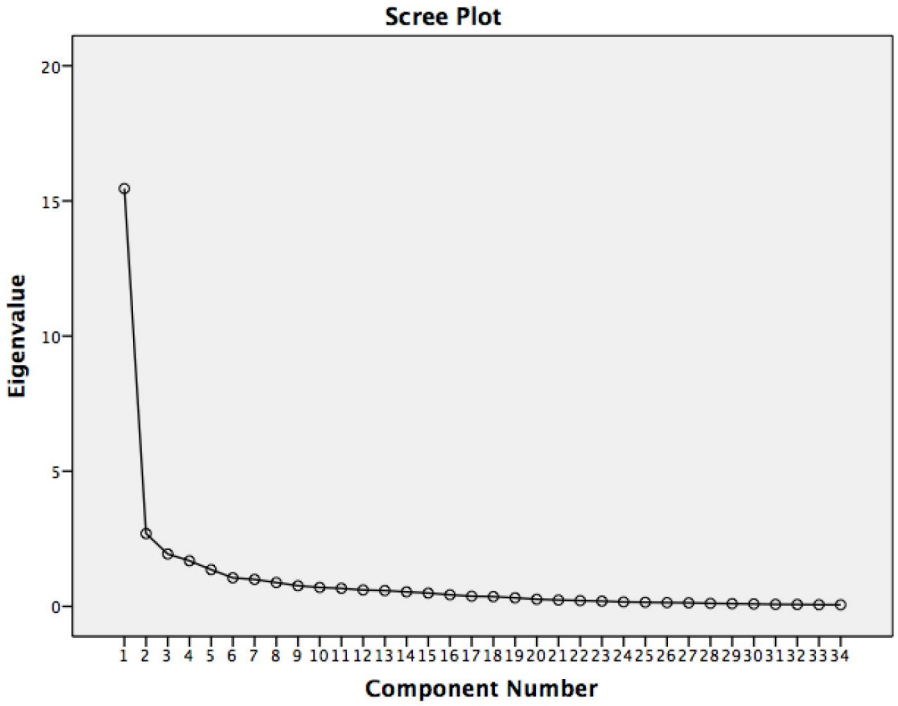
Factor Analysis

To assist in dimension reduction, I conducted a Principal Component Analysis (PCA) on the 34 survey items. A PCA creates linear combinations of variables without assuming an underlying structure of data, and is commonly used when sample sizes are large, the variables are highly correlated, and the goal is to reduce the number of variables (Suhr, 2005).

I assumed it would produce three (adherence to security regulations; admittance to change of behavior and attitude if a polygraph screening examination is randomly required; and belief that a polygraph screening is an effective deterrent against security compromises). It was also presumed that the factors would not be correlated. Therefore, I used an orthogonal rotation in the loading matrix (Tabachnick & Fidell, 2012). However, the results on the initial PCA indicated a total of six components, similar in nature to the pilot survey. Upon further examination, the factor correlation matrix indicated that most factors were correlated at .32 or above. Based on guidelines provided by Tabachnick and Fidell (2012), it is suggested any factors above .32 use oblique rotation methods. Therefore, the PCA was conducted again, where the researcher implemented a manual constraint of three factors, and then used direct oblimin rotation.

The first three components had eigenvalues greater than one and cumulatively explained 59% of the variance. The scree plot in Figure 1 shows that the first principal component accounts for the majority of the variance in the items.

Figure 1. Scree plot for factor loadings.



The first factor consisted of 11 items, the second factor consisted of four items, and the third factor consisted of 12 items. The results of the PCA can be seen in Table 2. The questions comprising the components are in Table 3.

Table 2. Eigenvalues of the Three Principal Components for Perceptions of Polygraph screening examinations

Eigenvalues of the Three Principal Components for Perceptions of Polygraph screening examinations

Principal Component	Eigenvalue	% of Variance	Cumulative % of Variance
Comp. 1	15.46	45.46	45.46
Comp. 2	2.70	7.93	53.39
Comp. 3	1.94	5.70	59.09

Table 3. Items in Factors Produced by PCA for Polygraph Examinations Perceptions

Items in Factors Produced by PCA for Polygraph Examinations Perceptions
Factor 1
RANDOM polygraph exams can help prevent espionage.
RANDOM polygraph examinations can help prevent leaks of classified information.
RANDOM polygraph exams can help prevent deliberate security compromises.
RANDOM polygraph exams can help prevent deliberate security compromises.
RANDOM polygraph exams can enhance workplace security.
A RANDOM polygraph exam can help detect deliberate security compromises.
Those subjected to RANDOM polygraph exams adhere more closely to the security regulations.
As part of a security program, personnel should be subjected to a RANDOM polygraph exam.
People with a high level security clearance should be subjected to a RANDOM polygraph exam.
More frequent polygraph exams can enhance the security of the Department of Defense.
I am willing to take a RANDOM polygraph exam as part of a security program.
Factor 2
I would adhere more closely to security regulations if I were subjected to a MANDATORY polygraph exam.
I adhere more closely to security regulation because I am subjected to a MANDATORY polygraph exam on security regulations.
I adhere more closely to security regulations because I am subjected to a RANDOM polygraph exam on security regulations.
I would adhere more closely to security regulations if I were subjected to a RANDOM polygraph exam.
Factor 3
I am willing to take a MANDATORY polygraph exam in order to enhance a security program.
People with a high level security clearance should be subjected to a MANDATORY polygraph exam.
As part of a security program, personnel should be subjected to a MANDATORY polygraph exam.
A MANDATORY polygraph exam can help detect deliberate security compromises.
MANDATORY polygraph exams can help prevent espionage.
MANDATORY polygraph exams can help prevent deliberate security compromises.
MANDATORY polygraph exams can enhance workplace security.
People with a high level security clearance should be given a polygraph exam.
Polygraph exams are a necessary part of a security program.
The results of a polygraph should not be used when making a security decision. (Reverse scored)
I would commit a security violation even if I was subjected to a polygraph exam. (Reverse scored)
Information on RANDOM polygraph examinations should be excluded from MANDATORY Threat Awareness briefings. (Reverse scored)

I examined the factors with regards to the research questions. It indicated that Factor 2 assessed adherence more closely to security regulations; thus, it was appropriate to address Research Question 1. This factor contained four items which were worded in a way that they would be suitable for each condition. Therefore, responses that were applicable for participants given categorization were used to create a composite score of two variables (security adherence due to random polygraphs and security adherence due to mandatory polygraphs).

Because the other factors produced by the PCA did not directly assess the remaining research questions, I created new composite scores. A composite score for admittance to change of behavior and attitude if a polygraph test is randomly required (Research Question 2) was created from the mean of seven items, and belief that a polygraph is an effective deterrent against security compromises (Research Question 3) was created from the mean of seven items. These composites, and the items contained in each, are presented in Table 4.

Table 4. Items in Composite Score for Perceptions of Screening polygraph examination

Items in Composite Score for Perceptions of Screening polygraph examination

Adherence to Security Regulations

I [would] adhere more closely to security regulations because I am [if I were] subjected to a mandatory polygraph exam.

I [would] adhere more closely to security regulations because I am [if I were] subjected to a random polygraph exam.

Admittance of Behavior and Attitude Change

Those subjected to random polygraph exams adhere more closely to the security regulations.

As part of a security program, personnel should be subjected to a random polygraph exam.

People with a high level security clearance should be subjected to a random polygraph exam.

More frequent polygraph exams can enhance the security of the department of defense.

I am willing to take a random polygraph exam as part of a security program.

People with a high level security clearance should be given a polygraph exam.

Polygraph exams are a necessary part of a security program.

Perceptions of Polygraph Efficacy

Random polygraph exams can help prevent espionage.

Random polygraph exams can help prevent leaks of classified information.

Random polygraph exams can help prevent deliberate security compromises.

Random polygraph exams can enhance workplace security.

Mandatory polygraph exams can help detect deliberate security compromises.

Mandatory polygraph exams can help prevent espionage.

Mandatory polygraph exams can enhance workplace security.

To ensure that each of these composite scores had good internal consistency, I used a Cronbach's alpha analysis for reliability. I used George and Mallery's (2010) guidelines for reliability where reliability greater than .90 is excellent and greater than .80 is good. I did not use any lower scores for reliability. The composite score for adherence to security regulations had excellent reliability (α= .92). The composite score for admittance to change

of behavior and attitude likewise had excellent reliability (α= .90), and the composite score for belief that a polygraph is an effective deterrent had excellent reliability (α= .92). The means, standard deviations, and reliability for composite scores are presented in Table 5.

Table 5. Means, Standard Deviations, and Reliability for Composite Scores

Means, Standard Deviations, and Reliability for Composite Scores

Variable	M	SD	α	No. of items
Adherence to Security Regulations	3.29	1.17	.92	2
Admittance of Change of Behavior and attitude	3.90	0.79	.90	7
Effective Deterrent Against Security Compromises	3.76	0.81	.92	7

Research Question 1. To what extent are there differences in the likelihood to adhere more closely to security regulations if a polygraph is required as a condition of employment by group (no polygraph-treatment vs. polygraph-treatment)?

To examine research question 1, I conducted an independent sample t-test to assess if there were differences in the likelihood to adhere more closely to security regulations if a polygraph is required as a condition of employment by group (taken polygraph in past year: yes vs. no). The independent sample *t*-test is the appropriate analysis to conduct when the goal is to assess for statistical differences in a continuous dependent variable by a dichotomous independent variable (Pallant, 2010). The composite score for adherence to security regulations was the continuous dependent variable and group (taken polygraph in past year: yes vs. no) was the independent variable. An alpha level of .05 was used for the test.

Prior to analysis, I assessed the assumption of normality with a Shapiro-Wilk test. The result of the test was significant, (p < .001), indicating a violation of the assumption of normality. However, Howell (2012) suggests that the *t*-test is robust despite violations of normality. The assumption of equality of variance was assessed using Levene's test. The result of the test was not significant, (p = .470), indicating the assumption of equality of variance was met.

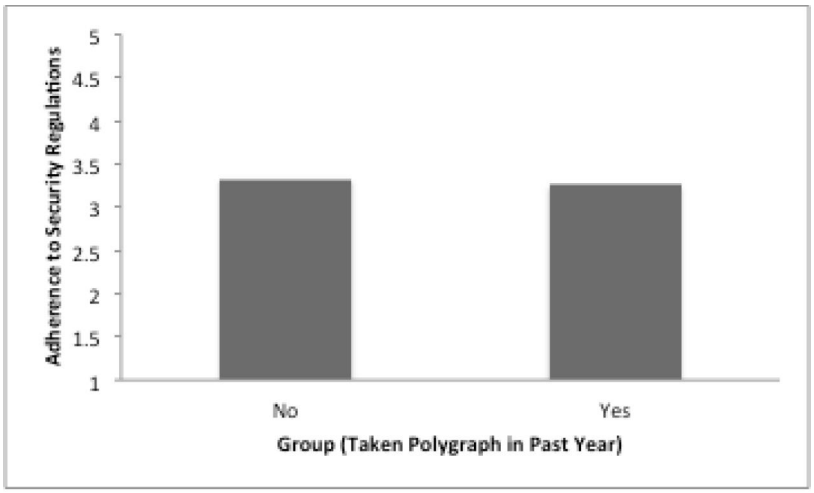
The results of the independent sample t-test were not significant, $t(324) = 0.55$, p = .584, suggesting that there was not a statistically significant difference in adherence to security regulations by group. Therefore, the null hypothesis was accepted and the alternative hypothesis was rejected. Results of the independent sample *t* -test are presented in Table 6. Figure 2 shows the average score for adherence to security regulations by group.

Table 6. Independent Sample t-Test for Adherence to Security Regulations by Group

Independent Sample t-Test for Adherence to Security Regulations by Group

				No		Yes
Variable	*t*(324)	*p*	Cohen's *d*	M	SD	M
Adherence to security regulations	0.55	.584	0.06	3.33	1.18	3.26

Figure 2. Adherence more closely to security regulations by group (taken polygraph in past year)



Research Question 2. To what extent are there differences in the changing of behavior and attitude if a polygraph can be randomly administered at work by group (no polygraph-treatment vs. polygraph-treatment)?

To examine research question two, I conducted an independent sample *t* test to assess if there were differences in admittance to change of behavior and attitude if a polygraph test can be randomly administered by group (taken polygraph in the past year: yes vs. no). Prior to the analysis, I assessed the assumption of normality with a Shapiro-Wilk test. The result of the test was significant, $p < .001$, violating the assumption of normality. However, Howell (2012) suggests that the t test is robust despite violations of normality. The assumption of equality of variance was assessed using Levene's test. The result of the test was significant, $p = .007$, violating the assumption of equality of variance; therefore, the Welch t statistic, which does not assume equality of variance, was used (Stevens, 1999).

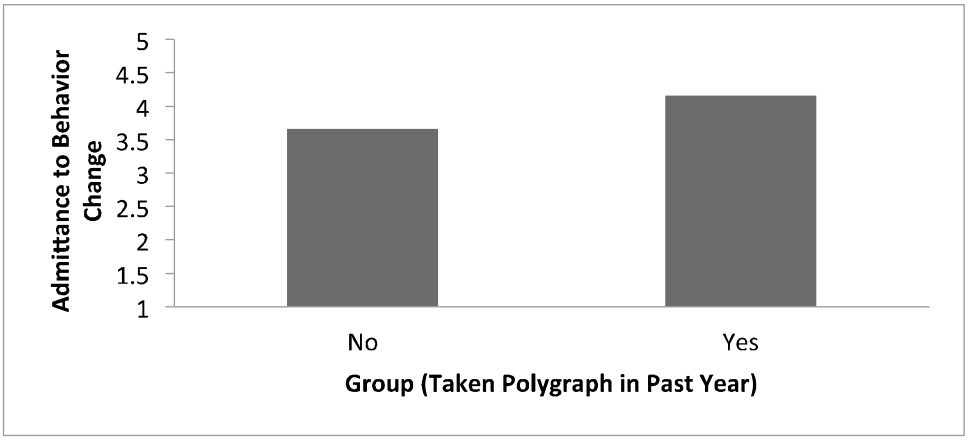
The results of the *t*-test were significant, $t(321) = -6.09$, $p < .001$, suggesting that there was a difference in admittance to change of behavior and attitude by group. Participants who had not taken a polygraph in the past year scored significantly lower than participants who had taken a polygraph in the past year. Based on Cohen's (1992) guidelines, the difference between the two groups was a medium effect size. The alternative hypothesis was accepted and the null hypothesis was rejected. Results of the t-test are presented in Table 7. Figure 3 shows the mean score for admittance to behavior and attitude change by group.

Table 7. Independent Sample *t*-Test for Admittance to Behavior and Attitude Change by Group (Taken Polygraph: Yes vs. No)

Independent Sample t-Test for Admittance to Behavior and Attitude Change by Group (Taken Polygraph: Yes vs. No)

				No		Yes
Variable	*t*(321)	*p*	Cohen's *d*	M	SD	M
Admittance to Behavior and attitude Change	-6.09	.001	0.67	3.66	0.83	4.16

Figure 3. Admittance of behavior and attitude change by group (taken polygraph in the past year.



Research Question 3. To what extent are there differences in the belief that a polygraph is an effective deterrent against security compromises by group (no polygraph-treatment vs. polygraph-treatment)?

I conducted an independent samples *t*-test to assess if there were differences in perceptions of polygraphs as effective deterrent to security compromises by group (taken polygraph in the past year: yes vs. no). Prior to analysis, I assessed the assumption of normality with a Shapiro-Wilk test. The result of the test was significant, (p < .001), violating the assumption of normality. However, Howell (2012) suggested that the t-test is robust despite violations of normality. The assumption of equality of variance was assessed using Levene's test. The result of the test was significant, p = .008, violating the assumption of equality of variance; therefore, the Welch *t* statistic, which does not assume equality of variance, was used (Stevens, 1999).

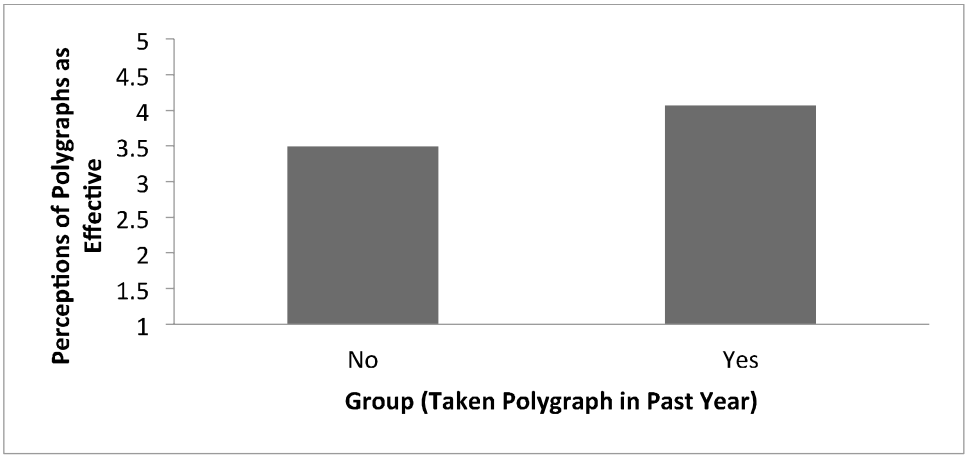
The results of the independent sample *t*-test were significant, $t(321) = -7.01$, $p < .001$, suggesting that there was a difference in perceptions of polygraphs efficacy in deterring and preventing security compromises by group. Participants who had not taken a polygraph in the past year scored significantly lower than participants who had taken a polygraph in the past year. Based on Cohen's (1992) guidelines, the difference between the two groups was a medium effect size. The alternative hypothesis was accepted and the null hypothesis was rejected. Results of the independent sample *t*-test are presented in Table 8. Figure 4 shows the mean score for perceptions of polygraphs efficacy in deterring and preventing security compromises by group.

Table 8. Independent Sample t-Test for Perceptions of Polygraphs Efficacy in Deterring/ Preventing Security Compromises by Group (Taken Polygraph: Yes vs. No)

Independent Sample t-Test for Perceptions of Polygraphs Efficacy in Deterring/Preventing Security Compromises by Group (Taken Polygraph: Yes vs. No)

Variable	(321)	p	Cohen's *d*	No M	No SD	Yes M
Perceptions of Polygraphs efficacy in deterring/preventing security compromises	-7.01	.001	0.77	3.49	0.83	4.07

Figure 4. Perceptions of polygraphs efficacy by group (taken polygraph in past year).



Summary

Two of the three research questions had statistically significant results, which indicated a deterrent effect with regards to utility of a polygraph with those who had recently taken a polygraph examination within the last year. Specifically, for research question 2, the results indicated that there is a significant difference in the changing of behavior and attitude if a polygraph can be randomly administered at work by group. For research question 3, results indicated that there is a significant difference in the belief that a polygraph is an effective deterrent against security compromises by group. On the other hand, for research question 1, findings indicated no significant difference in the likelihood to adhere more closely to security regulations if a polygraph is required as a condition of employment by group. However, when reviewing research question 1 factors, it is interesting to note that those who have not taken a polygraph within the past year and do not require a polygraph as part of their current job were more likely to display a supportive attitude towards increased adherence to security regulations.

Limitations

This study had several limitations. First, this study determined the perceived deterrent effect related to the use of polygraphs between two groups; therefore, the study remained distinct in its focus and limited in its scope. This study was not designed to answer questions related to the validity, reliability, or accuracy rates of polygraph examinations. And although these topics may be important to developing public policy, and to executives within the polygraph, administration, and psychology fields, they were not the focus of this research effort.

A second possible limitation of the study is the lack of stratification, as it included generalizing the results of a cluster sampling of 326 participants; all of whom were U.S. citizens or legal resident aliens located where I work. The 152 participants in the polygraph-treatment group had taken the polygraph screening examination. The 174 participants in the no polygraph-treatment group were non-intelligence U.S. citizens and legal resident aliens who lived and worked in proximity to my location, were students from a university participant pool, and individuals from social networking site LinkedIn. Thus, these employees' unique perceptions may not be generalizable to other populations.

Third, I used a 15-minute researcher developed survey, which has not been used in past studies. However, a pilot study was conducted on the survey prior to using it in the main study. In developing the questions in survey, I received assistance in developing questions from two agencies, the NCCA and the U.S. Army Intelligence Polygraph Program.

Therefore, to help establish validity of the survey, a member of the research department of the NCCA and a retired polygraph examiner and former employee of the CIA also reviewed the survey questions and provided additional comments to the proposed questions to ensure consistency with community standards. In addition, the survey was found to have very high reliability (Cronbach's alpha = >.90).

The fourth limitation to the study was selection or sampling bias. Individuals in the polygraph treatment group may expect preferential treatment from the polygraph examiner. However, participants were informed on the consent form that there were no connections between the study and their examination; therefore, they should not expect any preferential treatment as a result of their voluntary participation in the study. Thus, future research could exclude participants whereby examinees have been administered a polygraph test by the researcher. In addition, changes to the populations could be made in future research, where similar populations are compared. Specifically, two similar groups of participants who work only in the intelligence community, one group who required a polygraph screening examination within the last year compared to those who either had never experienced a polygraph screening or the experience was more than a year prior, could be compared and the results compared to the findings found in this study.

A fifth limitation was self-report or social desirability bias. Self-report or social desirability bias has to be considered as participants may want to be perceived positively so they may not respond honestly. In addition, there are problems inherent with self-report data as participants may not accurately or fully self-evaluate themselves. In order to address this bias, the Likert-scale format was used, which did not allow participants the freedom to include additional information that they may feel is important. In addition, it was assumed that participants answered honestly to the questions asked on the survey.

Discussion

The results of the factor analysis produced 3 factors but the research began with 3 questions prior to the factors being produced. An independent samples t-test was conducted to assess if there were differences in Factor 1 by group (taken polygraph screening in the past year: yes vs. no) (alpha = .95). Prior to analysis, the assumption of normality was assessed using a Shapiro-Wilk test. The result of the test was significant, ($p < .001$), violating the assumption of normality; however, the t-test is robust to violations of normality (Howell, 2012). The assumption of equality of variance was assessed using Levene's test. The result of the test was significant, ($p = .036$), violating the assumption of equality of variance; therefore, the Welch t-statistic, which does not assume equality of variance, was used (Stevens, 1999).

The results of the independent sample t-test were significant, $t(324) = -5.21$, $p < .001$, suggesting that there was a difference on Factor 1 by group. Participants who had not taken a polygraph screening in the past year scored significantly lower than participants who had taken a polygraph screening in the past year. According to Cohen (1988), the difference between the two groups was a medium effect size. Results of the independent sample t-test are presented in Table 9.

Table 9. Independent Sample t-Test for Factor 1 by Group (Taken Polygraph: Yes vs. No)

Independent Sample *t*-Test for Factor 1 by Group (Taken Polygraph: Yes vs. No)

				No		Yes	
Variable	*t*(324)	p	Cohen's d	M	SD	M	SD
Factor 1	-5.21	.001	0.58	3.60	0.83	4.05	0.71

Note: An independent samples *t*-test was conducted to assess if there were differences in Factor 3 group (taken polygraph screening in the past year: yes vs. no) (alpha = .89).

Prior to analysis, the assumption of normality was assessed using a Shapiro-Wilk test. The result of the test was significant, ($p < .001$), violating the assumption of normality; however, the t-test is robust to violations of normality (Howell, 2010). The assumption of equality of variance was assessed using Levene's test. The result of the test was significant, ($p < .001$), violating the assumption of equality of variance; therefore, the Welch t-statistic, which does not assume equality of variance, was used (Stevens, 1999).

The results of the independent sample t-test were significant, $t(313) = -9.04$, $p < .001$, suggesting that there was a difference in Factor 3 by group. Participants who had not taken a polygraph screening in the past year scored significantly lower than participants who had taken a polygraph screening in the past year. According to Cohen (1988), the difference between the two groups was a large effect size. Results of the independent sample t-test are presented in Table 10.

Table 10. Independent Sample t-Test for Factor 3 by Group (Taken Screening polygraph: Yes vs. No)

Independent Sample *t*-Test for Factor 3 by Group (Taken Screening polygraph: Yes vs. No)

				No		Yes	
Variable	*t*(313)	p	Cohen's d	M	SD	M	SD
Factor 3	-9.04	.001	0.99	3.52	0.70	4.13	0.51

Note: The effect size for factor 3 indicated a Cohen's d of .99, which indicated a large effect. While the research did not further define factor 3, the impact for policy should not be ignored.

Additionally, while the research may have provided some evidence of deterrence, this should only serve as an impetus to stimulate further research.

Survey

1. As part of a security program, personnel should be subjected to a RANDOM polygraph exam.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

2. As part of a security program, personnel should be subjected to a MANDATORY polygraph exam.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

3. RANDOM polygraph exams can help prevent espionage.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

4. MANDATORY polygraph exams can help prevent espionage.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

5. MANDATORY polygraph exams can help prevent deliberate security compromises.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

6. RANDOM polygraph exams can help prevent deliberate security compromises.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

7. I adhere more closely to security regulations because I am subjected to a RANDOM polygraph exam on security regulations.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

8. I adhere more closely to security regulation because I am subjected to a MANDATORY polygraph exam on security regulations.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

9. I would adhere more closely to security regulations if I were subjected to a RANDOM polygraph exam.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

10. I would adhere more closely to security regulations if I were subjected to a MANDATORY polygraph exam.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

11. Security will be enhanced if more people were subjected to a RANDOM polygraph exam

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

12. Security will be enhanced if more people were subjected to a MANDATORY polygraph exam

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

13. More frequent polygraph exams can enhance the security of the Department of Defense.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

14. Those subjected to MANDATORY polygraph exams adhere more closely to the security regulations.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

15. Those subjected to RANDOM polygraph exams adhere more closely to the security regulations.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

16. RANDOM polygraph exams can help prevent deliberate security compromises.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

17. MANDATORY polygraph exams can help prevent deliberate security compromises.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

18. Polygraph exams are a necessary part of a security program.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

19. A MANDATORY polygraph exam can help detect deliberate security compromises.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

20. A RANDOM polygraph exam can help detect deliberate security compromises.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

(question not evaluated, used to determine answering bias) -Taking a polygraph examination is an enjoyable experience.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

21. People with a high level security clearance should be given a polygraph exam.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

22. People with a high level security clearance should be subjected to a MANDATORY polygraph exam.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

23. People with a high level security clearance should be subjected to a RANDOM polygraph exam.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

24. MANDATORY polygraph exams can enhance workplace security.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

25. RANDOM polygraph exams can enhance workplace security.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

26. I would commit a security violation even if I was subjected to a polygraph exam.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

(question not evaluated, used to determine answering bias) -The results of a polygraph should not be used when making a security decision.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree

5	4	3	2	1

27. RANDOM polygraph examinations can help prevent leaks of classified information.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

28. MANDATORY polygraph examinations can help prevent leaks of classified information.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

(question not evaluated, used to determine answering bias) Information on RANDOM polygraph examinations should be excluded from MANDATORY Threat Awareness briefings.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

(question not evaluated, used to determine answering bias) A deliberate security compromise is OK.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

29. I am willing to take a RANDOM polygraph exam as part of a security program.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

30. I am willing to take a MANDATORY polygraph exam in order to enhance a security program.

Strongly agree	Agree	Neutral/No Opinion	Disagree	Strongly disagree
5	4	3	2	1

References

Bandura, A. (1971). Social Learning Theory. New York, NY: General Learning Corporation, General Learning Press. Retrieved from http://www.jku.at/org/content/e54521/e54528/e54529/e178059/Bandura_SocialLearningTheory_ger.pdf

Bandura, A. (1989). Social Cognitive Theory. In Annals of child development (Vol. 6, pp. 1–60). Greenwic h, CT: JAI Press. Retrieved from http://www.uky.edu/~eushe2/Bandura/Bandura1989ACD.pdf

Boston University School of Public Health. (2013). The Social Cognitive Theory. Retrieved November 28, 2015, from http://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/SB721-Models/SB721-Models5.html

Cohen, J. (1977). Statistical Power Analysis for the Behavioral Sciences. New York: Academic Press.

Costello, A., & Osborne, J. (2005). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. Practical Assessment, Research & Evaluation, 10(7), 1–9.

Field, A. (2009). Discovering statistics using SPSS (3rd ed.). London: Sage Publications.

George, D., & Mallery, P. (2010). SPSS for Windows step by step: a sample guide and reference (11th ed.). Boston, MA: Allyn and Bacon.

Howell, D. (2012). Statistical methods for psychology. Cengage Learning.

McNabb, D. E. (2008). Research methods in public administration and nonprofit

management: Quantitative and qualitative approaches (2nd ed.). Armonk, NY: M. E. Sharpe.

Mertler, C., & Vannatta, R. (2010). Advanced and Multivariate Statistical Methods: Practical Application and Interpretation (4th ed.). Los Angeles, CA: Pyrzak Publishing.

Nagin, D., & Pepper, J. (2012). Deterrence and the Death Penalty. Washington, DC: National Academies Press. Retrieved from http://www.nap.edu/catalog.php?record_id=13363

Nagin, D. S., & Paternoster, R. (1991). The Preventive Effects of the Perceived Risk of Arrest: Testing an Expanded Conception of Deterrence. Criminology, 29(4), 561–561.

Nagin, D. S., & Paternoster, R. (1994). Personal capital and social control: The deterrence implications of a theory of individual differences in criminal offending. Criminology, 32(4), 581–581.

Nagin, D. S., & Pogarsky, G. (2001). Integrating celerity, impulsivity, and extralegal sanction threats into a model of general deterrence: Theory and evidence. Criminology, 39(4), 865–892.

National Research Council. (2003). The Polygraph and Lie Detection. Washington, DC: The National Academies Press. Retrieved from http://www.nap.edu/openbook.php?record_id=10420

Pallant, J. (2010). SPSS Survival Manual (4th ed.). New York, NY: McGraw-Hill.

Paternoster, R., Saltzman, L., Waldo, G., & Chiricos, T. (1983). Estimating perceptual stability and deterrent effects: The role of perceived legal punishment in the inhibition of criminal

involvement. The Journal of Criminal Law & Criminology, 74(1), 270–297. http://doi.org/0091-4169/83/7401-270

Paternoster, R., & Simpson, S. (1996). Sanction Threats and Appeals to Morality: Testing a Rational Choice Model of Corporate Crime. Law & Society Review, 30(3), 549–583.

Sawyer, A. (1982). Statistical Power and Effect Size in Consumer Research. Association for Consumer Research, 9, 1–7.

Stevens, J. (1999). Intermediate statistics (2nd ed.). Mahwah, NJ: Routledge Academic.

Suhr, D. (2005). Principal component analysis vs. exploratory factor analysis. SUGI 30 Proceedings, 203–230.

Tabachnick, B., & Fidell, L. (2012). Using multivariate statistics (6th ed.). Boston, MA: Pearson.