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The Effect of Cognitive Load on Deception

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THE EFFECT OF COGNITIVE LOAD ON DECEPTION

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by

Terri D. Patterson

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To: Dean Kenneth Furton
College of Arts and Sciences

This dissertation, written by Terri D. Patterson, and entitled The Effect of Cognitive Load on Deception, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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Ronald P. Fisher, Major Professor

Date of Defense: October 2, 2009

The dissertation of Terri D. Patterson is approved.

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Dean Kenneth Furton
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DEDICATION

I dedicate this dissertation to my husband, Matthew, whose steadfast encouragement, understanding, and support made this work possible.

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I wish to thank the members of my committee for their prolonged dedication to this dissertation. Dr. Nadja Schreiber provided support in so many ways, offering everything from last minute laboratory assistance to much-needed words of encouragement. I owe a debt of gratitude to Dr. Janat Parker, who remained committed while transitioning into retirement. Dr. Lisa Stolzenberg brought vital criminal justice expertise to the committee.

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ABSTRACT OF THE DISSERTATION

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The current study applied classic cognitive capacity models to examine the effect of cognitive load on deception. The study also examined whether the manipulation of cognitive load would result in the magnification of differences between liars and truth-tellers. In the first study, 87 participants engaged in videotaped interviews while being either deceptive or truthful about a target event. Some participants engaged in a concurrent secondary task while being interviewed. Performance on the secondary task was measured. As expected, truth tellers performed better on secondary task items than liars as evidenced by higher accuracy rates. These results confirm the long held assumption that being deceptive is more cognitively demanding than being truthful.

In the second part of the study, the videotaped interviews of both liars and truth-tellers were shown to 69 observers. After watching the interviews, observers were asked to make a veracity judgment for each participant. Observers made more accurate veracity judgments when viewing participants who engaged in a concurrent secondary task than when viewing those who did not.

Observers also indicated that participants who engaged in a concurrent secondary task appeared to think harder than participants who did not.

This study provides evidence that engaging in deception is more cognitively demanding than telling the truth. As hypothesized, having participants engage in a concurrent secondary task led to the magnification of differences between liars and truth tellers. This magnification of differences led to more accurate veracity rates in a second group of observers. The implications for deception detection are discussed.

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

> “The failure of the [sic] police to realize that a man they were questioning was a human bomb and their attempts to explain how he made it through security onto a flight to Miami turned into finger-pointing and public defensiveness today.”
>
> The New York Times, December 27, 2001

The man referred to in the excerpt above is Richard Reid, otherwise known as the “shoe bomber.” Reid was accused and later found guilty of attempting to down an American Airlines flight bound for Miami from Paris in December, 2001. While the flight was airborne, passengers and crew saw Reid attempting to set fire to his sneakers, which were later found to contain explosive material. In the investigation that followed, it was discovered that Reid had earlier come to the attention of American Airlines screeners who referred the matter to the airport police. Police then conducted a brief interview of Reid before releasing him. He later boarded the Miami bound flight.

The law enforcement community is under more scrutiny than ever to perform in a proactive manner to prevent crime. While traditional law enforcement protocols focused heavily on reactive responsiveness and aggressive post-offense investigation to identify and prosecute perpetrators effectively, the priority today is preventing terrorism through proactive measures. This shift in strategy has led to an increase in the number of personnel assigned to federal law enforcement and intelligence agencies. Before these personnel can be hired, each must undergo an extensive background investigation as part of a rigorous security and suitability assessment. The polygraph examination is typically used by federal agencies to screen potential employees who will be working with sensitive information pertaining to national security. The polygraph is also used to conduct post-employment security screening (National Research Council, 2003). However, according to the Research Council, the polygraph examination may be susceptible to errors when used in proactive, security screening situations.

The current study reviewed traditional deception detection protocols and highlights their lack of effectiveness. A review and analysis of a second body of literature examining the effectiveness of an alternative approach to deception detection was undertaken. Finally, the merged classic cognitive capacity models and methodology with this new alternate approach to deception detection to show that telling a lie is more cognitively demanding than telling the truth. The goal is to extend this logic into a strategy whereby an interview technique can be introduced by investigators to magnify the differences between liars and truth tellers. The second portion of this study examined whether the strategic implementation of the intervention discriminates liars from truth tellers.

LITERATURE REVIEW

Arousal Based Protocols

Deception detection studies have traditionally mirrored the approach of the law enforcement community by studying arousal-based protocols. Arousal-based protocols center around two broad areas: physiological and behavioral cues. Central to these protocols is the assumption that when people engage in deception, there is a fear or concern that the deceit will be discovered. This concern raises arousal levels leading to a physiological or behavioral response that can then be measured by an observer.

A well-known method used by law enforcement to detect deceit is the polygraph examination. The polygraph examination is a commonly used arousal-based protocol that requires the use of sophisticated apparatus and a lengthy training period for examiners. The polygraph examination measures physiological responses. In a recent review of the scientific evidence on the polygraph examination, the National Research Council (hereinafter "The Council") (2003) examined the validity of the polygraph examination. The Council found that specific-incident polygraph tests, such as those used after a crime has been committed, can discriminate lying from truth-telling at rates above that expected from random chance. The Council cautioned however, that examinees trained in countermeasures may be able to effectively manipulate the outcome of the examination. The Council further advised that would-be terrorists have the motivation and resources to receive such training. Therefore, The Council recommended that other measures should be studied in addition to the polygraph examination (National Research Council, 2003).

The Council noted that there are no underlying theories on which the polygraph examination is based. Although deception is one factor that may cause a change in physiological responses, other factors may also lead to physiological changes that affect the polygraph examination. Unfortunately, these factors have not been examined empirically and no theoretical foundation has been established to explain why the physiological reaction seen on a failed polygraph examination is indicative of deceit rather than other states (National Research Council, 2003).

Aside from these shortcomings, there are additional problems with law enforcement relying solely on the polygraph examination for deception detection. It is impractical to utilize the polygraph examination as a mere screening tool. Even if an unlimited number of trained polygraph examiners were available to administer the exam, very few citizens would consent to such a lengthy examination without sufficient cause.

The reality is that the polygraph is a time-consuming examination and is therefore not an appropriate screening tool for deception in high-traffic areas.

Perhaps the most commonly used protocol for deception detection by law enforcement is the Behavioral Analysis Interview (BAI) (Inbau, Reid, Buckley, & Jayne, 2001). The BAI is an interview protocol with behavioral markers and is popular in large part because it does not stretch overburdened law enforcement resources. Unlike the polygraph and other measures of physiological responsiveness, it does not require expensive equipment. Furthermore, large numbers of investigative personnel can be trained at relatively little cost. The BAI is marketed as being an effective means by which law enforcement can not only identify behavioral cues to deception, but can actually elicit those cues through the use of the interview protocol. Problematic for the BAI is the vast body of deception literature challenging the assumption that all lies are accompanied by behavioral indicators of deceit (DePaulo, Lindsay, Malone, Muhlenbruck, Charlton, & Cooper, 2003; Ekman, O'Sullivan, Friesen, & Scherer, 1991; Vrij & Heaven, 1999; Vrij & Mann, 2001b).

Empirical research has called into question the efficacy of arousal-based approaches to deception detection like those described above. In general, researchers agree that a constellation of thoughts, feelings and behaviors may be experienced when one is lying (Burgoon & Buller, 1994; DePaulo et al., 2003; Ekman, 1992; Mann, Vrij, & Bull, 2002; Vrij, 1999; Vrij, 2000; Zuckerman, DePaulo, & Rosenthal, 1981). A variety of physiological disturbances have been observed in those being deceptive, such as speech errors, speech hesitations and increased intensity in voice (Ekman, Friesen, & Scherer, 1976; Ekman et al., 1991; Vrij, 2000). But most agree that these behaviors may simply be indicative of fear, guilt, nervousness or attempts to control behavior rather than deception (Ekman et al., 1976; Ekman & O'Sullivan, 1991; Gross, 1998; Richards & Gross, 1999; Vrij, 2000). This lack of discrimination seriously limits the effectiveness of any arousal-based approach to deception detection.

Additionally, when individuals are aware that the veracity of their statements is being evaluated, changes in behavior may occur (DePaulo et al., 2003; Ekman et al., 1991; Vrij, 1999; Vrij, Semin, & Bull, 1996). The attempt to control behaviors associated with deception, often referred to as impression management, requires that one control any signs of nervousness or guilt, while responding in a manner that appears to be unplanned (Buller & Burgoon, 1996; Burgoon & Buller, 1994). Many researchers have found that impression management may manifest in overt behaviors affecting body movements, speech patterns and facial expressions (Buller & Burgoon, 1996; Burgoon & Buller, 1994; DePaulo et al., 2003; Ekman et al., 1991; Vrij, 1999; Vrij, et al., 1996). Given these findings, it is clear that impression management can skew results obtained using arousal-based protocols.

Some of the problems with using existing arousal-based protocols to elicit cues to deception have been described above. Therefore, it is not surprising that efforts to detect deception using these protocols have met with disappointing results. In a review of laboratory studies, Vrij and Mann (2001) found the accuracy rate for laypersons who were attempting to detect deceit was 57%, not much better than random chance. They then examined studies that included professionals such as local, state and federal law enforcement officers and found that the accuracy rate was 55%, again, not much better than chance. The present review may demonstrate that individuals simply lack the knowledge that is necessary to make an accurate assessment of whether someone is being deceptive (Vrij, 1999). Others have found that individuals overwhelmingly believe that liars exhibit behaviors that indicate nervousness (Vrij et al., 1996). These "nervous" behaviors, however, include fidgeting, stuttering, avoiding eye contact, etc., all of which are likely to be controlled by a competent liar. In high-stakes situations, such as police interviews, truth-tellers sometimes demonstrate more nervous behaviors than liars (Vrij, Mann, & Fisher, 2006b), a finding that is counterintuitive to those engaging in deception detection.

Other studies have attempted to compare the beliefs of law enforcement officers and other professional "lie-catchers" with available empirical data regarding the cues to deception (Ekman & O'Sullivan, 1991; Ekman, O'Sullivan, & Frank, 1999; Stromwall & Granhag, 2003). In a unique survey that includes data from law enforcement officers, prosecutors and judges, Stromwall and Granhag (2003) found that legal professionals tend to hold stereotypic beliefs about verbal and non-verbal cues to deception that are not supported by empirical data. Particularly relevant to arousal-based interview protocols is the belief that liars exhibit increased gaze aversion and body movements. Research has not only failed to support these beliefs, but there is evidence of the opposite effect (Granhag & Stromwall, 2002).

These reviews of the deception detection literature confirm that the current arousal-based methods utilized by the law enforcement community may not be the most effective means by which to identify deceit (DePaulo et al., 2003; Ekman & O'Sullivan, 1991; Vrij, 2008; Vrij & Mann, 2006; Vrij, Mann, & Fisher, 2006a). Although the arousal-based approach to deception detection is by far the most commonly used method, the viability of alternatives to this protocol must be examined.

Deception and Cognitive Load

The current study proposes that an alternative to arousal-based protocols to deception detection is to examine evidence of cognitive load. Some studies have cited evidence of increased cognitive load in liars by examining behavioral differences between truth tellers and liars. These studies to date have been limited because they have not independently measured cognitive load in those who are being deceptive. A review of deception detection literature addressing cognitive load follows.

Experts in the area of deception detection have long argued that deception is accompanied by an increase in cognitive load. Although this argument has lacked a strong theoretical foundation, there are some logical assumptions that appear to support the notion. Experts in the study of deception detection offer several reasons to expect that an increase in cognitive demand accompanies deception (Vrij, Fisher, Mann, Leal, Milne, & Bull, 2007; Vrij, Fisher, Mann, & Leal, 2006). First, it is assumed that the formulation of the lie is a cognitively demanding task. Second, liars do not typically take their credibility for granted, while studies suggest that truth-tellers assume they will be believed (DePaolo et al., 2003). Third, liars are more likely than truth-tellers to monitor the reactions of others in order to assess the effectiveness of the lie. Fourth, the act of lying requires that the liar role-play and continually remind him/herself to sustain the lie. Fifth, trying to ensure that the truth is suppressed is a cognitively demanding task. And finally, since any deliberate, intentional act is more cognitively demanding than an automatic one, lying is more demanding than truth-telling.

Other researchers have suggested that deception leads to increased cognitive load due to additional self-monitoring that is presumed to accompany deception (Buller & Burgoon, 1996). This approach assumes that when a person engages in deception, he/she must monitor a wide range of physical and emotional changes, including formulation of the lie and controlling behaviors that may be indicative of deception, in order to be effective. Being deceptive is therefore more cognitively taxing than being truthful because it requires metacognitive processing of information. Providing a deceptive response requires that one generate a response, avoiding providing information that is inconsistent with the information already known about the incident, while committing to memory the details of the response for follow-up questions and responses (Granhag & Vrij, 2005). Remembering what has already been said in order to repeat the same story again and again places even more cognitive demands on the deceiver (Burgoon, Buller, & Guerrero, 1995).

All of these complex tasks must be performed by the individual in order to maintain the lie. The concept of increased cognitive load as a result of lying is crucial to the study of deception detection because of the general acceptance that for the most part, engaging in deceptive behavior is more cognitively demanding than engaging in non-deceptive behavior (Ekman & Friesen, 1971; Buller & Burgoon, 1996; Granhag & Vrij, 2005; Mann et al., 2002; Vrij & Mann, 2001a; Zuckerman et al, 1981).

Several deception detection studies have provided data suggesting there are behavioral indicators of increased cognitive load. For example, in an early study examining deception detection, Ekman and Friesen (1971) found that when people were asked to respond to a cognitively difficult task, excess body movement ceased while the individual generated a response. A separate body of research has also shown that increased cognitive load is evidenced by a decrease in eye blinking (Harrigan & O'Connell, 1996; Wallbott & Scherer, 1991). Because lying is presumed to be a cognitively difficult task, it is generally hypothesized that these and other behavioral indicators are also evident in individuals who are being deceptive.

In numerous studies, participants have reported that telling a lie is more cognitive demanding than telling the truth (Granhag & Stromwall, 2002; Stromwall, Hartwig, & Granhag, 2006; Vrij, Edward & Bull; 2001; Vrij & Mann, 2006; Vrij et al., 2006b; Vrij et al., 1996). These reports support the notion that lying requires more cognitive resources than truth-telling and that individuals are aware of increased cognitive demands that accompany deception.

In a recent study, Vrij and colleagues (2007a) manipulated task complexity based on the hypothesis that increased task complexity increases cognitive demand, leading to observable behavioral indicators. Participants either took part in a staged event or were given some information about the event and instructed to pretend they took part in the event. Participants were later interviewed and half were instructed to recall the event in reverse order. Results suggest that recalling an event in reverse order represents a complex cognitive task and thereby increases cognitive load. Specifically, more indicators of deceit were found in the reverse order condition than in the no-instruction condition. Behavioral indicators included both verbal and nonverbal cues, such as fewer auditory details, contextual embeddings and temporal details. They also included more cognitive operations, speech hesitations and errors and overall slower speech.

In the second phase of this experiment, police officers were shown samples of the participant interviews with instructions to make a judgment about whether the participant was being deceptive. Results indicated that identification of deceit was more accurate in reverse order participant interviews than in control interviews (Vrij et al., 2006; Vrij et al., 2007a).

In another experiment that mirrored the reverse order study, participants in the experimental condition were instructed to maintain eye contact with the interviewer while recalling the event (Vrij, 2008; Vrij et al., 2006; Vrij, Mann, Leal, & Fisher, 2007). Maintaining eye contact was hypothesized to increase demand on available cognitive resources, thereby leading to behavioral indicators of deceit. No instructions were given in the control condition. Results indicated that participants in the eye contact condition exhibited verbal indicators of increased cognitive load. These indicators included reporting fewer spatial and temporal details and recalling the event in chronological order.

Current trends in deception detection research involve novel approaches to deception detection. Recent studies have examined individual behavioral indicators of deception, such as eye blinks (Leal & Vrij, 2008; Leal, Vrij, Fisher, & Hooff, 2008). Other directions in cognitive-based deception detection studies include the introduction of interview strategies that have resulted in a magnification of differences between liars and truth-tellers, presumably due to increased cognitive load. Some of these strategies, such as reverse order questioning (Vrij, 2008; Vrij et al, 2007) and asking unanticipated questions (Vrij, Leal, Granhag, Mann, Fisher, Hillman, & Sperry, 2009), show great promise in offering varying options to law enforcement in the area of deception detection.

This body of research into a cognitive-based solution to deception detection also examines ways in which a baseline can be established in order to take into consideration individual differences in cognitive capacity and working memory (Leal et. al., 2008).

The research cited above generally assumes that when one generates a fabrication or lie, cognitive demands are greater than when one tells the truth. There is certainly enough evidence in the literature to expect that lying may lead to an increase in cognitive load. The current study proposes a theoretically-based means of measuring this increase in cognitive load. In order to determine whether lying leads to increased cognitive demand, this study will use classic cognitive capacity theory as a foundation.

Cognitive Capacity Theory and Deception Detection

Classic cognitive capacity theory assumes that everyone has a limited amount of cognitive resources at any given time. Kahneman (1973) set forth a comprehensive theory in which cognitive processing ability was described in terms of a fixed amount of capacity that was available for either a single or multiple tasks. An important component of all capacity models is that tasks compete for a limited amount of cognitive capacity. When a single task is being performed, all available resources can be applied to that task. When multiple tasks are performed, available resources must be shared among the tasks. Naturally, when this finite amount of capacity has to be shared among multiple tasks or task combinations, fewer resources are left for subsequent tasks and performance suffers. As such, performance on any one task should be impaired if the person is concurrently performing a second task, the divided attention effect. Task complexity is also a key determinant for the amount of cognitive capacity required to perform the task, with complex tasks requiring more cognitive resources than simple tasks.

In order to study cognitive processing using capacity models, researchers have traditionally examined performance on a secondary task as a function of processing demands, or cognitive load (Craik, 1978; Eysenck & Eysenck, 1979; Johnston, Greenberg, Fisher & Martin, 1970; Johnston, Griffith, & Wagstaff, 1972; Johnston & Heinz, 1978; Logan, 1979). The divided attention studies became the norm with the emergence of capacity models and what became known as the divided attention effect was well documented by researchers (Broadbent, 1958; Eysenck & Eysenck, 1979; Johnston et al., 1970; Johnston et al., 1972; Johnston & Heinz, 1978; Johnston & Heinz, 1979; Shulman & Fisher, 1972; Treisman, 1969).

The results of several studies indicate great promise for the emergence of a cognitive-based approach to deception detection (Vrij, 2008; Vrij, Mann, Kristen, & Fisher, 2007b). In these studies, interviewers were able to elicit both verbal and nonverbal indicators of cognitive load in participants. Additionally, those indicators led to improved deception detection accuracy among interview observers.

The current study applies Kahnman's classic cognitive capacity theory to improve deception detection by implementing a cognitive approach. The underlying premise for a cognitive-based approach to detecting deception follows the same logic. Since lying is purportedly more cognitively demanding than truth-telling, additional demands are placed on a limited amount of cognitive resources. With increased demand, available cognitive capacity is depleted, leading to poor performance, manifested as both verbal and non-verbal indicators. This theoretical underpinning offers a new approach to deception detection. If one could employ an interview technique that depletes the available mental resources of the interviewee, overt indicators of deception may be observed in the liar (Vrij, 2008; Vrij et al., 2006a; Vrij et al., in press a).

Current Methodology

Researchers have traditionally used performance on a secondary task to measure demands placed on cognitive capacity. The resulting divided-attention effect is well documented (Broadbent, 1958; Eysenck & Eysenck, 1979; Johnston, et al., 1970; Kahneman, 1973; Norman & Bobrow; 1975). These early cognitive capacity studies are the foundation of the current study. It is based on the same conceptual background introduced by Vrij, Fisher and colleagues, but incorporates a classic divided-attention methodology by utilizing a secondary task to manipulate cognitive load (Vrij et al., in press a; Vrij et al., 2006a).

EXPERIMENT 1

Method

Participants

Eighty-seven undergraduate students from introductory level psychology classes at Florida International University served as participants in exchange for course credit.

Design

The study used a 2 (secondary task: easy and difficult) x 2 (report status: truth and lie) + 1 (control group) between-subjects design. Dependent variables are reaction time on secondary test items, accuracy of secondary test items and metacognitive judgments. Reaction time and accuracy scores were obtained for each item of the secondary task. Metacognitive judgments were made for the secondary task and report status.

Materials

Secondary test items were presented to participants on a laptop computer. Instructions were presented on the computer screen. After the instructions were presented, participants responded to stimulus items by pressing the keys on the computer keyboard. The computer program then recorded and scored each stimulus item and documented reaction time for each item.

Procedure

Truth Report Condition

Participants were randomly placed in small groups of 2-4. Individuals in the truth report-status condition were instructed as follows:

> "Go with your fellow students to the University Bookstore. While in the Bookstore, do the following:
>
> 1) Identify the most popular "FIU" item sold recently. In order to do this, you must ask bookstore staff their opinion or knowledge of which item is the most popular (eg. T-shirt, sweatshirt, hat, snack items).
>
> 2) Locate a General Psychology textbook that was sold this semester. Identify the price and other information about the book.
>
> 3) Locate a newspaper and discuss today's headline with one another. Specifically, discuss your thoughts on the topic for 5 minutes.
>
> You have 20 minutes to complete all 3 tasks and you must work together as a group to complete each of the individual tasks. You must work together on the entire task."

Participants were given 20 minutes to complete the activity. Immediately after completing the activity, participants were interviewed individually. Each participant was given a different location to wait for the interview and was instructed not to discuss the task prior to the interview.

The interview included a free narrative followed by focused questions about the activity (see Attachment A). The interview took place in a private setting and was conducted by the researcher. The interview was conducted in an information-gathering style of questioning and was not adversarial in nature. The interviewer was blind to the experimental condition to which the participant was assigned. Each interview began with the interviewer telling the participant the following: "Tell me everything that happened when you and your fellow students went to the Bookstore." After the participant provided a narrative to the interviewer, a series of short answer questions followed (see Attachment A).

Participants were instructed to perform a computer-based secondary task concurrent with the interview. Each participant was given the following instructions prior to the interview:

> "In a few moments, you are going to be asked about the activity you engaged in when you went to the Bookstore. You are also going to be asked to engage in a computer task while you tell your story. You will be asked to engage in both activities (an interview and the computer task) at the same time. It is very important for you to focus primarily on the interview. Your role is to convince the interviewer that you are being completely honest in response to his/her questions. Convincing others is an important life skill, and is predictive of life success. So

try to be as convincing as you can when being interviewed. You should try to perform well on both tasks, but the interview is the most important one and you should focus on it primarily."

After receiving instructions regarding the interview, participants were placed in front of a computer and were asked to read the instructions on the screen as the interviewer read them aloud (see Attachment B). After reading the instructions on the computer screen, each participant was given an opportunity to practice the computer-based task. After the practice session, each participant was asked if he/she had any additional questions prior to starting the actual interview. The participant was then instructed to press any key on the computer screen to start the interview and the secondary, computer-based task. At the conclusion of the interview, each participant was asked to answer two metacognitive judgments on a 7-point Likert scale (see Attachment C). These judgments are related to the difficulty of the combined interview and secondary tasks and the believability of the interview.

Lie Report Condition

Participants in the lie report-status condition were placed in small groups of 2-4 and were provided the following instructions:

"Assume that you and some fellow students engaged in the task described below. You are going to be interviewed in a few minutes about your involvement in this task. Even though you did NOT engage in this exercise, your job is to convince the interviewer that you did. Convincing others is an important life skill, and is predictive of life success. So try to be as convincing as you can when being interviewed. Answer all questions in a manner to convince the interviewer that you actually engaged in the task. You obviously will not have the answers to the questions asked, so you must make up a convincing story to relay to the interviewer. Take a few minutes now to create your story. You must work alone to create the story."

Each participant was then provided with the details of the task provided to the truth report condition (those who went to the Bookstore) and was given 20 minutes to fabricate a lie about completing the activity. Participants were then interviewed individually about the activity.

Secondary Task

Each participant completed a computer-based secondary task while being interviewed. Participants were assigned to one of five task conditions. The study is a [(2x2)+1] design (Secondary Task complexity: easy or difficult and Secondary Task type: number identification or math expressions with a control condition: no secondary task).

There were 2 types of secondary task: number identification and math expressions. In the number identification task, participants were asked to press a computer key when a specified number (the number 7) appeared on the computer screen (easy condition) or if a combination of numbers (the numbers 769) appeared on the computer screen (difficult condition). In the math expression condition, participants were asked to press a computer key if a given math expression is true. For example, in the easy condition, the math expression 1+1=2 appeared on the screen, while in the difficult condition, the math expression 12+11=23 appeared on the screen. Pilot testing was conducted utilizing these secondary tasks and participants were asked to provide a rating of secondary task difficulty. In pilot testing, participants in the difficult conditions rated the secondary task as more difficult than participants in the easy conditions. The instructions for the computer tasks are provided (see Attachment B).

On each trial, a stimulus item appeared on the computer screen. The participant then provided a response to the stimulus item by pressing a computer key. When the participant provided the correct response, the next stimulus item appeared on the screen. When the participant provided an incorrect response, the computer did not present the next stimulus item. The computer continued to display the same stimulus item until the correct response was given. The next item appeared on the screen only after a correct response was provided by the participant.

In addition to the easy and difficult computer task conditions, 15 participants were interviewed without completing a concurrent computer task. The purpose of this small, "no secondary task" group was to create stimulus materials to be used in Experiment 2. These participants were assigned to a report status condition (lie or truth-telling).

Hypotheses

The following hypotheses were tested:

a. There will be a main effect of report status such that participants in the truth condition will obtain faster reaction time scores than participants in the lie condition.

b. There will be an interaction such that participants in the lie condition will obtain higher reaction time scores in the difficult secondary task condition than in the easy secondary task condition: this effect will be less pronounced in the truth condition.

c. Participants in the lie condition will report that the concurrent tasks were more difficult than participants in the truth condition.

Analysis of Data

An examination of data from Experiment 1 revealed outliers that were skewing the results. Specifically, these data included unusually high reaction time scores compared to other participants. Six participants who obtained a mean reaction time score over 40 seconds (sec) were eliminated from analysis.

Reaction Time

Cumulative reaction time was recorded to the nearest millisecond for each participant. Additionally, the number of items presented was recorded, allowing for an examination of reaction time at the overall task level and mean reaction time per individual item for each participant. An analysis of variance (ANOVA) was used to examine the mean reaction time per item for each participant.

Accuracy

Responses to each stimulus item were recorded as accurate or inaccurate utilizing a preprogrammed computer software package. The software package was programmed to advance to the next stimulus item only after an accurate response was provided. This was intended to minimize pressing a single key in response to each stimulus item. Items that were correct on the first attempt were scored as accurate. Items that were not correct on the first attempt were scored as inaccurate, regardless of how many attempts were made to obtain a correct response. For each participant, the proportion of accurate responses to total items was calculated. For example, if 30 items were presented and the participant provided accurate responses to 15 items on the first attempt, an accuracy score of .50 was obtained. The number of attempts made by the participant was not a factor in accuracy rate calculations. An ANOVA was used to examine the accuracy scores.

Metacognitive Judgments

Metacognitive judgments were obtained from each participant regarding the difficulty of answering the interviewer's questions, completing the computer task, and the believability of the interview. Each judgment was measured on a scale of 1 to 7. Judgments were then examined using an ANOVA.

Results

Results are reported for the following dependent variables: reaction time, accuracy and metacognitive judgments. All effects are reported at the .05 level of significance.

Manipulation Checks

The secondary task was found to effectively manipulate cognitive load. There was a main effect of secondary task on reaction time (F (1, 72) = 55.28, MSE =1742318.36 sec) such that mean reaction time was lower for easy (5.54 sec) than difficult (15.38 sec) items. There was also a main effect of secondary task on accuracy (F (1, 72)= 22.25, MSE=.36) such that accuracy was higher in the easy condition (.91) than in the difficult condition (.77). Finally, there was a main effect of difficulty level (F (1, 72=4.03, MSE=12.50) on metacognitive judgments such that participants in the difficult condition (4.86) reported that the computer task was more difficult than participants in the easy condition (3.97).

Reaction Time

A 2 (report status: truth vs. lie) x 2 (secondary task: easy vs. difficult) ANOVA was conducted on mean reaction time. Contrary to expectations, there was no main effect of report status (F (1, 72) = .016, MSE = 516.95 sec). No interactions were found between report status and difficulty level (F (1, 72) = 2.07, MSE=65256.79 sec). Descriptive statistics for reaction time scores are provided in Table 1.

Table 1. Mean reaction time scores in seconds (standard deviations)

Secondary Task	**Report Status**	**Time (sec)**
Easy	Truth	4.78 (2.36)
	Lie	6.48 (3.37)
	Total	5.54 (2.95)
Difficult	Truth	16.29 (8.01)
	Lie	14.25 (7.02)
	Total	15.38 (7.55)

Accuracy

A 2 (report status: truth vs. lie) x 2 (secondary task: easy vs. difficult) ANOVA was conducted on mean accuracy rate. There was a main effect of report status (*F* (1, 72) = 5.45, MSE=.09) such that accuracy was higher in the truth condition (.88) than in the lie condition (.81). There was no interaction between report status and difficulty level (*F* (1, 72)=.023, MSE=.00). Means and descriptive statistics for accuracy rates are provided in Table 2.

Table 2. Mean accuracy scores (standard deviations)

Secondary Task	**Report Status**	**Accuracy Score**
Easy	Truth	.94 (.05)
	Lie	.87 (.12)
	Total	.91 (.09)
Difficult	Truth	.80 (.14)
	Lie	.74 (.18)
	Total	.77 (.16)

Metacognitive Judgments

A 2 (report status: truth vs. lie) x 2 (secondary task: easy vs. difficult) ANOVA was conducted on each of the metacognitive judgments (see Table 3).

Metacognitive Judgment: Computer Task Difficulty

On the Difficulty of the Computer Task Judgment, there was a main effect of report status (F (1, 72=5.52, MSE=17.11) such that participants in the lie condition reported that the computer task was more difficult (4.94) than participants in the truth condition (3.95). There was no interaction between report status and difficulty level (F (1, 72=3.01, MSE=9.33).

Metacognitive Judgment: Interview Question Difficulty

Contrary to expectations, on the Interview Questions judgment, there were no main effects of report status (F (1, 72)=.58, MSE=1.39) or difficulty level (F (1, 72)=.01, MSE=.03). There was no interaction between report status and difficulty level (F (1, 72)=2.47, MSE=5.89).

Metacognitive Judgment: Believability of Participant

On the Believability Metacognitive Judgment, there was a main effect of report status (F (1, 72)=12.10, MSE=27.12) such that participants in the truth condition (5.21) reported that they were more believable during the interview than participants in the deception condition (4.0). There was no main effect of secondary task (F (1, 72)=1.51, MSE=3.38). There was no interaction between report status and secondary task (F (1, 72)=.23, MSE=.514).

Table 3. Metacognitive Judgment Scores (Standard Deviations)

Secondary Task	**Report Status**	**Metacognitive Judgments**		
		Computer	**Interview**	**Believability**
Easy	Truth	3.22 (1.80)	3.5 (1.79)	5.09 (1.48)
	Lie	4.89 (1.87)	4.33 (1.24)	3.72 (1.45)
	Total	3.98 (1.99)	3.87 (1.60)	4.47 (1.60)
Difficult	Truth	4.75 (1.77)	4.10 (1.48)	5.35 (1.35)
	Lie	5.00 (1.55)	3.81 (1.56)	4.31 (1.74)
	Total	4.86 (1.66)	3.97 (1.50)	4.89 (1.60)

EXPERIMENT 2

It was hypothesized based on cognitive capacity models that participants' performance would suffer under dual-task conditions compared to single-task conditions. This effect was believed to be more pronounced under complex dual-task conditions than simple dual-task conditions. Experiment 1 was designed to assess the effect of increased cognitive load, as manipulated by the introduction of a secondary task on both liars and truth-tellers. Theoretically, there should be a decline in performance leading to the availability of more cues to detect deception when participants are interviewed under dual-task conditions, particularly complex, dual-task conditions.

The goal of Experiment 2 was to examine whether this decline in performance would lead to greater discrimination between truths and lies by observers. Additionally, Experiment 2 was designed to examine whether interviewees would give the impression of thinking hard to determine whether there is a behavioral difference between interviews under dual-task and single-task conditions.

Method

Participants

Sixty-nine individuals served as participants for Experiment 2. Most of these participants were undergraduate students from introductory level psychology classes at Florida International University, serving in exchange for course credit (n=64) and undergraduate students from Brevard College, serving on a strictly voluntary basis with nothing in exchange for their participation (n=5).

Design

The study used a 3 (secondary task: none, easy and difficult) x 2 (report status: truth and lie) design. Secondary task was manipulated between subjects. Report status was manipulated within subjects. Dependent variables are accuracy and cognitive load judgments.

Materials

Videotaped interviews produced during Experiment 1 were used as stimulus materials. Videotaped interviews (“clips”) included a representative sample of interviews from Experiment 1. While each interview included a free narrative followed by focused questions, only the narrative portion of the interviews was shown to participants. None of the interviews lasted longer than 5 minutes.

Procedure

Participants were randomly placed in groups, ranging in size from five to 31 participants. The videotaped interviews were shown on a large screen in a classroom for the large groups of participants. For the small groups of participants, videotaped interviews were shown on a standard television screen (ranging in size from 32 inches to 47 inches). Participants were informed that they were going to be shown a selection of videotaped interviews of students who were either lying or telling the truth about taking part in a series of activities. Participants were then informed that truth tellers had actually taken part in the scenario as assigned by experimenters, whereas liars were simply informed about the activity without completing it. Participants were not told how many videotaped interviews would be shown or how many would be truths or lies. They were told that there would be fewer videotaped interviews than reflected on the questionnaire. This was to prevent participants from being biased by the number of comprehensive truth/lie judgments. The questionnaire reflected twelve interviews, while participants were shown only ten interview clips. Participants were told that after each videotaped interview clip, they would make a judgment about whether the person in the videotape was lying or telling the truth about taking part in the activity. After each participant documented his/her judgment on the questionnaire, the next videotaped interview was shown. For each videotaped interview, participants made a truth/lie judgment and a cognitive load judgment.

Nineteen participants saw 10 videotaped interviews of individuals providing a narrative about an activity. Thirty-one participants saw 10 videotaped interviews of individuals providing a narrative while executing an easy secondary task. Finally, 20 participants saw 10 videotaped interviews of individuals providing a narrative while executing a difficult secondary task. Of the 10 interviews seen by each participant, half the interviewees were lying and half were telling the truth. Participants in the No Secondary Task condition were provided the following instructions prior to watching the videotaped interviews:

> "The students that you are about to see have been asked to report in as much detail as they can, what happened."

Participants in the two secondary task conditions were provided the following instructions prior to watching the videotaped interviews:

> "The students that you are about to see have been asked to report in as much detail as they can, the activity in which they participated. Furthermore, they have been asked to explain everything that happened while executing a computer task at the same time."

After watching each of the videotaped interviews, participants were asked to answer the following questions: 1) Do you think that the student is telling the truth (dichotomous answer); and, 2) To what extent does the person in the video look as if he/she is having to think hard? These answers were given on a 7-point Likert scale ranging from (1) not at all to (7) extremely (see Attachment D).

Hypotheses

The following hypotheses were tested:

a. Participants who watch videotaped interviews conducted under dual-task conditions will be able to assess the interviewee's veracity (truth or lie) better than when they watch videotaped interviews conducted under single-task conditions.

b. Participants who watch videotaped interviews conducted under difficult dual-task conditions will be able to assess the suspect's veracity better than when they watch videotaped interviews conducted under easy dual-task conditions.

Analysis of Data

Veracity Accuracy

Each dichotomous veracity judgment was scored for accuracy. A final score was obtained for each participant by calculating the proportion of correct judgments. For example, a participant who provided 8 of 10 correct veracity judgments received a score of .80. An ANOVA was used to examine accuracy rates.

Cognitive Load Judgments

An average cognitive load score was obtained by averaging the total scores provided to liars and truth tellers. The cognitive load judgment was measured on a scale of 1 to 7. An ANOVA was used to examine cognitive load judgments.

Results

Results are reported for the following dependent variables: veracity accuracy and cognitive load judgments. All post hoc analyses were conducted using Scheffee's method. All effects are reported at the .05 level of significance.

Veracity Accuracy

Secondary task affected veracity accuracy such that participants scored higher in the easy (.57) and difficult (.62) secondary task conditions than in the no secondary task condition (.45) (F (2, 69) = 5.19, MSE = .16). Veracity scores were also examined for truth and lie items separately. There were no differences in the overall accuracy rate of truth and lie items (F (1, 67) = 3.36, MSE=.09). When observing interviews under single-task conditions, observers classified 43% of the truths and 46% of the lies accurately (the total accuracy rate was 45%). However, when observing interviews under easy divided-attention conditions, observers classified 55% of truths and 60% of lies accurately (the total accuracy rate was .57). When observing interviews under difficult divided-attention conditions, observers classified 58% of truths and 66% of lies accurately (the total accuracy rate was 62%). These means are shown in Table 4.

Table 4. Veracity Accuracy Mean Scores (Standard Deviations)

Secondary Task	**Veracity**	**Accuracy Scores**
None	Truth	.43 (.24)
	Lie	.46 (.23)
	Total	.44 (.22)
Easy	Truth	.55 (.20)
	Lie	.60 (.21)
	Total	.57 (.16)
Difficult	Truth	.58 (.17)
	Lie	.66 (.19)
	Total	.62 (.15)

Cognitive Load Judgment

A 3 (secondary task: none, easy and difficult) x 2 (veracity: truth and lie) ANOVA was conducted on mean cognitive load judgment scores. There was an interaction between veracity and secondary task (F (2, 67) = 14.96; MSE = 5.04), such that when observing individuals telling a lie, higher cognitive load scores were attributed to individuals engaging in difficult secondary task items than on easy or no secondary task items. On truth items, there was no difference in cognitive load scores across secondary task conditions. These results are shown in Table 5.

Table 5. Cognitive Load Judgment Mean Scores (standard deviations)

Secondary Task	**Veracity**	**Judgment Scores**
None	Truth	4.50 (.75)
	Lie	3.28 (.67)
	Total	3.89 (.51)
Easy	Truth	4.54 (.51)
	Lie	3.59 (.89)
	Total	4.06 (.63)
Difficult	Truth	4.10 (.62)
	Lie	4.21 (.75)
	Total	4.37 (.43)

DISCUSSION

Implications of Study

The current study adds to a growing body of literature that applies classic cognitive capacity models to deception detection. It incorporated a divided attention task to successfully manipulate cognitive load in liars and truth tellers. Experiment 1 of this study found that compared to truth telling, engaging in deception led to a decline in performance on a concurrent secondary task. This suggests that when asked to formulate and maintain a lie, fewer cognitive resources are available for secondary task performance than when telling the truth. In Experiment 1, participants were encouraged to focus primarily on the interview and were told that it was the more important task. It was therefore assumed that performance on the secondary task would suffer due to depleted cognitive capacity. Results support this assumption. With the introduction of a secondary task in Experiment 1, differences between liars and truth tellers were magnified, leading to more accurate veracity judgments by observers in Experiment 2. The current study is the first deception study to use a divided attention task to measure cognitive load in liars and truth tellers.

Kahneman's (1973) cognitive capacity model was applied to deception detection in this study through the introduction of a divided-attention technique. The model asserts that greater use of cognitive resources will manifest in degraded performance on a secondary task. Since lying is assumed to be more cognitively demanding than truth telling, subsequent secondary task performance was expected to suffer more in liars than truth tellers. As cited earlier, Vrij (2008) outlines conditions under which it is assumed that lying is more cognitively demanding than truth telling. These conditions can be evaluated by asking two questions. Is the liar motivated to be believed? And, is the truth easily accessible? A review of both of these questions was conducted in the context of the current study.

Participants were offered extra credit and advised that being convincing was an important component of the study. Additionally, instructions to the interviewees were specific with respect to the importance of being convincing. It was stressed that being convincing was not just important for this study, but was also indicative of overall life success. Finally, participants were videotaped during the interview, which is presumed to have raised participants' motivation to be convincing during the interview. Based on these factors, it is believed that participants were motivated to be convincing liars and truth tellers in this study.

Since the current study examined deception in a controlled, laboratory setting, there is little question that the truth was easily accessible to participants. Participants in the truth condition were instructed to engage in a series of actions and a confederate verified that the instructions were followed by participants. Soon after the task was completed, each participant was interviewed based on the actions he/she had completed minutes earlier. For this reason, it can be assumed that participants in this study had reasonable access to the truth during the interview.

Based on the evaluation described above, it is assumed that lying was more cognitively demanding than truth telling in the current study. This study merges two cognitively based approaches to deception detection that assume that lying is, in most cases, more cognitively demanding than truth telling. The first approach was introduced by Zuckerman and colleagues (1981) and attempts to measure cognitive demand as a result of being deceptive. These studies measure behavioral cues associated with cognitive load in order to differentiate liars from truth tellers. The second approach introduced by Vrij and his colleagues (2006) imposes cognitive demand via interview strategies in order to magnify the differences between liars and truth tellers. That approach employs interview strategies that increase cognitive demand, resulting in the presence of observable behavioral cues associated with deception.

The current study, unlike other cognitively based deception studies, is the first to use a divided attention task to both impose and measure cognitive load in liars and truth tellers. The use of a divided attention task is a well validated, theoretically-driven method of measuring cognitive demand in the classic cognitive capacity literature (Johnston et al., 1970; Johnston & Heinz, 1979; Kahneman, 1973; Shulman & Fisher, 1972). While other deception studies are grounded in cognitive theory, the specific dependent measures employed often lack empirical validation (Zuckerman et al., 1981; Vrij et al., 2008; etc.).

Without this foundation, it is unclear whether the differences observed are due to increased cognitive load, or other unknown variables. For example, it is unknown why some interview strategies, such as recalling an event in reverse order, increase behavioral cues that are not associated with cognitive load, such as apparent signs of nervousness (Vrij et al., 2008).

The incorporation of a divided attention task in Experiment 1 of the current study accomplished two goals: 1) it introduced a secondary task that increases cognitive load, thereby magnifying the differences between liars and truth tellers; and 2) it allowed for the measurement of cognitive load using an empirically valid technique. Experiment 2 was designed to determine whether the implementation of the divided attention task led to better veracity accuracy in observers. The introduction of this technique had the effect of magnifying the differences between liars and truth tellers on three different measures: performance on the secondary task, veracity judgments made by observers, and metacognitive judgments.

In the current study, truth tellers performed better than liars on secondary task performance (Experiment 1). These results suggest that the divided-attention task depleted cognitive resources in liars more so than truth tellers, leading to poor performance on a secondary task. This finding was confirmed in the use of two separate divided attention tasks, a number identification task and a mathematical expressions task. This convergence provides convincing evidence that lying was more cognitively demanding than truth telling in this study.

These results also provide support for the future use of divided-attention tasks to measure the effect of lying on cognitive load. Critics might argue that liars simply placed greater focus on the interview, neglecting the secondary task. However, if that argument were valid, liars should be as convincing as truth tellers based on later veracity judgments. Liars not only performed more poorly on secondary task performance in Experiment 1, but the veracity of liars was also judged slightly more accurately than the veracity of truth tellers in Experiment 2.

Other measures that showed that lying increased cognitive demands are metacognitive and cognitive load judgments. When asked to rate the difficulty of the secondary task, liars rated the task as more difficult than truth tellers. Liars also rated themselves less believable than truth tellers. And when observers in Experiment 2 rated liars and truth tellers from Experiment 1 on the degree to which they appeared to be thinking hard, truth tellers received similar scores across varying secondary task conditions (none, easy, and difficult), whereas the scores attributed to liars was higher in the difficult secondary task condition than in the none and easy conditions. These results suggest that cognitive load in liars increased with the introduction of a difficult divided-attention task difficulty.

Surprisingly, there was no interaction between report status and secondary task difficulty as measured by accuracy and reaction time scores. The failure to demonstrate a relationship between different degrees of secondary task and veracity can be explained by Kahneman’s (1973) theory regarding the allocation of cognitive resources and the depth of processing required in response to various demands. Kahneman’s theory suggests that when experiencing increased cognitive demands, individuals have significant latitude in allocating available resources to address those demands. In the present study, available cognitive resources may have been adequate to perform the interview and secondary task concurrently as long as the secondary task was not too difficult. Deeper cognitive processing is often needed as task difficulty increases, requiring more cognitive resources for successful completion of the task (Eysenck & Eysenck, 1979). So as secondary task difficulty increased, so did the depth of processing required for completion, leading to a shortage of capacity at the difficult task level. The easy secondary task may not have been demanding enough to force the reallocation of cognitive resources away from the interview.

Conversely, the difficult secondary task may have required a deeper level of processing, leading to the reallocation of cognitive resources away from the primary task (the interview) to the secondary task. This reallocation of resources led to a decline in performance on the primary task, increasing veracity accuracy of observers in Experiment 2. Had participants failed to shift available resources from the primary task (interview) to the secondary task, performance of liars in the difficult secondary task condition would have declined at a much greater rate than truth tellers, leading to the expected interaction.

There is another possible explanation for the failure to obtain expected results when examining the relationship between different secondary task conditions and interview performance. This explanation suggests that behavioral indicators of depleted cognitive load may be present in interview performance, but these indicators were not detected in the current study. The measure used to assess the magnification of differences in liars and truth tellers in Experiment 2 was veracity judgments. These judgments may not have been sensitive enough to detect graded differences in liars and truth tellers. Since this study did not employ a dependent measure that would examine and code specific behavioral indicators, it is not possible with available data to support or refute this explanation.

Results of Experiment 2 indicate that participants assigned to the easy secondary task condition were not statistically distinguishable from the difficult secondary task condition as measured by veracity judgments of observers. However, when observers in Experiment 2 were asked whether liars and truth tellers were thinking hard, liars were judged to be thinking harder in the difficult secondary task condition than in the no secondary and easy secondary task conditions. The results of these judgments provide more evidence that the introduction of a divided-attention task magnified the differences between liars and truth tellers.

In Experiment 2, observers made veracity judgments after viewing videotaped interviews of liars and truth-tellers from Experiment 1. This method of measuring the efficacy of imposed cognitive load is common to many deception studies. Most of these studies produce veracity accuracy rates at or near the chance level. These findings have held true even when professional law enforcement were the observers (Vrij, 1999; Vrij, Mann, Kristen, & Fisher, 2007b). The current study found that with the introduction of a divided-attention task that was difficult enough to deplete cognitive resources, later veracity accuracy rates were .62. Veracity accuracy rates were particularly impressive (.66) when observers were judging liars under difficult divided-attention task conditions.

These results are impressive in part because making veracity judgments in laboratory studies is extremely difficult for two reasons: individual differences in liars and truth tellers and the motivation of liars to avoid detection. Individual differences in liars and truth-tellers make it difficult to judge veracity accurately. There is no single behavioral cue that is displayed by everyone who lies. Rather, there are a constellation of behaviors that are often present in liars, such as speech hesitations, intensity in voice, speech volume, pupil dilation, etc. (Zuckerman et al., 1981; Ekman, Friesen and Scherer, 1976; Ekman et al., 1991; Vrij, 2000). Unfortunately, many of these cues are also readily displayed by truth-tellers, as well. Therefore, skeptics have questioned whether these behaviors are appropriate measures of deception (Gross, 1998; Richards & Gross, 1999). This makes judging veracity accurately based on interview performance alone very difficult. Liars who are highly motivated to be convincing during the interview make it even more difficult for observers to make accurate veracity judgments. When one considers the difficulty of making veracity judgments under the conditions utilized in this and other studies in the literature, the results of this study are quite impressive. Veracity accuracy judgments must also be considered in the context of their practical application. The implication of these veracity judgments will be discussed in more detail as they relate to practical application of the study.

Practical Implications

The law enforcement community has embraced the polygraph examination, an arousal-based protocol, for both investigative and security screening purposes. Although research has supported its use in case-specific investigations, showing accuracy rates that are well above chance, the same is not true for employment screening scenarios (National Research Council, 2003). This is a concern because the exclusive use of the polygraph for employment screening is widespread among agencies with expanded missions that include national security. The National Research Council (2003) recommended more research in the area of deception detection in order to overcome some of the vulnerabilities that arise from its exclusive use as a deception tool for pre- and post-employment security screening.

This study offers an additional method of detecting deception in employment screening scenarios. Although there continue to be questions regarding the empirical validity of the polygraph examination, it is not likely to be abandoned by law enforcement in the absence of alternative measures. This is especially true since security decisions following the polygraph examination are typically based on subsequent in-depth investigations and self-incriminating admissions, not on the results of the polygraph alone. As pointed out by the National Research Council (2003), however, a primary benefit to the polygraph examination is the widespread belief that it is highly accurate.

The present study offers a cognitive approach to deception detection to be used in conjunction with the polygraph examination, particularly in employment screening scenarios. Benefits of this approach are grounded in both theory and practicality. Unlike the arousal approach on which the polygraph examination is based, the cognitive approach recommended in this study is based on classic psychological theory and uses a technique that is well-validated. From a practical perspective, this approach can be easily incorporated in the field as a supplement to the traditional polygraph. Adding a cognitive measure to an existing detection protocol will likely be better accepted by a law enforcement community that is under great pressure to prevent future terrorist attacks.

Traditionally, law enforcement has not been receptive to dramatic paradigm shifts. It must be convinced of the utility of a new approach based on effective practical application before embracing it. This is likely more true than ever due to the ongoing threat to our national security by various terrorist groups. Combining the arousal-based polygraph examination with a cognitive-based secondary task measure will add to the data for consideration by polygraph examiners in practical settings. Adding a newly emerging technique to an established one, like the polygraph, will increase the likelihood of its use by law enforcement since it will be an enhancement rather than replacement of existing protocol. This will also allow for the study of the new cognitive technique in the field. Finally, this satisfies the recommendation of the National Research Council (2003) following the first comprehensive review of the effectiveness of the polygraph examination.

The polygraph examination takes place in a controlled, office environment. It would be minimally intrusive to incorporate the cognitive technique into that setting. The testing session for the polygraph typically includes rapport-building and a pre-polygraph interview (National Research Council, 2003). The cognitive technique, in the form of a secondary task like the one used in this study, should be incorporated during the pre-polygraph interview portion of the session. This is the logical placement of interview strategies that serve to magnify the differences between liars and truth tellers. If an examinee struggles under the burden of increased cognitive load, the result will likely be errors in response to the questions and increased behavioral disturbances in the liars versus truth tellers. These cues can then be used to drive additional questioning prior to administering the polygraph examination.

A benefit to the cognitive-based technique is the ability to objectively measure performance on the secondary task. In the current study, this performance was evaluated using accuracy rates and reaction times. The measure of cumulative reaction time scores rather than individual item scores in the current study may be seen as a limitation; however, it is an ecologically valid approach to collecting and analyzing reaction times. In an applied setting, it is highly unlikely that responses to individual items can be measured and analyzed in an interview setting. Using cumulative reaction times, accuracy rates, and behavioral indicators of increased cognitive load provides a global assessment of the examinee and does not interfere with the continuity of the interview setting.

Establishing baseline performance on a secondary task is challenging in an applied setting. The same will be true is using this type of performance metric. A possible solution is to utilize the rapport building phase of the pre-polygraph interview to establish a baseline for each examinee. This could be accomplished by subjecting the examinee to the secondary task while asking questions for which the answer is known by the examiner. For example, contact that the examiner had with the individual leading up to the actual examination is an area that can be used to establish a baseline. Information that has been well vetted during a pre-employment background investigation could also be used as the foundation for questions to establish a baseline of performance on the secondary task measure. For example, questioning the individual about where he or she lived during a specific time frame that has already been verified may be used to establish baseline performance. If researchers can validate a method of establishing individual baseline performance in the field, the “cognitive polygraph” has great promise in increasing the effectiveness of deception detection by law enforcement in employment screening scenarios. (National Research Council, 2003). An emerging threat discussed by national security experts is the possibility that law enforcement agencies will be infiltrated by an individual or individuals who pose a direct threat to our national security due to their desire to commit a terrorist attack on U.S. soil. These individuals may also be the most likely to produce false negatives on a polygraph examination. This is based on the presumption that these individuals would be highly motivated to receive employment with a law enforcement agency and likely have the resources to be trained in countermeasure techniques to "beat" the polygraph. These two factors increase the possibility of a false negative result.

Critics of a cognitive-based technique may argue that it is as susceptible to countermeasures. There are reasons to believe otherwise. The secondary task that the individual will complete is simply a cognitive test that is employed in order to make lying more difficult. Although the individual will know that the secondary task is part of the evaluation scenario, it will simply be described as a cognitive test, not a deception detection technique. Cognitive capacity theory suggests that additional cognitive tasks performed by the examinee will further deplete available cognitive resource. It is therefore argued that any sophisticated attempt to engage in countermeasures on this cognitive-based technique would likely lead to more behavioral indicators of increased cognitive load because it will require additional cognitive resources. Ironically, the attempted use of countermeasures may actually enhance the effectiveness of the cognitive-based technique introduced in this study.

Conclusion

The terrorist attacks of September 11, 2001, led to major shift in priority for law enforcement agencies in the United States (U.S.), particularly at the federal level. Before that time, the majority of law enforcement resources were devoted to the investigation and prosecution of specific criminal violations. The polygraph examination, although never without its critics, met those investigative needs of law enforcement effectively. In recent years, with the expanding role of law enforcement in the U.S. from predominantly investigative to intelligence-based prevention, the use of the polygraph examination in support of this mission has come under fire (National Research Council, 2003). As more federal resources continue to be directed at hiring law enforcement professionals in order to enhance our national security, additional methods to ensure effective employment security screening must be identified. Following its review of the polygraph examination in a post-September 11 environment, the National Research Council (2003) recommended that it be combined with other deception detection measures in order to minimize its limitations. This study offers a technique that is based on classic psychological theory and applied research principles that can be readily incorporated in these critical security screening situations.

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ATTACHMENT A

"In a few moments, you are going to be asked about the activity you engaged in when you went to the Bookstore. You are also going to be asked to engage in a computer task while you tell your story. You will be asked to engage in both activities (an interview and the computer task) at the same time. It is very important for you to focus primarily on the interview. Your role is to convince the interviewer that you are being completely honest in response to his/her questions. Convincing others is an important life skill, and is predictive of life success. So try to be as convincing as you can when being interviewed. You should try to perform well on both tasks, but the interview is the most important one and you should focus on it primarily."

NOTE: Place participant in front of computer screen with instructions. Read the instruction aloud with the participant and ask if he/she has questions. Instruct participant to press space bar when ready to begin. At the moment the space bar is pressed, give the participant the following instructions:

Narrative: Tell me everything that happened when you and your fellow students went to the Bookstore.

Ask the following questions after the narrative:

1) What is the most popular item sold in the bookstore?

2) Who in the bookstore gave you this information?

3) Who specifically spoke to the bookstore employee (you or a fellow student)?

4) Describe the bookstore employee.

5) What is the title of the General Psychology textbook you located?

6) Describe the cover of the textbook.

7) Tell me about the newspaper headline you read. What did you tell your fellow students about the headline (what was your opinion)?

8) What was your fellow students' opinion about the headline?

9) How many people were in the bookstore?

10) Describe what your fellow student was wearing when you went to the bookstore.

ATTACHMENT B

Instructions for Math Expressions (Easy and Difficult Conditions)

"You are about to be presented with some mathematical expressions. Press the letter Y is the expression is correct or the letter N if the expression is incorrect. Press any key to start the experiment."

Instructions for Number Identification (Easy)

"You are about to be presented with some numbers. Press the letter Y if the number 7 appears on the screen. Press the letter N if the number 7 does not appear. Press any key to start the experiment."

Instructions for Number Identification (Difficult)

"You are about to be presented with some numbers. Press the letter Y if the numbers 7, 6, AND 9 appear on the screen. Press the letter N if they do not appear. Press any key to start the experiment."

ATTACHMENT C

Participant Number:_____________________

Condition:_____________________

Date:_____________________

1) How difficult was it to answer the interviewer's questions?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

2) How difficult was the computer task?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

3) How confident are you that the interviewer believed you?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

ATTACHMENT D

Participant Number:____________________ Condition_____________

Date:___________________

1) Do you think that the student is telling the truth? Yes No

To what extent does the person in the video look as if he/she is having to think hard?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

2) Do you think that the student is telling the truth? Yes No

To what extent does the person in the video look as if he/she is having to think hard?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

3) Do you think that the student is telling the truth? Yes No

To what extent does the person in the video look as if he/she is having to think hard?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

4) Do you think that the student is telling the truth? Yes No

To what extent does the person in the video look as if he/she is having to think hard?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

5) Do you think that the student is telling the truth? Yes No

To what extent does the person in the video look as if he/she is having to think hard?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

6) Do you think that the student is telling the truth? Yes No

To what extent does the person in the video look as if he/she is having to think hard?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

7) Do you think that the student is telling the truth? Yes No

To what extent does the person in the video look as if he/she is having to think hard?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

8) Do you think that the student is telling the truth? Yes No

To what extent does the person in the video look as if he/she is having to think hard?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

9) Do you think that the student is telling the truth? Yes No

To what extent does the person in the video look as if he/she is having to think hard?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

10) Do you think that the student is telling the truth? Yes No

To what extent does the person in the video look as if he/she is having to think hard?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

11) Do you think that the student is telling the truth? Yes No

To what extent does the person in the video look as if he/she is having to think hard?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

12) Do you think that the student is telling the truth? Yes No

To what extent does the person in the video look as if he/she is having to think hard?

Not at all			Neutral			Extremely
1	2	3	4	5	6	7

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PUBLICATIONS AND PRESENTATIONS

Patterson, Terri & Fisher, Ronald (March, 2004). Consistency in Memory for Schema-typical & Schema-atypical Items. Poster presentation at the meeting of the American Psychology and Law Society.