Evaluating the Feasibility of Using Noncontact Sensors to Conduct a Targetless Concealed Information Test

Jeffrey Gainer Proudfoot

Workshop on Innovation in Border Control
Uppsala, Sweden - August 14, 2013
Background

- Over 300 million individuals legally pass through ports of entry between Mexico and the United States annually.

- This traffic volume presents challenges for government agencies attempting to facilitate commerce without jeopardizing security.

- To address this problem, new screening methods and technologies are being developed to streamline security operations.
Example: AVATAR

Psychophysiological & Behavioral Measures

- Linguistics
- Vocalics
- Kinesics
- Blood Pressure
- Heart Rate
- Respiration
- Facial / Orbital
- Body Temperature
- Blink Frequency
- Startle Response
- Iris Identification
- Pupil Dilation
- Gaze Behavior
- Object Recognition
- Pattern Classification

Sensors

- Video Cameras
- Laser-Doppler Vibrometer
- FLIR Thermal Camera
- UltraFast Near Infrared
- Pupilmetric Near Infrared
- Eye Tracker

DATA FUSION ENGINE

Recommendation
Concealed Information Test (CIT)

• Rather than detecting physiological indicants of deceit, the CIT identifies *concealed knowledge*.
  – Eliminates accusatory tone of standard polygraph interview

• “...a guilty person will show some involuntary physiological response to stimuli related to remembered details of a crime.” (Lykken, 1959)

• This is often referred to as an orienting response.
Concealed Information Test (CIT)

- The CIT is now being researched for rapid screening contexts due to its:
  - Simplicity
  - Inherent minimization of human biases and influences
  - Wide acceptance among scientists

- The CIT is among the most commonly investigated interviewing techniques
  - Limited use for criminal investigations
    - Need to identify target items with discriminatory power
    - Media cooperation

- Electrodermal activity (EDA) is the traditional measurement used to conduct a CIT.
  - Measuring EDA requires contact
  - Not conducive for automation

National Center for Border Security and Immigration – RESEARCH LEAD:
University of Arizona
Concealed Information Test (CIT)

- EDA measures changes in **phasic skin conductance (µS)**
  - Used to measure fear, anger, startle response, orienting response and sexual feelings
- In a CIT context, interviewers look for larger trough-to-peak amplitudes in response to target items

A. Kitchen
B. Bathroom
C. Basement
D. Living Room
E. Parlor
F. Office
Concealed Information Test (CIT)

- A CIT is comprised of several foils. As the number of foils increases, the power of the test increases and the chances of a false positive occurring decreases.
  - 1 target per foil, several foils (e.g. 3 foils, .8% chance of max. response on all target items)
Sensors used for CITs

• CIT research has employed a variety of measurement devices, including:
  – EDA
  – Electroencephalogram
  – Electrocardiogram
  – fMRI
  – Plethysmograph

• Recently, noncontact sensors have been investigated for use in conducting CIT examinations.
  – Eye tracking and vocalics have shown indications of promise
Adaptations of the CIT: Hybrid Study

• Screening experiment comparing oculometric and vocalic differences to EDA (between concealers and the control group in a CIT) – Proudfoot et al., 2012

• Several significant findings:
  – Concealers exhibited:
    • Oculometric differences...
      – Fixation on the center of the screen
      – Increased pupil dilation within foil items
      – Oculomotor threat avoidance
    • Vocalic differences...
      – Longer response latencies
      – Differences in vocal quality
Problem / Research Question

• One stumbling block is the need to identify and incorporate target items which can be used to identify the person(s) concealing knowledge.
  – Identifying items with discriminatory power
  – Media cooperation

• CIT research reports main effect differences between concealers and the control group for pupil dilation, oculomotor threat avoidance, and response latency.
  – Proudfoot et al. 2012
  – Lubow and Fein (1996) found a main effect difference for pupil dilation in a GKT

• Research Question: Can a targetless CIT be used to identify individuals concealing information?
THEORY / HYPOTHESES
Interpersonal Deception Theory

- The findings presented previously suggest the possibility that a **targetless CIT** could be used to elicit and identify differences between concealers and the control group.

- This is supported by **Interpersonal Deception Theory (IDT)**.
  - “Compared with truth tellers, deceivers (a) engage in greater strategic activity designed to manage information, behavior, and image and (b) display more nonstrategic arousal cues, negative and dampened affect, noninvolvement, and performance decrements.”
Hypotheses

• **H1:** Concealers will fixate longer on the center of the screen than the control group for both target and control stimuli.
Hypotheses

- **H2**: Concealers will demonstrate larger pupil dilation than the control group for both target and control stimuli.
Hypotheses

- **H3**: Concealers will demonstrate longer vocalic response latencies than the control group for both target and control stimuli.
Hypotheses

• **H4**: Oculometric differences between concealers and the control group will diminish over time.

• **H5**: Vocalic differences between concealers and the control group will diminish over time.
METHODOLOGY
Methodology

• Will conduct an experiment using a smuggling scenario (n=150) in which participants will smuggle contraband for a criminal organization to one of three possible recipients
  – Task incorporates both (1) realism and (2) generalizability to screening environments

• Screening conducted with CMI/BORDERS kiosk & AVATAR testbed
  – Standardized interview

• Participants incentivized with monetary reward (given to those appearing the least suspicious) and threat of further screening
Experimental Procedure

1. Scenario / Familiarization Process / Pack Bag
   - 5 Target Items
   - Study Target Items

2. Sensor Calibration for Eye Tracking
   - Fixate on 9 Points

3. Automated Interview by ASK
   - 5 Foils / 5 Target Items
   - 100 Total Images: 4 per Slide
   - 10 Seconds per Slide

4. Manipulation Check
   - Participants will Select Target Items from Corpus of All Items
Example Target Items - Scenario

SINALOA CARTEL
Familiarity Task

Please list several characteristics of this person’s face that you will use to identify them.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feature 1</td>
<td></td>
</tr>
<tr>
<td>Feature 2</td>
<td></td>
</tr>
<tr>
<td>Feature 3</td>
<td></td>
</tr>
</tbody>
</table>
Slide Examples

- Zetas Cartel
- Guadalajara Cartel
- Norte de Valle Cartel
- Cali Cartel
Data from this slide will not be considered.

One “target” image will appear per 5 slides.

*Rotations*
### CIT Interview Questions

<table>
<thead>
<tr>
<th>CIT Foil</th>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faces</td>
<td>“The following individuals are wanted by local authorities. Are you familiar with any of these people?”</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Banned Items</td>
<td>“The following items are not allowed beyond this point. Are you carrying any of these items?”</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Criminal Organizations</td>
<td>“The following criminal organizations are operating in the area. Are you involved with any of these organizations?”</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>
Instruments

EyeTech VT2 Eye Tracker

Andrea Array Microphone
Summary

There is a growing demand for new screening/interviewing technologies and methodologies.

The CIT is an interviewing technique that is scarcely applied in practical settings, yet it has been the focus of much scientific research.

Recent work has focused on developing adaptations of the CIT that leverage new, noncontact sensors.

One of the remaining obstacles is the need to identify target items.

The present research investigates the feasibility of using a targetless CIT. If feasible, this approach has the potential to be used in a variety of screening and interviewing contexts.