# The Use of Physiological Measures to Detect Deception in Juveniles

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# Abstract

This study examined the effectiveness of a directed lie polygraph test in a juvenile population (9-15 years of age). Eighty-four juveniles were tested regarding their possible involvement in the tearing of a page from a book. A computer model for classifying adults as truthful or deceptive used physiological measures to determine the participant's involvement in the "crime." The adult-based model accurately identified 72.6% of the juveniles and was more accurate at identifying innocent than guilty participants. A separate classification model, derived from the juvenile data, correctly classified 73.8% of the juveniles. Although the accuracy rates were not as large as those reported for adults, there was a significant difference in the patterns of physiological responses for guilty and innocent juveniles. The modest accuracy rates with juveniles in the present study are discussed in relation to limitations in the design and the potential impact of the observed low reliability of the juveniles' physiological responses. Future directions in assessing the validity of the polygraph to detect deception in juveniles and the impact of cognitive developmental changes on detectability are discussed.

# Introduction

Crime rates among juveniles have declined since their peak in the mid-1990s, but a substantial number of juveniles continue to commit violent offences and many are being treated as adults by the justice system (OJJDP, 2003). Juvenile suspects in violent crimes place burdens on law enforcement and the legal system and create difficult problems for criminal investigation and prosecution. Methods and tactics used to investigate adult crimes may not be as effective or have not been tested in the investigation of juvenile crime. One such tool is the polygraph, which has been used by police and government agencies to assess the veracity of criminal suspects and by correction systems to evaluate parolees' compliance with the terms of their parole (Adang, 1995; Honts, 1994; Orne, Thackray, & Paskewitz, 1972). However, it has not been tested with juveniles

in a manor consistent with the use of the polygraph in the field.

A growing body of research on polygraph techniques (Honts, Raskin, & Kircher, 2006) has shown the polygraph to be a highly reliable and accurate method for detecting deception and verifying the truthfulness of subjects regarding specific acts or events. Decision accuracies in excess of 90% are commonly reported in the polygraph literature, which makes the polygraph a valued law enforcement tool in criminal investigations of adults. However, only a few studies have examined the use of the polygraph for assessing deception in juveniles under the age of 16 (Abrams, 1975; Bradley, Russell, & Li, 1996; Lieblich, 1971; Voronin, Konovalov, & Serikov, 1969). The results of these studies with juveniles are mixed. Some studies found age effects in detection (Abrams, 1975; Lieblich, 1971; Voronin et al., 1969), whereas others did not (Bradley et al., 1996).

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Voronin et al. (1969)used а card/number deception task with subjects from age six to adult and measured skin resistance (SR) to identify the memorized target. For the 6- to 7-year-olds, no targets were correctly identified, and for the 8- to 12year-olds, only 12% were correctly identified, both significantly lower than identification rates for the older populations. Lieblich (1971) administered an information detection task, similar to the guilty knowledge test (GKT) polygraph test, to 3- and 4-year-old Skin resistance was the only children. physiological measure recorded during the test. Lieblich found that the detection rates, based on adult criteria, did not differ from chance. However, Lieblich noted that "the psychophysiological mechanisms necessary for the detection process seem to function, in the sense that it can be manipulated using the same variable structure as in the adult sample" (p.440). Abrams (1975) conducted a GKT study with fourth- to eighth-grade children. Abrams found that the accuracy for children below 11 years of age was low (63%), whereas accuracy for children over 11 years of age was comparable to that obtained with adults (91%). Finally, Bradley et al. (1996) tested second- and sixth-grade children using the GKT. Accuracy rates ranged from 82% to 88%, with no effect of age. As in the previous studies, only skin conductance was used to determine if the child was innocent or guilty. A gender effect for detection of information was found; girls were more detectable than boys. Anticipated problems recording from the children such as "squirming, shaking, and wiggling in an uncontrollable fashion" (p. 18) did not occur.

Although these studies used physiological measures to detect deception with juveniles, none used the polygraph in a manner consistent with field detection of deception, nor did they employ laboratory methods routinely used with adults to assess the effectiveness of the polygraph for detecting deception. In all of these studies, the seriousness of the lie the child may have told was relatively minor (denying the flavor of a candy they had received or if they had memorized a card). The inconsistencies in the findings might be attributed to the wide variety of methods employed and the use of only electrodermal responses to the presentation of test items being utilized.

Although there is a paucity of empirical research on the use of the polygraph with a juvenile population, there appears to be little hesitation by law enforcement and others to use the polygraph with juveniles as young as 12 years old (Craig & Molder, 2003). Based on survey responses from examiners, it is evident that the polygraph is being used in criminal investigations with juveniles to assess deception (Adang, 1995; Craig & Molder, 2003) and in the monitoring of their parole (Adang, 1995; Craig & Molder, 2003; Emerick & Dutton, 1993). Although the number of polygraph tests administered to juveniles is not as large as with adults, some examiners report testing children as young as nine years old (Craig & Molder, 2003).

In the field, the comparison question test (CQT) is the most commonly used technique for the detection of deception with the polygraph with adults (Horowitz, Kircher, Honts, & Raskin, 1997) and juveniles (Craig & Molder, 2003). One of the major concerns in the use of the CQT with a juvenile population is that the comparison questions may be beyond the cognitive and verbal capabilities of young subjects. They may not recognize the comparison questions as important or relevant, since the terms used to generate and explain the probable lie are sometimes quite abstract. In the present study, a variant of the COT, known as the directed lie test (DLT) was used to address concerns associated with the use of the CQT with juveniles.

The directed lie test has been proposed as an effective alternative to the CQT for the physiological detection of deception (Bell, Kircher, & Bernhardt, 2008; Honts, Kircher, & Raskin, 1995; Honts & Raskin, 1988; Horowitz, Kircher, Honts, & Raskin, 1997; Raskin, 1989; Raskin et al., 1989). The DLT is based on the same principles as the CQT. However, comparison questions for the DLT are not probable lies, but are known lies. During the pretest interview, the subject is instructed that the examiner needs to observe the specific pattern of physiological responses when the subject lies. The examiner then asks several questions about minor transgressions that everyone has committed (e.g., "Have you ever told a lie?). The examiner instructs the subject to lie to these questions and to think about a time when they actually did commit the transgression (Honts, 1994; Honts et al., 1995; Honts & Raskin, 1988; Raskin, 1989). The polygraph test is then conducted in a manner similar to the CQT using the directed lie questions as the basis for comparison to the questions directly relevant to the crime or event.

The use of the directed lie eliminates many of the procedural criticisms that have been associated with the CQT (Furedy, 1993; Honts, 1994; Honts et al. 1995; Iacono & Patrick, 1988). The DLT does not require the examiner to maneuver the subject to lie to the comparison questions. Instead, the examiner simply instructs the subject to lie about a minor transgression. The same comparison questions can be used for almost every subject, since the transgressions addressed by the DL questions are ubiquitous. Thus, all subjects are able to lie to these questions with no rewording (Raskin, 1989). Finally, the directed lie questions are straightforward, require less preparation by the polygraph examiner, and reduce the length and complexity of the pretest interview. The DLT is easily adapted for use with juveniles since it reduces the complexity of explaining the comparison questions to the subjects, and even young juveniles should be able to comprehend the underlying concepts.

The dearth of empirical polygraph research with juveniles raises questions about whether the polygraph is appropriate for investigating crimes committed by juveniles or in monitoring juveniles who are on parole. It is essential to determine if the polygraph can successfully detect deception in juveniles and to explore developmental factors that may influence detection rates.

# Methods

#### Participants

Eighty-four juveniles from 9 to 15 years of age participated in the study, 6 male and 6 female for each year of age. Most participants were middle class, Caucasian, and all native English speakers. Participants were a sample of convenience obtained by advertising in psychology classes and postings on campus and community billboards for parents willing to allow their child to Participants received participate. \$10 monetary compensation for their time. All participants were accompanied to the

experiment by a parent or legal guardian. Two participants were replaced due to malfunctions in the physiological recording equipment; 4 participants were replaced because they confessed to the polygraph examiner; and 6 were replaced because they had discussed the details of the experiment with a previous participant.

#### Apparatus

Physiological responses were monitored and scored with a computerized physiological recording and analysis system known as CPS-LAB (Kircher & Raskin, 1988). The system was used to collect, edit, and extract the physiological data of interest. Skin conductance, blood pressure, finger pulse amplitude, heart rate, and respiration were continuously recorded by the digitized physiological data acquisition subsystem (PDAS) of CPS-LAB.

Respiration was obtained from two indium-gallium Life-Tech strain gage respiration transducers secured around the upper thoracic and abdomen region just below the rib cage. A Finapres Blood Pressure Monitor was used to record blood pressure via a finger cuff placed on the middle phalanx of the third finger of the left hand and held in place with Velcro. Research by Podlesny and Kircher (1999) reported that the Finapres measurements are highly correlated with the standard field polygraph arm cuff. The Finapres was preferred because it is more comfortable and less likely to distract young juveniles from the task.

Skin conductance was obtained by applying a constant voltage of .5V to two Beckman electrodes placed on the thenar and hypothenar eminences of the left palm after the recording sites had been cleaned with soap and water. Finger pulse amplitude was obtained from a UFI model 1020 infra-red photo-electric plethysmograph placed on the distal phalanx of the fourth finger of the left hand.

#### Procedure

Upon arrival at the laboratory, a research assistant obtained consent from the participant and their parent. The parents then met with the polygraph examiner, were asked to provide a short medical and personal history of the juvenile, and given the option of waiting in the laboratory or in a separate waiting area. Parents who chose to wait in the laboratory were seated where the juvenile could not see them. Five parents elected to stay in the exam room.

#### The "crime"

The participants were asked to complete a workbook created for this experiment. The 11-page booklet with color the deception/nondeception figures had instruction written on the last page. The research assistant was present while the participant completed the workbook. The participant was allowed to ask the research assistant questions, and there were no time constraints on completing the task. Half of the participants (Guilty Group) received the deception instructions on the last page of the book. The instructions directed them to tear that page out, place it in their pocket, and deny to the next experimenter that they tore out the page (Appendix A). For the other half of the participants (Innocent Group), the last page of the book had been torn out prior to their receiving the book. The research assistant informed them that someone else had torn the page out and that they were to deny tearing having done it. Participants were asked if they had any questions about what they were to do in the next part of the experiment. They were then handed \$3 in movie passes and instructed that if they successfully convinced the polygraph examiner that they did not tear the page from the book they would be allowed to keep the movie passes.

Following a 5-minute filler task, participants were taken to the polygraph examination room and introduced to the polygraph examiner who was not aware of the participant's condition. The examiner told the participants that he knew someone had damaged the book and they were suspected of having done it. They were asked directly if they had torn the page from the book. If they denied tearing the page out, they were asked if they would be willing to take a polygraph test to determine if they were telling the truth.

The physiological sensors were placed on the participant, and the polygraph examiner explained the importance of sitting still during the test. Participants were videotaped during the polygraph test to record any movement. They were then informed that prior to the examiner asking them about the book, he would run some tests to see if they were going to be a good participant for the polygraph. A variation of the WISC digit span was conducted to measure physiological responding during a cognitive task. All participants were told that they did very well on the task and that the examiner was able to record their responses.

Following this task, participants were again asked if they had torn the page from the book. If they continued to deny the act, the examiner explained how the polygraph works, including a discussion of the autonomic Any questions from the nervous system. participants were answered until they stated the process made sense to them. A standard number test was then conducted to calibrate the system and allow the participant to adjust to the situation. After the completion of the number test, the participants were told that their physiological reactions during the test were large when they lied and that no reaction occurred when they answered truthfully. They were reminded that if they responded truthfully to a question, then no physiological changes would take place since responses occurred only when they were lying.

## The polygraph examination

The test questions were then introduced to the participant, the three relevant questions and one sacrifice relevant question regarding the destruction of the book, four neutral questions, and three directed lie questions were reviewed (Table 1). Any problems with the phrasing of the questions were clarified. The participants were reminded that if they answered the questions truthfully, there would be no change in their body but if they were lying there would be large changes. Any questions raised by a participant were answered at this time.

Question type	Questions
Sacrifice Relevant	Are you going to answer all of the questions about the destruction of the Food Pyramid book truthfully?
Relevant	Did you tear the page from the Food Pyramid book?
Relevant	Did you tear the page from that book?
Relevant	Do you have the page from the Food Pyramid book with you now?
Initial Neutral	Is your name?
Neutral	Are you years old?
Neutral	Are you in the grade?
Neutral	Do you live in?
Directed Lie	Before today, have you ever told a lie?
Directed Lie	Have you ever done something your parent told you not to do?
Directed Lie	Did you ever do something at school you weren't suppose to do?

#### Table 1. Relevant, directed lie, and neutral questions asked during the polygraph exam.

The participant was informed that the examiner would present questions three times in different orders with a short break between each presentation. Each presentation began with the Initial Neutral and Sacrifice Relevant questions, followed by the Neutral, Directed Lie, and Relevant questions systematically combined in differing orders across the three presentations. Pairing across the three presentations were such that each Directed Lie (DL) question was presented with each Relevant (R) question. In the first presentation the pairings were DL1/R1, DL2/R2 and DL3/R3; in the second DL2/R3, DL3/R1, & DL1/R2; and the third DL3/R2, DL1/R3, & DL2/R1. The examiner asked the questions with the participants responding either "Yes" or "No" and a 20-s recovery period between each question. Each presentation of the list of questions lasted 6 minutes, and participants were reminded during each break not to move during the test. Following the third presentation of the question list, the participant was informed the test was over and the physiological sensors were removed.

#### Debriefing

Participants were thanked and informed that the results of the polygraph test would not be ready for some time. The juveniles were told that since they were good

participants and sat still, they could keep the movie tickets. It was pointed out that by allowing them to keep their movie tickets, the examiner was not saving they were good or bad liars, only that they were good The participants were then participants. allowed to tell the examiner the truth about whether or not they tore the page from the book. The examiner then discussed the purpose of the experiment with the participants, including a discussion of the difference between the lie they may have told and other lies. Any questions the participants had were answered, and they were told that their parents had been given a phone number to call if they had any further questions. Finally, they were given the \$10 remuneration and reunited with their parent.

#### **Physiological Data Editing**

A research assistant visually examined the physiological data for each participant, on each test. Changes in the physiological recordings that were due to movement of the participant or caused by adjustments in the recording equipment were edited prior to analysis. The research assistant had no knowledge of the guilt or innocence of the participants, and less than 1% of the entire data set required edits. Of the 1512 possible question-response pairings for relevant and directed lie questions from the three directed lie charts for the 84 participants, 14 directed lie (1.8%) and 6 (.78%) relevant responses were removed due to excessive movement. The investigator verified all movements by reviewing the videotaped recording of the examination.

### **Computer Analyses**

Computer measurements used in the analysis were skin conductance amplitude, blood pressure amplitude, mean and respiration excursion. Skin conductance amplitude was obtained by taking the largest amplitude, in relative units, between the lowest point and every succeeding high point in the 20-s response curve that began at question onset. A blood pressure mean curve was calculated by taking the average of the systolic and diastolic points, and the amplitude of baseline increases in mean blood pressure was obtained in the same manner as was used for the skin conductance response. An average respiration excursion was produced by measuring the vertical distance between adjacent samples for 10 seconds following question onset for thoracic and abdominal respiration channels. The measurements for each channel were transformed to standard scores. The mean thoracic and abdominal standard scores were then computed for each test question. These three physiological measures, individually and in combination, have been shown in previous lab and field research with adults to be diagnostic of truth and deception (Kircher & Raskin, 1988; Raskin et al., 1988).

An index of differential reactivity to the directed lie and relevant questions was produced for each physiological measure. The 18 presentations of the directed lie and relevant questions, presented during the three repetitions of the question sequences, yielded a set of 18 discrete measurements of the participant's skin conductance, mean blood pressure, and respiration responses. The set of 18 measurements of each physiological feature was converted to standard scores. For each physiological measure and each chart, the mean standard score for relevant questions was then subtracted from the mean standard score for the directed lie questions. The sign of the difference score indicated whether the relevant or directed lie questions produced the stronger reaction, and the magnitude of that score provided a precise measure of the difference in the participant's reactions to the two types of questions. This method of feature extraction and quantification is similar to the approach developed by Kircher and Raskin (1988) for adults.

# Results

#### Detectability of Juveniles Using Adult Discriminant Function

The difference scores between the participants' physiological responses to the directed lie and relevant questions were transformed using the CPS discriminant function derived by Kircher and Raskin (1988) that was based on adult cases and laboratory studies. The discriminant score depended on the magnitude of the difference between the physiological responses to the directed lie and relevant questions. positive the Α discriminant score was indicative of an innocent participant, who responded more strongly to directed lie questions than to relevant questions; a negative discriminant score was indicative of a guilty participant, who responded more strongly to relevant questions.

To test the ability of the CPS function to distinguish between guilty and innocent participants and to examine the possible impact of age and repetitions of the directed lie sequence (charts), CPS discriminant scores were calculated for each of the three charts separately. A 2 x 7 x 3 split-plot ANOVA, with guilt and age as between-subject variables and charts as a within-subjects variable was used to test for main and interaction effects on discriminant scores. There was no violation of the sphericity assumption for the within-subjects variable of charts. There was a significant within-subjects effect for charts  $(\underline{F} (2, 140) = 3.34, \underline{p} < .05)$ . Discriminant scores for chart 1 ( $\underline{M}_{ch1}$  = .65) and 3 ( $M_{ch3}$ =.57) were greater than those obtained for chart 2 ( $M_{ch2}$  = .13). There was a significant between-subjects main effect for guilt, F (1, 70) = 35.33, p < .05, innocent participants had larger (M = .94) discriminant scores than did guilty participants ( $\underline{M} = -.05$ ). There was also a significant effect for age, <u>F</u> (6, 70) = 3.97, <u>p</u> <.05. Differences in the average discriminant scores based on age and guilt are presented in Figure 1. The predicted interaction of Guilt x

Age was not significant; discrimination between guilty and innocent older juveniles

was no different than for guilty and innocent younger juveniles.





The CPS discriminant function correctly classified 72.6 % of the cases as either guilty or innocent. The CPS function was better at identifying innocent (88.1%) than guilty participants (57.1%,  $X^2$  (1) =10.12, p < .01).

#### Discriminant Function for Detectability Based on Juveniles Data

Since the CPS discriminant function was based on adult data, a new function based on the difference scores from the present sample of juveniles may have been more effective at detecting deception in juveniles. The loadings of variables on discriminant scores based on the raw juvenile physiological data differed from those for the adult CPS discriminant function. The CPS discriminant scores for the juveniles placed less weight on skin conductance and more weight on blood pressure and respiration.

The discriminant scores, based on the equation derived from the present sample of juveniles, were calculated for each chart separately to test for changes across charts. A 2 x 7 x 3 split-plot ANOVA was performed, with guilt and age as between-subject variables and charts as a within-subjects variable. The within-subjects effect for charts was significant <u>F</u> (2, 140) = 3.49, <u>p</u> <.05; discriminant scores for charts 1 and 3 ( $M_{ch1}$  = .15,  $M_{ch3}$  =.20) were greater than those for chart 2 ( $M_{ch2}$  = -.42). A significant betweensubjects effect of guilt was present,  $\underline{F}(1, 70) =$ 42.45, p <.01. As predicted, innocent participants had larger discriminant scores (M = .66) than did guilty participants ( $\underline{M}$  = -.66).

No other main or interaction effect was significant.

The discriminant function correctly classified 73.8 % of the cases as either guilty or innocent. The function performed as well at classifying guilty participants as innocent participants.

#### Concordance Between Adult CPS and Juvenile Raw Data Discriminant Scores

Discriminant scores were dichotomized at 0 to classify cases into groups. Participants with positive discriminant scores were classified as innocent, and participants with negative discriminant scores were classified as deceptive. A crosstab evaluation of the two classification models yielded 87% agreement (73 of 84) in the classifications by the adult CPS and juvenile discriminant functions. The two functions disagreed on five innocent and six guilty cases. The discriminant function based on the juvenile data predicted guilty cases better than the CPS function, McNemar test  $\underline{z} = 2.04$ ,  $\underline{p} < .05$  (see Table 2). There was no difference in the detection of innocent participants between the two functions, McNemar test,  $\underline{z} = 1.79$ ,  $\underline{p} > .05$  (see Table 3).

Table 2. Concordance between polygraph outcomes using discriminant function from CPSand juvenile sample for innocent participants.

		Discriminant Function based on Juvenile Data			
		Correct	Incorrect	Total	
CPS Discriminant	Correct	32	5	37	
Function	Incorrect	0	5	5	
	Total	32	10	42	

# Table 3. Concordance between polygraph outcomes using discriminant function from CPSand juvenile sample for guilty participants.

		Discriminant Function based on Juvenile Data			
		Correct	Incorrect	Total	
CPS Discriminant	Correct	24	0	24	
Function	Incorrect	6	12	18	
	Total	30	12	42	

# Reliability $(\mathbf{r}_{xx})$ and Validity $(\mathbf{r}_{pb})$ of the Physiological Measures

The reliability of each physiological measure was assessed via coefficient alpha (Cronbach, 1951) across the nine difference scores generated by subtracting the standardized physiological responses for each relevant question from the preceding directed lie question. The reliability coefficients are presented in Table 4. The point-biserial correlation between the differential physiological responses to the relevant and directed lie questions and a dichotomous variable that represents guilt status for each of the three physiological measures are also presented in Table 4. The point-biseral correlation provides an index of the diagnostic validity of a variable for distinguishing between the two groups.

	$\underline{r}_{\mathrm{kk}}$	<u>r</u> pb
Skin Conductance	.29	.36**
Mean Blood Pressure	.36	.51**
Respiration	.35	.21*

Table 4. Cronbach's Alpha ( $\underline{\mathbf{r}}_{\mathbf{kk}}$ ) and point-biserial correlation with Guilt/Innocence for<br/>physiological measures during directed lie test.

\*\* <u>p</u><.01 \* <u>p</u><.05

# Discussion

The use of a directed lie polygraph test was a moderately effective way to detect deception in a juvenile population regarding the mock "crime" of tearing a page from a book. The CPS discriminant function developed by Kircher and Raskin (1988) identified innocent participants quite well, though it was less effective at identifying guilty participants. A discriminant function derived from these data produced an overall detection rate of 73.8%. However, the detection rates for both models were not as high as the detection rates reported for adults using the CPS model (Kircher & Raskin, 1988). The overall accuracy of decisions in the present study was only 72.6% using the CPS model, whereas the accuracy of decisions with adults typically exceeds 90%. The findings from this study should not be viewed as addressing the validity of the CPS model when used with adults, since the CPS model was designed and intended for use with an adult population and has been previously tested only with that population (Kircher & Raskin, 1988; 2001).

There were differences between the CPS juvenile-based discriminant and functions in the weights assigned to the physiological measures. The CPS relied more heavily on skin conductance, whereas the juvenile function gave greater weight to changes in blood pressure. Although the two models emphasized different physiological features in their discriminant functions, the outcome scores were very highly correlated and produced similar detectability rates overall. The function based on the juvenile data was better at detecting guilty juveniles and was similarly effective in identifying innocent juveniles. In addition, the present study found no age effects in the detection of deception for participating age groups.

One possible explanation for differences in the juveniles' detectability relative to that of adults is that the manipulation was not strong enough to generate an adult-like response. An adult comparison group, using the same manipulation, could address this issue. Tearing a page from a book is not as involving a situation as the commission of a real crime, and the potential loss of \$3 in movie tickets is not as personally significant as the potential consequences of being found guilty of a more realistic mock crime. Thus, the detection rates from the present laboratory study may be lower than they would be in the field because the mock crime scenario was insufficient to simulate a real-world context.

Guilty juveniles were less detectable than were innocent juveniles, using the CPS model. It may be that the guilty juveniles did not show larger physiological responses to relevant questions due to the salience of the directed lie question. The directed lie questions may have produced a strong physiological response from juveniles because the particular memory elicited was more salient and important than the questions regarding the destruction of the book. The imaginary audience effect (Elkind & Bowen, 1979) may have affected older juveniles' responses to the directed lie questions. In early adolescence, juveniles develop greater self-reflective capacities and increased selfconsciousness. Consequently, they may have been more concerned about concealing their deception to the directed lies and avoiding

embarrassment than the fact they had damaged a valueless book. Thus, the guilty juveniles may have been more concerned about revealing what they were asked to lie about to the directed lie question and less concerned about their responses to the relevant questions.

#### Effects of Age on Detection of Deception

No age effects on detectability were found for either the CPS function or the function based on the raw data for the age groups tested in the present study. This finding is inconsistent with Abrams' (1975) findings that juveniles under 11 were less detectable on a guilty knowledge task than older juveniles and adults. However, it is consistent with Bradley et al. (1996) who did not find age differences in the detection of knowledge. Even young participants were able to understand and respond to the demands of the directed lie task and to discriminate among the relevant, directed lie and neutral questions.

Although the questions were not a problem for juveniles, the physical requirement of remaining still and attending to the task was more difficult for them. No direct assessments were made for movement or attention during the polygraph test, but the researcher noted that several of the younger participants frequently moved and had to be reminded several times to sit still. It was also noted that during the latter portions of the test, the participants began to visually scan the room, yawned frequently, and spoke less loudly when they answered the test questions. Some of the younger participants even indicated they were bored and asked how much longer they would need to be there. The issue of sustained attention has also been examiners who raised by field have administered polygraph tests to juveniles (Adang, 1995). Adang noted that younger children required greater patience on the part of the examiner and a reduction in the time it takes to administer the exam. All of these behaviors are potentially measurable and would be an important step toward a better effectiveness understanding of the of polygraph techniques with juveniles.

#### Limitations of This Study

There are several limitations in the present study that call for caution in the interpretation and generalization of these results. This a laboratory study where participants lied about tearing a page from a book, not about breaking a law, and they were motivated to conceal the truth by a reward of movie tickets. Several issues have been identified that may limit the generalizability of laboratory research on polygraph tests to field applications (Kircher et al., 1988).

The duration of the polygraph examination, including the additional tasks, was approximately 45 min from start to finish and may have been too long, even for the older participants. Some participants appeared to lose interest in the task and gazed about the room, yawned repeatedly, shifted in the chair, or closed their eyes. This loss of interest and shifts of attention may also account for the low reliability of the differential reactivity during the polygraph test.

Participants were not asked if they had tried to use countermeasures to defeat the test, although all were asked if they knew much about the lie detector test and how it worked. All of the participants reported limited knowledge of the polygraph, most having heard about it in movies or on television. No overt countermeasures were noted by the experimenter.

Only "normal" juveniles were used in this study. Nearly all of these juveniles were from upper-middle-class homes. The population of juveniles that would be tested in the field application of the polygraph might include suspects with a variety of disorders, previous experiences with the legal system and the polygraph, and a wide range of socioeconomic status. Thus, the generalizability of the present results is somewhat limited. Finally, a small percentage of (less than 10% of the guilty participants sample) confessed to tearing the page from the book and their data were eliminated. Thus, the sample of guilty participants may have been biased by including only those participants who did not confess.

#### Future Research Directions

The next study should employ a stronger manipulation, such as a mock crime. The greater level of involvement in the crime may result in greater attention to the relevant questions for guilty participants and improve their detectability. Attempts to equate the significance of the directed lie across participants, possibly by using directed lie questions related to the immediate context, might also increase the differences in physiological responses to the relevant and directed lie questions. The inclusion of juveniles more similar to the population of juvenile suspects who would be likely candidates for field polygraph examinations (juveniles with criminal records or diagnosed with conduct disorder or both) would improve generalizability of findings to the field.

Finally, it is of paramount importance that field polygraph research be conducted with juveniles regarding actual allegations of

Laboratory studies may give real crimes. police and others in the criminal justice system direction and information about the effectiveness of polygraph techniques, but laboratory studies only simulate the field conditions, motivations, and experiences of juveniles who take a polygraph examination regarding accusations against them. It is of particular concern that the polygraph is being ordered as part of juvenile offenders' probation (Adang, 1995) although there has been little research on the application of the polygraph for criminal investigation of juvenile suspects. If the polygraph is to be used to investigate juvenile criminal activity, it must have a scientific basis.

# Appendix A

#### **Instructions for Guilty Participants**

At this time I want you to tear this page out of the book, fold it up, and place it in your pocket. When you are asked by the next interviewer if you tore this page out, I want you to lie and say you didn't do it. If you convince the interviewer you didn't do it, you will get two tickets to the movies. If you have any questions, ask for assistance.

#### **Instructions for Innocent Participants**

Return this book with this page in it. Some children have torn this page out, but it is important that you leave it in the book. When you are asked by the next interviewer if you tore this page out, I want you to tell the truth and say you didn't do it. If you convince the interviewer you didn't do it, you will get two tickets to the movies. If you have any questions, ask for assistance.

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