Credibility Assessment for Public Safety Background Screening

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Introduction

Studies show that 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 how cognitive load and its correlation to certain behaviors can be measured and analyzed to indicate deception. This is a revolutionary discovery that is not only improving the science of deception detection but also changing the way credibility assessment professionals conduct their business.

The Discovery

While climbing Mt. Rainier in Washington in the spring of 2002, Drs. John Kircher and Doug Hacker, scientists at the University of Utah, had a thoughtful discussion along the trail with Don Kraphol, the Deputy Director of the National Center for Credibility Assessment (or NCCA), about different ways to detect deception. Note: The NCCA is the U.S. federal agency that analyzes and validates credibility assessment (lie detection) technologies. The NCCA also operates a polygraph training school for federally-approved polygraph examiners. It was formerly named the Department of Defense Polygraph Institute, or DoDPI, and the Defense Academy for Credibility Assessment, or DACA.

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 the polygraph. Dr. Kircher has also published more than 50 scientific articles on credibility assessment. Additionally, Kircher has consulted with and conducted research for the U.S. Department of Defense, National Science Foundation, CIA, U.S. 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.

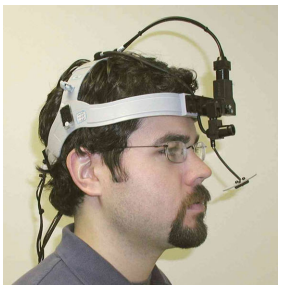
Left to right: Dr. Kircher, Don Kraphol and Dr. Hacker at Mt. Rainier, circa spring 2002.

While at Mt. Rainer, Dr. Hacker mentioned the adage, "The eyes are the windows to the soul." With that, Dr. Kircher suggested that it would be interesting to conduct research to determine if the adage was true.

When he proposed the research concept to the U.S. federal government, Kircher was given a grant in 2003 to buy the latest eye-tracking hardware to conduct the study. Drs. Kircher and Hacker began their work with eye-trackers that were primitive by today's standards (see next page).

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

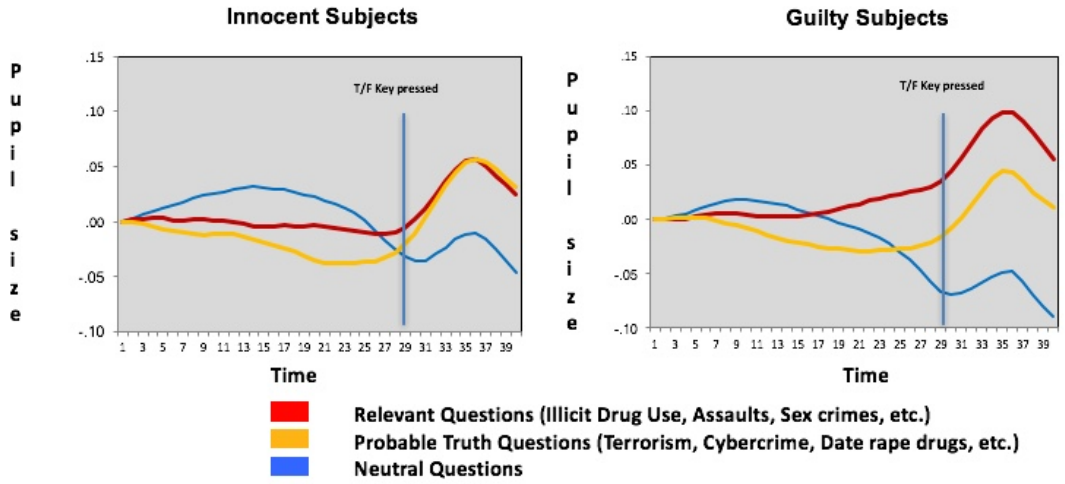
Applied Sciences Laboratory Tracker, circa 2003.



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. Both groups of participants were paid to participate. The scientists offered an extra $20 to those that had stolen money from the purse if they could avoid detection by the eye tracker.

When analyzing the data, Drs. Kircher and Hacker discovered that when questioned about the theft, guilty participants showed an increase in pupil dilation that innocent participants did not. They repeated the experiment multiple times and saw the same patterns in the data. Dilation of approximately 1 millimeter occurred in guilty subjects a few seconds prior to telling a lie and it persisted for 5 to 6 seconds afterwards. (See below.)



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 and 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 improve 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 and other 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 and 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 to determine if the same behaviors are consistent among test subjects in other languages and cultures. Lab and field studies have been conducted in Mexico and the Middle East recently. The Mexico study, "Generalizability of an ocular-motor test for deception to a Mexican population," was published in January 2016 in the *International Journal of Applied Psychology*. Two lab studies conducted in the Middle East (in Arabic) and a field study conducted in Mexico (in Spanish) will soon be published.

Other Studies

As mentioned, the science team has conducted various lab and field studies. The lab studies are summarized in table 1 below. The point estimate for average accuracy of the guilty individuals (true positives) is 82.9%, and for innocent individuals (true negatives) the point estimate average accuracy is 89.3%. The mean point estimate average accuracy rate of 86.1%.

Table 1- A summary of lab studies conducted following the standard testing protocol.

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

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

For the field study described in table 2, the "Guilty" subjects were tested on drugs and contact with test developers (corruption) or affiliation with a religious terrorist organization. The "Truthful" subjects were tested on espionage and sabotage.

Table 2 – The combined results of a field study.

Field Validation	N	n_G	n_I	Guilty	Innocent	Mean
INM FP PGR	154	71	83	88.7	88	88.4

Test accuracies seem highly consistent, probably due in part 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 better than a polygraph by a poorly trained, inexperienced or biased examiner. The use of EyeDetect is like having access to the very best examiner at a moment's notice, 24x7, 365 days a year.

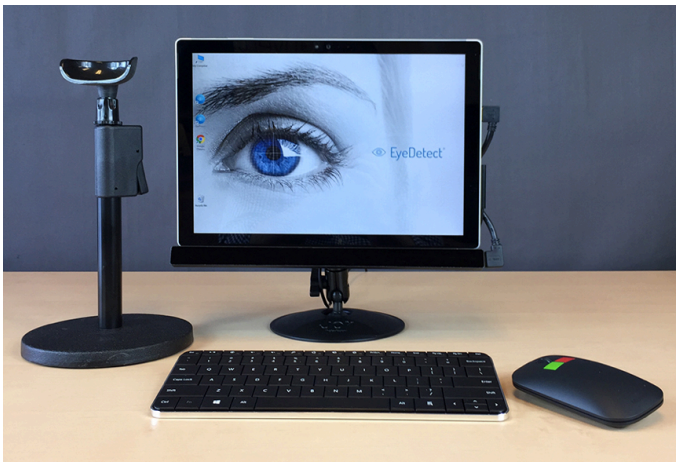
Converus

After the published the peer-reviewed study in 2012, a group of interested parties contacted the Technology Transfer Office at the University of Utah. The role of the Technology Transfer Office is to help professors sell or license their inventions or discoveries to investors that want to commercialize the scientific breakthroughs.

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 and signed agreements with the scientists to continue their R&D. Investors also hired an experienced executive team for Converus to develop and market the product, eventually branded as EyeDetect®. Converus investors include three venture capital funds, company executives, scientists, and other technology investors such as Mark Cuban. After almost three years of additional product development, Converus began selling EyeDetect in 2014.

EyeDetect Hardware

EyeDetect is a hardware and software solution. The hardware currently consists of a Microsoft Surface 4 tablet with Windows 10, wireless keyboard and mouse, chinrest, headphones (not shown), and an eye tracker.



The eye tracker is a high-definition, infrared camera that is connected to the tablet by USB port and is mounted along the bottom of the tablet. This eye tracker takes 60 measurements per second of each eye with pupil measurements as small as 1/100 of a millimeter.

EyeDetect Software

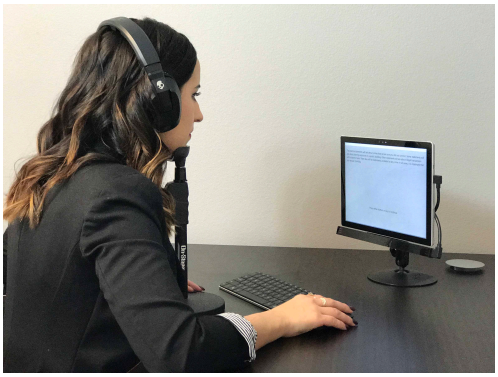
The software for administering tests, monitoring examinees, scoring and viewing test results includes:

1) **EyeDetect Software** – allows tests to be downloaded from the cloud to be administered on the tablet; video records tests; it also uploads the test data to a cloud-based server to be analyzed.
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 680 unique tests in 18 different languages in the Converus test library. Tests are translated and 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. Most tests are completed in about 30 minutes. EyeDetect tests begin with a pre-test explanation of topics using an audio-visual presentation, often through Interview Route Maps, IRMs. 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 when responding quickly.

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).

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

Countermeasures

Countermeasures (actions taken by examinees to affect the test data in order to produce a negative, or truthful, outcome or to not produce a positive, or deceptive, outcome) are difficult with EyeDetect.

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. This also helps identify if there is some organic dilation problem with the test subject's pupils.
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 behaviors.
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.

Dr. Charles Honts, Boise State University, one of the foremost experts on polygraph countermeasures, 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 connection between the brain and the eyes is more direct; the channel from the examinees' central nervous system to the eyes is different than the channel to the autonomic nervous system. The rapid questioning keeps the examinee from using countermeasures effectively. For this reason, I do not currently see any immediate active countermeasure threats to EyeDetect."[4]

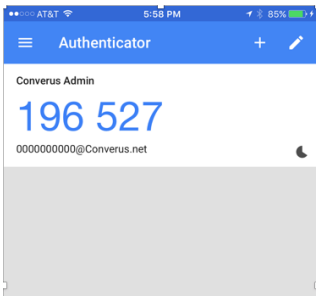
Testing Process

Public Safety agencies can easily administer an EyeDetect test in their office in about 30 minutes. As mentioned, the test results are usually 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.



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

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 – (78 minutes)** Instruction on how to access test results from the cloud-based Dashboard. Administrators also learn how to add users and manage test licenses.

In addition, Converus personnel are available to review any questions and concerns on a subsequent phone call or Skype call.

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

Public Safety Screening Applications

Pre-employment screening for target behaviors including illegal drug use, commission of serious crimes and work-related disciplinary actions are common at U.S. public safety agencies such as police departments, sheriff's offices, fire departments, corrections facilities, etc. EyeDetect can be used to screen both sworn and non-sworn applicants to ensure they meet agency standards.

Testing with EyeDetect early in the recruitment process allows background investigators to focus on recruits that have a high likelihood of passing their hiring process and/or polygraph. Those that fail EyeDetect often self-select out of the recruitment process or make confessions and admissions when informed they failed the EyeDetect test.

EyeDetect was developed as a pre-employment screening tool and standardizes the test questions for all applicants. There is no variability in the test because the computer is the examiner. One EyeDetect test proctor can perform up to 10 EyeDetect tests per standard work day. EyeDetect maximizes the efficiency of the screening process by allowing examiners to do more testing in less time.

EyeDetect Limitations

To take an EyeDetect test, the examinee must read at least at a junior high school reading level, though Converus' science team is working on an "audio-only" version of EyeDetect tests. Preliminary reports show encouraging results and Converus hopes to remove this limitation in 2017 to allow poor or nonreaders to be tested.

There are certain eye diseases or conditions that may impact an EyeDetect test, such as:

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		
• 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 can "learn" as they process additional data sets, therefore EyeDetect's accuracy rates will hopefully continue to improve.

EyeDetect's low cost is compelling to organizations or individuals that cannot afford traditional credibility assessment testing. Also, 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

1. Hacker, D. J., Kuhlman, B., & Kircher, J. C., Cook, A.E., & Woltz, D.J. (2014). Detecting deception using ocular metrics during reading. In D. C. Raskin, C. R. Honts, & J. C. Kircher (Eds.), Credibility assessment: Scientific research and applications. Elsevier, pp 159-216.
2. Kuhlman, B. B., Webb, A. K., Patnaik, P., Cook, A. E., Woltz, D. J., Hacker, D. J., & Kircher, J. C. (2011, September). Evoked Pupil Responses Habituate During an Oculomotor Test for Deception. Poster presented at the Society for Psychophysiological Research convention, Boston, MA. (abstract)
3. Patnaik, P., Woltz, D.J., Cook, A.E., Webb, A.K., Raskin, D.C., & Kircher, J.C. (2015, March). Ocular-motor Detection of Deception in Laboratory Settings. Meeting of the American Psychology and Law Society, San Diego, CA.
4. Webb, A. K., Hacker, D.J., Osher, D., Cook, A.E., Woltz, D. J., Kristjansson, S. K., & Kircher, J. C., (2009). Eye movements and pupil size reveal deception in computer administered questionnaires. In D. D. Schmorrow, I. V. Estabrooke, & M. Grootjen (Eds.), Foundations of Augmented Cognition. Neuroergonomics and Operational Neuroscience (553-562). Berlin/Heidelberg: Springer-Verlag.
5. Webb, A. K, Honts, C. R., Kircher, J. C., Bernhardt, P.C., & Cook, A. E. (2009). Effectiveness of pupil diameter in a probable-lie comparison question test for deception. Legal and Criminal Psychology, 14(2), 279-292.