Deception Detection Techniques for Rapid Screening

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Why Study Credibility Assessment?

- Humans are poor lie-detectors
  - ~54% accuracy rate for general population
  - Accuracy deeply affected by base rates
  - Poor performance affects novices and professionals

- Confidence in judgment is not correlated with accuracy
  - Affects attentiveness, verification efforts, and misallocation of resources
Improving Human Detection

- Detection accuracy rates may improve with:
  - Training
    - Mixed results, but generally significant positive effect
  - High stakes scenarios
    - Detection in criminal interviews approaches 80% accuracy
    - However, the linkage between motivation and deception performance is currently being debated
  - Familiarity with individual’s usual behavior patterns (baseline)
Problems for Humans to Overcome

- Excessive focus on nondiscriminatant or a small subset of cues
  - Gaze aversion
  - Nervous gesturing
  - Preening

- Vigilant observation
  - Attention required for multiple channels
Border Crossing Environment

National Center for Border Security and Immigration – RESEARCH LEAD: University of Arizona
“Challenges and Solutions at the Northern Border” – Bellevue, WA
Border Scenario

Test Your Skills!
Results

- Fluid motion
- Resonant voice
- Spontaneous positive affective displays
Border Scenario

Test Your Skills!
Results

- Rigid during non-speech, abrupt during speech
- Elevated voice frequency
- Submissive responses
  - Low gain
  - Signs of deference
- Negative affective displays
  - Perhaps in response to agent
- Various contextual cues
Research Purpose

- Unobtrusive credibility assessment and intent detection
  - No sensors attached to the body
  - Real-time, remote analysis
  - Scalable and robust for high traffic
  - Useful across contexts

- Investigating technologies to augment/replace the polygraph
Research Approach

Intent

Exhibited by

Manifestations of Intent

Internal

External

Remote Observable Cues

Physiological
Heart Rate
Blood Pressure
Respiration
Iris/Pupil
Thermal
Blink

Behavioral
Linguistic
Kinesic
Vocalic
Eye Tracking
Microfacial
Chronicmic
Content

Deviations/Responses

Observed -vs- Individual norm

Observed -vs- General Norm

Fusion Engine

Judgment

Inferred Intent
- Hostile
- Benign
Deception Detection
- Deception Indicated
- No Deception Indicated

Expected Behavioral Norms

Past Profiles (Norms)

General Behavioral Norms

Individual Behavioral Norms

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“Challenges and Solutions at the Northern Border” – Bellevue, WA
Non-invasive Credibility Assessment

- Video Cameras (3)
  - Linguistics
  - Vocalics
  - Kinesics
- Laser-Doppler Vibrometer
  - Blood Pressure
  - Heart Rate
  - Respiration
- Thermal Camera
  - Eyes
  - Ears
  - Forehead & Face
- Blink Camera
  - Blink Rate/Frequency
  - Changes in Blink Activity
- Pupillometry Camera
  - Iris Identification
  - Pupil Dilation
- Eye-tracking System
  - Gaze Behavior
  - Object Recognition
  - Pattern Classification

TRUTH OR DECEPTION
FUSION ENGINE
Approach for Multimodal Credibility Assessment Validation

- Multi-institution research program

- Multi-method approach
  - Prototype development
  - Field studies
  - Laboratory studies
  - Surveys

- Over 4600 subjects
Experiment Lab setup
Credibility Assessment Devices
(Provided by DACA – Defense Academy for Credibility Assessment)

LDV

THERMAL

BLINK

PUPILLOMETRY

EYE-TRACKING
Laser-Doppler Vibrometry
Laser-Doppler Vibrometry

- Uses a laser pointed at the carotid artery
- Tracks minute changes/movement in the artery
- Can remotely track pulse and blood pressure
- Currently exploring other identifiable physiological features
  - Respiration
  - Muscle tension
  - Artery stiffness
Laser-Doppler Vibrometry
Operational Benefits and Drawbacks

Benefits

- For use with screening questions
  - No narrative responses
- Tracks well known physiological features

Drawbacks

- Noise introduced by speaking, movement, etc.
- Small target area
Thermal Video Imaging Technology
Thermal Video Imaging Technology

- Uses a thermal camera
- Tracks minute changes in skin temperature
- Can identify increase blood flow to the brain
- Arousal signature shows as a temperature plume in the lower forehead and between the eyes
Thermal Video Imaging Technology

Operational Benefits and Drawbacks

Benefits

- For use with screening questions

Drawbacks

- Expensive
- Noisy equipment
- Time intensive calibration
- Sensitive to environmental changes
- Data intensive
High-speed Blink Imaging Technology
High-speed Blink Imaging Technology

- Uses a high speed camera (~250 fps)
- Tracks blink responses to questions
### High-speed Blink Imaging

**Operational Benefits and Drawbacks**

**Benefits**
- For use with screening questions

**Drawbacks**
- Used with a startle generator
  - Can be unwieldy during an interview
- Data intensive
Pupillometric Video Imaging Technology
Pupillometric Imaging Technology

- Uses an IR camera to track pupil dilation
- Deceptive responses correlate with pupil dilation
Pupillometric Imaging Technology

Operational Benefits and Drawbacks

Benefits

- For use with screening questions
- Brief responses need be measured

Drawbacks

- Sensitive to noise
- Most diagnostic when subject is stationary
- Requires unobstructed view of eyes
Eye-tracking Systems

- Uses multiple IR cameras
- Tracks search patterns as participant views an image
- Can separate familiar images from unfamiliar images
Eye-tracking Systems & Applications
Eye-tracking Systems
Operational Benefits and Drawbacks

**Benefits**
- Deployable system
- Non threatening interaction
- Immediate feedback

**Drawbacks**
- Requires guilty knowledge
- Requires subject cooperation
  - Calibration
  - Proper scanning of images
- Tracking not possible with all subjects
Embodied Avatar Kiosk

*Rapid Deception Assessment Screening*

- **Mission**
  - Rapid, automated deception assessments using kiosk-based embodied avatars and intelligent agents

- **Objectives**
  - Identify deception cues in rapid standing assessments
  - Intelligent agent-based real-time cue processing & analysis
  - Temporal cue pattern identification
  - Embodied avatar effectiveness optimization
  - Repeated assessment analysis and baseline profiling
  - Effective threat index and deception index development
Intelligent Agent (IA) Selects Interview
Embodied Avatar presents Question
Sensors Capture Subject Responses
Real-Time Response / Cue Analysis
IA Fuses Analyses, creates ranking
IA Selects Next Question
Done?
IA Generates Final Ranking and Analysis

Embodied Avatar Kiosk
Rapid Deception Assessment Screening
Embodied Avatar Kiosk

Video Example