EyeDetect®

Automated Deception Detection for Adult and Juvenile Sex Offenders

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>converus®

Introduction

Deception takes more mental effort than telling the truth.[1] Deceptive individuals use more mental resources to fabricate lies, remember the specifics of their lies, and portray to others that their lies are believable. Deceptive individuals also try to control their emotions; they do not want to "leak" any facts or information that could cause their deception to be discovered[2].

Scientists refer to this mental effort as cognitive load. This document discusses the scientific discovery of how cognitive load and its correlation to certain eye behaviors can be measured and analyzed to improve the ability to detect deception. This discovery enhances the science of deception detection.

The Discovery

In the spring of 2002, Drs. John Kircher and Doug Hacker, scientists at the University of Utah, were hiking at Mt. Rainer with Don Krapohl. Don was the top polygraph program director for the CIA and eventually became the Deputy Director of the National Center for Credibility Assessment (or NCCA).

Dr. Kircher is one of the world's leading experts in credibility assessment. In 1991, he and colleague Dr. David Raskin invented the first computerized polygraph. Dr. Kircher has also published more than 50 scientific articles on credibility assessment and consulted with / conducted research for the U.S. Department of Defense, National Science Foundation, CIA, Secret Service, National Institute of Justice, Department of Homeland Security, National Science Foundation, National Research Council, Royal Canadian Mounted Police, as well as other organizations.

Left to right: Dr. Kircher, Don Kraphol and Dr. Hacker at Mt. Rainier, circa spring 2002.

While hiking, Dr. Hacker mentioned the adage, "The eyes are the windows to the soul." Dr. Kircher suggested that it would be interesting to conduct core research to determine if there were markers in the eyes of deception. He proposed a research concept to the CIA and was given a grant to buy the latest eye-tracking hardware to conduct a study.

Drs. Kircher and Hacker began their work in 2003 with eye-trackers that were primitive by today's standards:

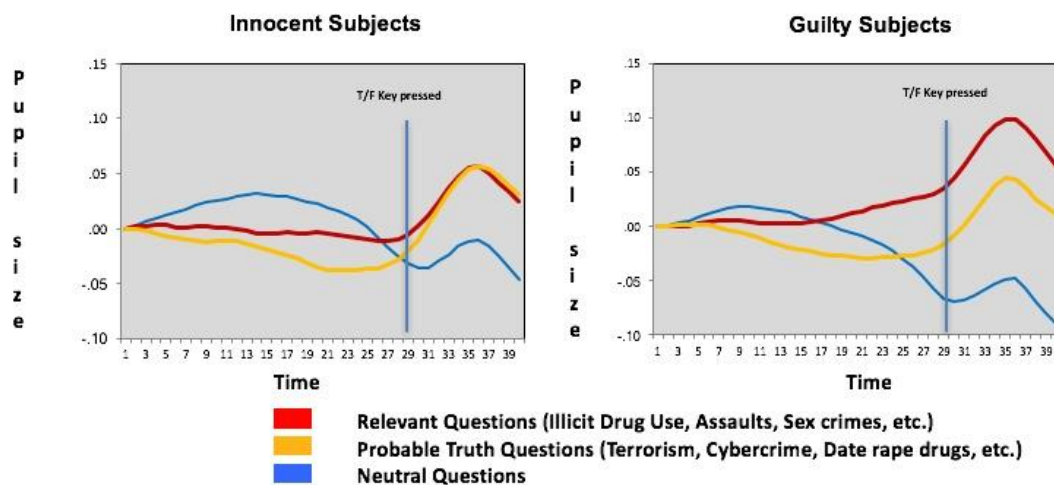[1] Johnson, Barnhardt, & Zhu, 2005; Kircher, 1981; Vrij, Fisher, Mann, & Leal, 2000.
[2] Kircher, 1981

Applied Sciences Laboratory Tracker, circa 2003.   Arrington Research Tracker, circa 2003.

They began with a "mock crime" laboratory experiment on campus. One hundred study participants were instructed to steal a $20 bill from a department secretary's purse when she turned her back and another 100 participants, as part of a control group, did not steal any money. The scientists offered an extra $20 to those that had stolen money from the purse if they could avoid detection by the eye tracker.

Drs. Kircher and Hacker discovered that when questioned about the theft, guilty participants showed an increase in pupil dilation and innocent participants did not. They repeated the experiment multiple times and saw the same patterns in the data. Dilation of approximately 1/10th of a millimeter occurred in guilty subjects a few milliseconds prior to telling a lie and it persisted for 3-4 seconds afterwards. (See below.)

Relevant Questions (Illicit Drug Use, Assaults, Sex crimes, etc.)
Probable Truth Questions (Terrorism, Cybercrime, Date rape drugs, etc.)
Neutral Questions

The image on the left, labelled "Innocent Subjects" shows the pupil dilation pattern of 100 truthful people. The red line (relevant questions) and yellow line (probable truth questions) are similar, which implies that there is no additional pupil dilation for relevant questions.

The image on the right, labelled "Guilty Subjects," shows the pupil dilation pattern of 100 deceptive subjects. The difference in red and yellow lies indicates more pupil dilation for relevant questions than probable truth questions. In an actual test, the gap between the yellow line and red line is measured and analyzed by the decision model and a "credibility score" between 1 and 99 is given. A score of 1 is the least credible and a score of 99 is the most credible.

Kircher and Hacker knew they were witnessing a scientific breakthrough and asked other scientists to help with the research. Drs. David Raskin, Dan Woltz and Ann Cooke soon joined the research team. Since that time, this core group of five scientists have worked to perfect the science. They have researched ocular-motor deception testing since 2003 (more than 14 years at the time of this document).

Scientific Validation

As the research advanced, pupil dilation remained the leading indicator of deception. But at the same time, other useful eye behaviors were discovered to be diagnostic. The scientists observed that deceptive individuals blink less often, respond faster, make fewer eye fixations, and spend less time reading and re-reading statements about activities in which they have engaged—but lied about.

In 2012, the peer-reviewed article "Lyin' Eyes: Ocular-motor Measures of Reading Reveal Deception"[3] was published in the *Journal of Experimental Psychology: Applied* with the initial findings of the science team. Since that time, the science team has conducted additional research in multiple countries to determine if the same eye behaviors are consistent among test subjects in other languages and cultures.

"Generalizability of an ocular-motor test for deception to a Mexican population," was published in January 2016 in the *International Journal of Applied Psychology*. "Laboratory and Field Research on the Ocular-motor Deception Test", was published in January of 2017 in *European Polygraph*.

Other Studies

The science team has conducted various lab and field studies in addition to those previously mentioned. (See summary data below.) The point estimate accuracy for guilty individuals (true positives) averages 82.9%, and for innocent individuals (true negatives) the point estimate accuracy average is 89.3%.[4] The mean point estimate accuracy rate of 86.1% is summarized in the table below:

Experiment	Factors	N	n_G	n_I	Guilty	Innocent	Mean	Validation$_G$	Validation$_I$	Mean
Osher 2	Issues; serial format	40	20	20	85	85	85.0	85	70	77.5
Webb	Sex; motivation; difficulty	112	56	56	82.1	89.2	85.7	89.3	80.4	84.9
Patnaik 1	Direct interrogation	48	24	24	83.3	95.8	89.6	83.3	83.3	83.3
Monterrey	Language; culture	145	82	63	84.1	87.3	85.7	81.9	87.5	84.7
Patnaik 3	Distributed; pretest feedback; post-response interval	80	40	40	82.5	90	86.3	80	90	85.0
Middle East 1	Language; culture	112	51	61	80.4	88.5	84.5			
Middle East 2	Language; culture	101	52	49				75	85.7	80.4
Standard Protocol	weighted by n		325.0	313.0	**82.8**	**89.0**	**85.9**	82.1	81.7	81.9
Standard Protocol	unweighted				**82.9**	**89.3**	**86.1**	82.4	82.8	82.6

Test accuracy is highly consistent due to the standardization and automation of testing protocols. A mean accuracy of 86.1% is comparable to an expertly administered, event-specific, diagnostic polygraph. It is significantly <u>better</u> than most polygraphs because of the "human elements" of training, inexperience, or bias, etc.

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[3] "Lyin' Eyes: Ocular-motor Measure of Reading Reveal Deception," Journal of Experimental Psychology: Applied, 18(3), 301-313, 2012.
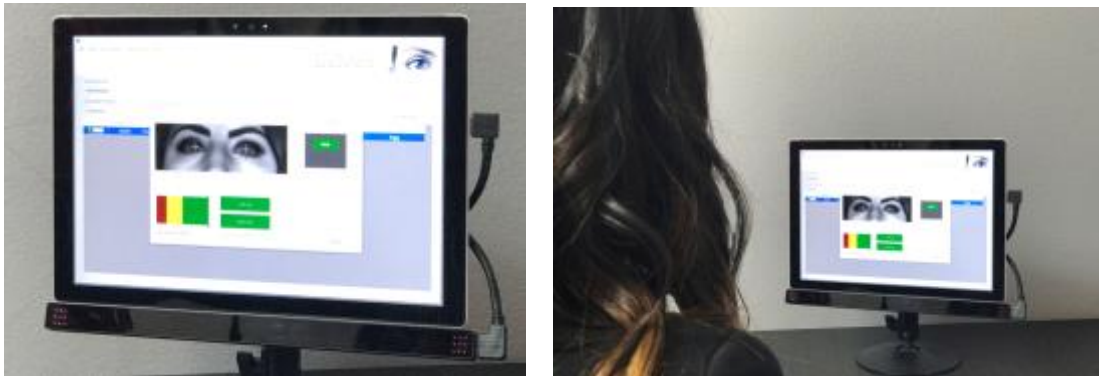[4] Cook et al., 2012; Patnaik, 2013.

Converus

Alta Ventures, a venture capital fund located in Salt Lake City, Utah, formed a company to bring this technology to the market. The company, later to be known as Converus, acquired the technology from the University and signed agreements with the scientists to continue their research and development.

Alta Ventures also hired an experienced executive team for Converus to commercialize the science, now branded as EyeDetect®. Converus investors now include three venture capital funds, company executives, scientists, and other notable technology investors (Mark Cuban). Converus is the first venture-backed technology supplier to enter the credibility assessment market.

EyeDetect Hardware

EyeDetect is a hardware and software solution. The hardware is a Microsoft Windows computer running Windows 10. A high-definition, infrared eye-tracking camera connects to the computer's USB port and is mounted along the bottom of the computer. This eye tracker takes 60 measurements per second of each eye with measurements as small as 1/100 of a millimeter.

EyeDetect Software

The software for administering tests, monitoring examinees, scoring and viewing test results includes:
1) **EyeDetect Software** – allows tests to be downloaded from the cloud to be administered on the tablet; it also uploads the test data to a cloud-based server.
2) **EyeDetect Manager** – allow the test proctor to observe examinees remotely; it runs on any Windows computer that is on the same Wi-Fi network with the tablet.
3) **EyeDetect Dashboard** - a web portal providing access to test results and reports that reside on cloud-based servers; test reports can be viewed from any web browser.
4) **EyeDetect Administrator** – allows one tablet to be configured for a variety of organizations or agencies, to keep test results separated and confidential.

Tests are created by Converus and are downloaded via the Internet onto the tablet. Examinees read true/false statements onscreen and respond to True/False questions by pressing mouse buttons (left/green is true and right/red is false).

Currently, there are over 600 unique tests in 13 different languages in the Converus test library. Tests are localized for different countries to ensure that test topics are well understood and local language is used. For example, tests in Spanish have been localized for Mexico, Colombia, Panama, El Salvador, Guatemala, Peru and the Dominican Republic.

Tests cover a wide variety of topics, including drug use, serious crimes (including sex crimes), theft, bribery, divulging confidential information, ties to gangs/cartels, espionage, terrorism, and hiding prior disciplinary actions. Tests are completed in about 30 minutes. EyeDetect tests begin with a pre-test explanation of topics using an audio-visual presentation on the screen. Afterwards, two short practice sessions are given to familiarize the examinee with the testing process. Finally, the test is administered.

The examinee responds to 318 statements per test. If an examinee doesn't answer quickly enough, the statement will "time out." This is part of the science; it is more difficult to lie under rapid questioning.

Once the test is completed, the eye tracker data is uploaded to a secure web server and a Converus Credibility Score (between 1 and 99) is calculated within 5 minutes.

Test reports are available in PDF or HTML format, and a "Guidance Category" is given for each examinee. The most common guidance categories are "Credible" (Truthful) and "Not Credible" (Deceptive). There are no inconclusive EyeDetect tests.

Converus has data from tens of thousands of tests, and the overall percentage of credible examinees depends on the country, language, culture, and specific job title of the applicant or employee. The software includes a pop-up window to record confessions and admissions at the end of the test.

Countermeasures

Countermeasures are actions taken by examinees to counteract testing procedures. They are common in polygraph and instructions are available on several web sites. EyeDetect has been tested by Dr. Charles Hontz at his lab at Boise State University. Dr. Hontz is the foremost worldwide expert on polygraph countermeasures. To date, we have developed the following countermeasure detection tools:

1) To determine if an examinee is using drugs or eye dilation drops, EyeDetect administers a 45-second "light test" to ensure that the examinees' pupils are reacting normally.
2) Examinees may close their eyes or squint when responding to questions. This is easy to detect because EyeDetect software tracks data loss, which directly corresponds to these conditions.
3) Some examinees answer all questions the same way (true or false), fail to answer questions, or answer randomly to avoid thinking about responses. EyeDetect alerts the test proctor when an examinee is using these countermeasures and delivers guidance categories such as: (1) Indeterminate, (2) Insufficient Data from Eye Scanner, (3) Not Credible/Too Many Timeouts or (4) Not Credible/Random Responses or Low Comprehension.

Further, Dr. Honts stated:
"The countermeasures that are used to beat a polygraph invoke autonomic responses over a relatively long period (20 seconds). Simply put, polygraph can be beaten because the examinee has enough time for the countermeasures to work. Unlike Polygraph, EyeDetect test questions are delivered rapid fire (every 3-4 seconds), so examinees must pay close attention and stay mentally involved to answer the questions correctly. Also, the response mechanisms in the pupil are faster than the systems measured by the polygraph. The rapid response of the pupil makes it very difficult to mask a deceptive response to a question.

Countermeasure designed to produce responses to control questions would take longer to evoke pupillary changes than the innate response to questions being answered deceptively. Moreover,

the rapid questioning in an EyeDetect examination would make it extremely difficult for an examinee to attempt a countermeasure designed to produce a pupillary response and still maintain accurate responses the in test. For these reason, I do not currently see any immediate active countermeasure threats to EyeDetect."[5]
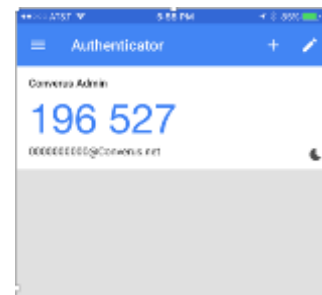
Testing Process

Public Safety agencies can easily administer EyeDetect tests in-office in 30 minutes. Test results are available within 5 minutes after the test concludes. Applicants should be encouraged to show integrity and disclose information that might better explain their Converus credibility score, especially if a low (deceptive) score is given. Any admissions or confessions could be written, notarized, scanned and attached to an applicant's electronic record.

Security

The EyeDetect tablet uses Microsoft BitLocker to encrypt test responses and eye measurements stored temporarily on the tablet. Once the test data is synchronized with the Converus data center, it is deleted from the BitLocker drive.

Access to test reports online requires a two-step (two-level encryption) login process from any web browser. After a person provides their user name and password, a unique 6-digit number is required. This unique number is created by a mobile app such as Google Authenticator on a smartphone (right). Only authorized users can access the test results on the Converus dashboard.

Converus web servers store and process eye measurements and test responses collected during testing. Access to these servers is controlled by a firewall and incoming web traffic is monitored for threats. All servers are housed in a private, locked rack in a certified data center. Access to the data center is controlled by key card and biometric scanners and is monitored 24/7.

Some EyeDetect customers may not want personal information uploaded to Converus' web servers. In those cases, you may assign a unique number to each examinee to remove all personally identifiable information. Only the test responses and eye measurements would be uploaded.

Training

With EyeDetect, the Microsoft Surface Pro tablet is the test administrator and examiner. Extensive training is not required to administer a test. Converus offers the following two training courses via YouTube, free of charge:

1. **Test Proctor training – (79 minutes)** Instructs how to set up the EyeDetect Station, calibrate the eye tracker, start a test, and upload test data. Also includes how to setup and use EyeDetect Manager for monitoring examinees. If desired, there is a Test Proctor certification exam. Upon successful completion of that test, the proctor is awarded a certificate from Converus.

2. **Dashboard Administrator training – (71 minutes)** Instruction on how to access test results from the Dashboard. Administrators also learn how to add users and manage test licenses.

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[5] Email correspondence between Dr. Honts and Converus on January 12, 2017.

EyeDetect Test Library. EyeDetect tests cover a wide variety of illegal activities, including:

- Theft
- Drug use
- Divulging confidential information
- Ties to gangs or organized crime
- Bribery
- Document fraud
- Drug trafficking
- Other fraud (financial)

- Money laundering
- Sex-based crimes
- Corporate espionage
- Fuel theft
- Counterfeiting money
- Cyber crimes
- Identity theft
- Terrorism
- Document fraud

- Violent crimes
- Sexual abuse
- Athlete doping
- Unauthorized financial transactions
- Use of date rape drugs
- Parole violations
- Theft of car parts
- Sports event fixing

Adult Sex Offender Tests

Treatment providers, supervising officers (pardons/parole), and polygraph examiners work together to manage and treat sex offenders convicted of sexual assault, sexual abuse, exhibitionism, voyeurism and viewing child pornography, among other crimes. EyeDetect tests are available for specific issues, re-offense, probation/parole violations and sex histories.

EyeDetect is also nonintrusive as there are no wires or sensors attached to the examinee. Such things have shown to be uncomfortable for those with mental disorders such as Post-Traumatic Stress Disorder (PTSD) or Attention Deficit Disorder (ADD) or for others with character disorders such as Autism spectrum disorder (ASD) or Asperger syndrome (AS).

Experts estimate that over 70% of sex-offender polygraphs performed in the United States are improperly administered and scored.[6] Treatment providers and supervising officers typically are not experts in lie detection and their natural inclination is to instruct examiners to ask broad and open-ended questions. These types of questions do not adhere to the American Polygraph Association (APA) Post-Conviction Sex Offender Testing policies, which were released in 2009. As such, polygraph examiners may be reluctant to correct those paying their service fees, and rather than insist on proper test question construction they ask inappropriate questions. Also, there is wide variability in polygraph examiner training, temperament, competence and bias.

EyeDetect was created by polygraph experts to minimize the subjectivity inherent with human examiners in obtaining an accurate assessment of an offender's credibility. Sex offender test questions are properly constructed and computer administered.

Offenders report that they perceive EyeDetect is more "fair" because it is standardized and computerized. Also, EyeDetect does not require the switching of examiners due to the habituation to a specific examiner. For these reasons, compliance rates are likely to increase.

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[6] The use of Clinical Polygraph in the Assessment and Treatment of Sex Offenders, 5th Annual CSOT Conference, San Marcos, TX. Sunday, February 19, 2017.

Juvenile Sex Offenders

On February 7, 2017, Mike Miner, President of the Association for the Treatment of Sexual Abusers (ATSA), issued the following Adolescent Guidelines Statement: "… without a clearly identified benefit and with a potential for harm, ATSA recommends against using polygraph or plethysmography with adolescents under age 18."

Adolescents are very comfortable with mobile devices, tablets and computer screens. A survey[7] conducted by Common Sense Media found children between the ages 8 to 12 years spent six hours with digital media and teens averaged nine hours daily. This included web browsing, social media, streaming music and videos, texting, TV, and gaming. School or homework-related screen time was not included in this data. Also, 35 percent of U.S. children first play with a mobile device before age 2 and almost 85 percent of teens have smartphones. Thirty-four percent admit using their phones almost constantly. In short, juvenile offenders are often more comfortable in front of a computer than in front of another person.

For this reason, EyeDetect is a promising screening tool for juvenile offender sex histories and maintenance. Converus has already designed EyeDetect tests for juveniles and is actively working with ATSA chapters to conduct field studies. Converus will provide this study data to the national ATSA board and local ATSA chapters.

Below is an example of instructions and real questions that are being used for juvenile maintenance:

Test #65301 - Juvenile sex offender probation violations

Pre-test instructions

This is a lie detection test to find out if you have used any date rape drugs. The test will also ask if you have violated any of the conditions of your probation.

First, probation officials are aware and concerned that some sex offenders have given date rape drugs to other people to make it easier to have sexual contact with them, or to assault them. Date rape drugs include Rohypnol, GHB and ketamine, as well as tranquilizers such as Xanax, Valium and Klonopin. Any involvement with these types of drugs to commit a sex crime will result in an investigation by the police. As a sex offender, if you use a date rape drug to have sexual contact or to sexually assault someone, it is a serious crime and you may be arrested, prosecuted, and sent to jail.

Second, we are concerned that you may have violated conditions of your probation. Probation violations could include: 1) using illegal drugs, synthetic drugs, or alcohol; 2) cheating on a urinalysis test; 3) having contact with people that are forbidden or restricted; or 4) sneaking away from supervision. There may be other conditions not mentioned here that you have been ordered to do as part of your probation. It is also a probation violation to commit new crimes, even if you have not been caught. In this lie detection test, you will be asked about using date rape drugs and you will be asked if you are guilty of any probation violations.

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[7] Common Sense Media, San Francisco non-profit, 2015 survey of 2,600 children ages 8 to 18.

Think about your activities. Have you given someone date rape drugs to have sex? Have you used any illegal drugs or synthetic drugs? Have you had any alcohol? Have you misused any prescription drugs? Have you cheated on a drug urine test by taking something or by using a device? Have you worked with or hung out with any criminal gang members? Have you spoken to or hung out with anyone on your "no contact" list? Have you hung out with anyone on probation, on parole, or other type of supervision? Have you snuck out of your house? Have you snuck away from supervision? While under supervision, have you left your home past curfew or skipped school? Have you violated any other conditions of your probation and hid it from your probation officer?

In summary, this test will ask you about using date rape drugs. As previously mentioned, you will also be asked about violating the conditions of your probation. Some examples could include: 1) using illegal drugs, synthetic drugs, or alcohol, 2) cheating on a drug urine test, 3) having contact with people that are forbidden or restricted, or 4) sneaking away from supervision. If you are guilty of using date rape drugs or if you have violated probation, please tell the test administrator now.

The following are examples of relevant questions asked during an EyeDetect test:
1. I have not committed any probation violations.
2. I have been truthful with my probation officer about my behavior.
3. I have lied to my probation officer about my behavior.
4. I am guilty of a probation violation.

The following are examples of probable truth (comparison) questions asked during an EyeDetect test:
1. I have never used a date rape drug on someone to have sex.
2. I am guilty of using date rape drugs to have sex with someone.
3. I used a date rape drug to have sex in the past.

EyeDetect Limitations

To take an EyeDetect test, the examinee must read at least at a junior high reading level. Converus' science team is working on an "audio-only" version of EyeDetect tests and preliminary studies are encouraging. Also, there are certain eye diseases or conditions that may impact an EyeDetect test:

Eye Diseases	EyeDetect is OK	Potential Problems w/ EyeDetect	Notes
• Amblyopia		Yes	
• Astigmatism	Yes		OK with glasses
• Blepharitis		Yes	
• Blepharospasm		Yes	
• Cataracts		Yes	
• Allergic conjunctivitis		Yes	
• Color blindness	Yes		
• Macular degeneration		Yes	
• Entropion and Ectorpion		Yes	
• Strabismus		Yes	
• Glaucoma		Yes	
• Hyperopia	Yes		OK with glasses
• Lagophthalmos	Yes		
• Tearing	Yes		
• Myopia	Yes		

Condition			
• Dry eye	Yes		
• Presbyopia or tired eye	Yes		OK with glasses
• Eyelid ptosis		Yes	
• Keratitis		Yes	
• Keratoconus	Yes		OK with glasses
• Diabetic retinopathy		Yes	
• Hypertensive retinopathy		Yes	

Summary

EyeDetect is a new and useful credibility assessment tool that can quickly, noninvasively, accurately and cost-effectively detect deception. Converus continues to improve the EyeDetect decision model (algorithm) as more tests are administered and analyzed. Computer algorithms learn as they ingest additional data sets, therefore EyeDetect's accuracy rates will continue to improve.

EyeDetect's low cost is compelling to organizations or individuals that cannot afford credibility assessment testing. It is an excellent tool to screen, manage, and monitor many types of offenders. EyeDetect improves outcome confidences and cost-effectively protects citizens from those in the public that have committed illegal acts or are a danger to others.

Additional References

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