Automated Deception Detection for Adult and Juvenile Offenders

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Introduction

Most theories of deception detection hypothesize that lying is more cognitively demanding than telling the truth.[1] Deceptive individuals use cognitive resources to inhibit the truth, fabricate the lie, and maintain its consistency, coherence, and believability over time. Deceptive individuals may surveil their own behavior and internal state of arousal to monitor whether they are leaking incriminating information, especially during an interrogation or examination[2]. During interrogation, they may also use cognitive resources to observe the behavior of any interviewers for feedback on their own perceived believability. Inhibiting truthful responses, attempting to maintain credibility over time, monitoring the interviewer and self-monitoring for signs of information leakage are cognitive processes that require mental effort. Therefore, it is more difficult to lie than to tell the truth, and lying causes increases in mental effort (cognitive load), which are measurable.

Psychologists have long known there is a correlation between increased cognitive load and certain eye behaviors. For example, pupils dilate commensurate with cognitive workload increases.[3] For instance, an individual's pupils will dilate slightly when attempting to mentally multiply 17 x 2. By contrast, that individual's pupil dilation will be more pronounced when attempting to mentally multiply 17 x 31. In the same way, an individual's pupils dilate slightly when responding truthfully to questions; but when responding deceptively to questioning, the individual's pupils will show greater dilation because of the cognitive load increase required to fabricate a response. These are two simple examples of how an increase in mental exertion will temporarily increase pupil diameter.

Other important ocular-motor indicators of cognitive processes include:

1) Guilty individuals blink less often as they process statements answered deceptively versus those answered truthfully.
2) Guilty participants respond faster, make fewer fixations, and spend less time reading and re-reading statements about their own inappropriate behaviors than when responding to statements about neutral topics or inappropriate behaviors in which they do not engage.
3) Guilty participates show an increase in cognitive load associated with recalling a task and when distinguishing between deceptive and non-deceptive responses. This is more pronounced when responding to complex statements.

Polygraph and Other Lie Detectors

For decades, the de facto standard in lie detection technology has been the polygraph. Invented in the 1920s, polygraph has been the only credibility assessment tool to show accuracy rates of up to about 90% when used in specific event questioning and 81% in screening tests.[4] The traditional polygraph approach to detecting deception for criminal investigations and general screening applications is to base decision on within-subject comparisons of physiological responses to different types of test questions. Polygraph sensors record breathing movement using transducers wrapped around the chest and abdomen, electro dermal activity from electrodes attached to the tips of two fingers, and relative blood pressure changes via a blood pressure cuff on the upper or lower arm.

In polygraph, various theoretical constructs have been proposed to explain the differential physiological responses of truthful and deceptive people to the different types of test questions. Physiological responses are loaded on one type of question or another as a function of truthfulness or deception. The putative physiological underpinnings of the responses include attention, conflict, conditioned response, and fear of detection. No single explanation is sufficient to account for all effects. Despite the lack of consensus about specific mechanisms producing physiological response, it is clear that emotional processes play an important role in polygraph testing, especially in the field where there may be serious consequences to the individual if he or she fails the test.

In recent years, several new cognition-based tests for deception have been developed, all of which are generally based on the notion that lying is cognitively more demanding than telling the truth. In theory, tests based on the

[1] Johnson, Barnhardt, & Zhu, 2005; Kircher, 1981; Vrij, Fisher, Mann, & Leal, 2000.
[2] Kircher, 1981
[3] Kahneman & Beatty, 1966
[4] Meta-Analytic Survey of Criterion Accuracy of Validated Polygraph Techniques, 2012, table 2.

concept of mental workload may be predominantly cognitive. However, these tests likely include an emotional component, just as polygraph techniques include a cognitive component.

Ocular-motor Deception Test

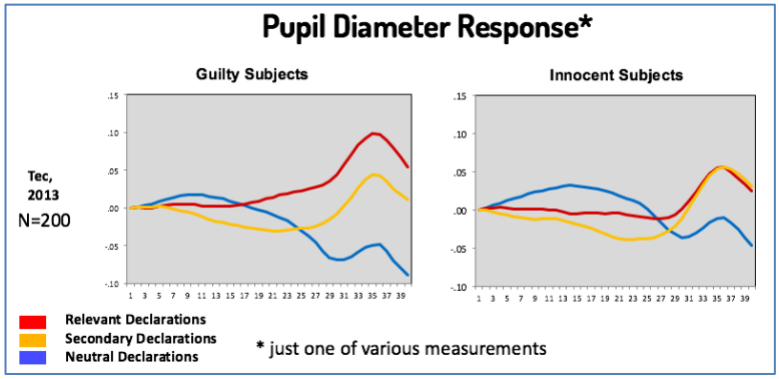
The concept of measuring deception based on ocular-motor (eye) behavior was first conceived in 2003 by two psychologists from the University of Utah, Dr. John Kircher, a psychophysiologist and pioneer in deception detection, and his colleague Dr. Doug Hacker, an educational psychologist with expertise in the psychology of reading. In addition to Kircher and Hacker, three others joined the science team including cognitive scientists Dr. Dan Woltz and Dr. Ann Cooke, as well as well-known polygraph expert Dr. David Raskin. This group researched and tested the concept of an ocular-motor deception test (ODT) for more than a decade.

Kircher, the lead scientist, was co-inventor with Raskin of the computerized polygraph in 1991. Both are recognized experts in deception detection. Kircher has published more than 50 scientific articles and reports related to credibility assessment. He has consulted with, and conducted research on, deception detection 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, and many police departments.

Initially, the science team looked at existing theories that discussed the affects of deception on eye and reading behavior. Then they devised experiments to evaluate a variety of ocular motor responses in cognitive-based exercises to determine if a correlation existed. After nine years of research, their findings were published in 2012 in a peer-reviewed article entitled, "Lyin' Eyes: Ocular-motor Measures of Reading Reveal Deception."[5] In this seminal study, subjects were randomly assigned to either a "Guilty" group that committed one of two mock crimes or they were assigned to an "Innocent" group that only learned about the crime after-the-fact. Subjects completed a computer-administered questionnaire that used true/false statements to address their possible involvement in the mock crimes. Subsequent experiments also manipulated the participants' incentive to pass the test and changed the difficulty of the true/false statements on the test.

In these experiments, Guilty participants had increased pupillary responses to true/false statements answered deceptively. In addition, Guilty participants spent less time fixating on, reading, and rereading true/false statements than participants responding truthfully. These various ocular motor behaviors were measured and were optimally weighted in a logistic regression analysis. By definition, a logistic regression analysis combines one or more variables in a data set to predict a binary outcome, such as truthful or deceptive.

Findings from these and subsequent studies indicated that discrimination between guilt and innocence was improved when offering greater incentives to pass the test and when using statements with simple syntax. These findings suggested that two cognitive processes are involved in deception: 1) vigilance and 2) strategy; and these processes are reflected in various ocular motor and behavioral measures.



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

The science team's efforts produced a cognition-based test that uses ocular-motor measures of cognitive effort, including some based on reading behavior. In general, when a person experiences difficulty in reading a word or phrase, their eyes behave in specific ways and eye responses correlate with performance on a wide variety of cognitive tasks. Although early research on eye behavior suggested that emotional factors are relatively unimportant in determining eye responses, there is an association between the eye response and emotional arousal.[6]

Lab and Field Study Results

In 2016, Kircher conducted field studies with the support and assistance of three groups in the Mexican federal government and published new data that showed the mean accuracy of ODT to be 86% for screening tests using the Relevant-Comparison Test (RCT) protocol. The data was published in in December 2016 in "Laboratory and Field Research on the Ocular-motor Deception Test" in the European Polygraph Journal.

In late 2018, Kircher and Raskin reviewed field data on a small sample of tests using the Directed Lie protocol, which is primarily used for diagnostic or single-issue testing. That data showed the mean accuracy of that protocol to be over 90%. More data will be gathered prior to any publication.

In June 2019, Converus announced the availability of its third testing protocol: Multi-Issue Comparison Test (MCT). The MCT protocol was developed to allow screening tests with 3 relevant issues and 1 comparison issue, where all issues are scored independently. This new protocol is the focus of the dissertation work of Andrew Potts, candidate for Ph.D. at the University of Utah. Andrew is working under the direction of Dr. John Kircher. In his initial lab studies, the overall mean accuracy of the MCT is 88%.

EyeDetect

After the science team reached its conclusions and published the peer-reviewed study in 2012, skilled programmers followed the lab-based processes and developed computer-based software to administer tests in an automated, standardized and objective process. They also developed a web-based dashboard and administration tool to summarize test results. With this software in place, credibility assessment testing precision is increased as potential human error is minimized. There is no examiner bias, nor can the examiner affect the outcome of the test.

These software programs were made commercially available in April 2014 under the brand name EyeDetect® — the world's first ocular-motor deception test (ODT). It is the only screening test to have a mean accuracy as high as 85% in determining deceptive and truthful examinees.

Test Format

In polygraph, there are a number of testing techniques that are considered validated. Some examples include AFMGQT, CIT, DLST, Federal ZCT, and the Utah. With EyeDetect, there are three techniques in use today, and more are being developed.

Relevant Comparison Test

The first to be developed was the Relevant Comparison Test (RCT). Coincidentally, it was originally developed for an automated polygraph screening system by Kircher, Raskin, Gardner, Jewell, and Patnaik in 2002. It was designed primarily as a screening test at border entry points. In the European Polygraph Journal of December 2016, Dr. Kircher and Dr. Raskin published the mean accuracy at 86%. (TN .89 and TP .83)

[6] Bradley, Miccoli, Escrig & Lang, Psychophysiology, 2008 July; 45(4): 602-607.

Essentially, in an RCT, two to four issues are presented to the examinee. Each test includes an issue of primary concern (Relevant Question or RQ) of a variety of target behaviors, such as sex crimes, criminal history, drug use, stealing, association with known criminals, divulging confidential information, drug trafficking, falsifying a police application, etc.

When considering the target behaviors to address with the test, it is important to be as specific as possible to eliminate any uncertainty for the examinee.

The following is a list of common relevant issues. For each issue, additional clarifying information should be provided in the pre-test instructions to ensure the examinee understands the issue.

- ***Stealing***
  - From previous employers or from the current employer
  - Examples: money, products, equipment, raw materials, etc.
  - Value of items: any value, $100, $500, etc.
- ***Drug use***
  - Examples: marijuana, cocaine, heroin, amphetamines, steroids, etc.
  - Time frame: 90 days, 12 months, 24 months, as an adult, etc.
- ***Serious crimes***
  - Crimes against a person or property
  - Committed as an adult
  - Whether caught or not caught
  - Examples: burglary, robbery, drug manufacturing, domestic violence, etc.
- ***Criminal ties***
  - Examples: cartels, gangs, organized crime, other delinquents
  - Type of affiliation: support, work with, receive benefits from, etc.
- ***Divulging confidential info***
  - To unauthorized persons
  - Examples: confidential, classified, secret, top secret, etc.
- ***Bribes***:
  - Accepting or asking for bribes
  - Examples: money, gifts, favors, vacations, etc.

In addition to the relevant question, the RCT includes a secondary relevant issue (called the Comparison Question or CQ). This issue must meet the following criteria:

- Must be a crime more serious than the relevant issue
- No cross over with the primary relevant issue (should not be a related topic)
- Must have face validity for the examinee; the examinee must believe the issue is important
- Expected prior probability of guilt of 1-3%

Examples of CQ topics include terrorism, violent crime, identity theft, counterfeiting, arms trafficking, and others. The CQ is used to measure differences in the examinee's reaction to the RQ. As such, an ipsative, or within-subject measurement is derived to quantify the examinee's comparative reactions between the relevant and comparison issues.

During an RCT, the examinee responds to a series of true (T) and false (F) statements regarding the issues, as well as neutral (irrelevant) and alpha-arithmetic statements. A high-precision eye tracker measures and records eye movements and reading behavior. The eye tracker takes up to 60 measurements per second and records the data while software records aspects of the subject's responses to all T/F statements.

At the conclusion of the test, the ocular-motor measures and test question responses are combined by means of a logistic regression equation to compute the probability of deception to the RQ and CQ questions. There are more than 1 million data points gathered during the RCT.

The test format includes a set of pre-test instructions of the topics using an audio-visual presentation and may include mind maps. Mind maps are graphical representations of the test topics.

The pre-test instructions are followed by two short practice sessions that are used to familiarize the examinee with the testing process. For better test results, it is important the examinee become familiar with the testing process during a practice test rather than during the "real" test.

After the pre-test instructions and practice test, the test is administered for about 22 minutes.

During the test, the examinee must read T/F statements on-screen and respond using a computer keyboard or mouse. There are over 300 questions given during the test. Each question is allocated a specific response time.

Questions are asked every 6 to 9 seconds. To extract the best reaction in the event the examinee is deceptive, examinees must respond quickly. Examinees that intentionally delay in responding, those that respond randomly, or those that attempt to use countermeasures are considered non-cooperative and will be given a Not Credible score in the test.

During the RCT, the examinee must confirm or deny participation in the disqualifying behavior(s) no less than 80 times each. The examinee will also respond to 80 irrelevant questions (general knowledge questions) and 48 alpha-arithmetic questions.

These highly repetitive responses, carried out in a minimal time frame, generate a sufficient amount of data to use for comparison, analysis, and score calculation.

At the conclusion of the test, a Converus Credibility Score is calculated in less than 5 minutes. Credible scores range from 50 to 99 and deceptive scores range from 1 to 49. The closer to 99, the higher the probability of correctly classifying a subject as credible. The closer to 1, the higher the probability of correctly classifying a subject as deceptive.

Also, when test data is scored, a summary report is generated and saved in PDF or HTML format. Test results and scores are available from any web browser that has two-level encryption for access. Each test scored requires a test license.

Directed Lie Test

EyeDetect also supports the Directed Lie Comparison (DLC) test protocol, which is a technique originally developed for polygraph. The mean accuracy is 90%, according to field data gathered and analyzed by Kircher and Raskin in December 2018.

In the DLC test, one relevant issue is presented to the examinee. The RQ could cover issues of primary concern such as specific sex crimes, robbery, theft, drug use, compliance with probation rules, etc. The relevant question pertains directly to the matter under investigation for which the examinee is being tested. The relevant question can also address a screening concern.

In the case of the DLC test, the CQ consists of a series of directed lie questions. These are questions about transgressions that most everyone will readily admit. During the test, the examinee is **directed** to **lie** to this question. In the pre-test instructions, they are referred to as questions for which the examinee is "**required to lie**."

As such, a within-subject measurement is derived to quantify the examinee's comparative reactions to the relevant versus comparison issue, just as the RCT.

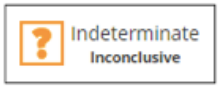
During the DLC test, the examinee will respond to a series of T/F statements regarding the RQ, CQ (directed lie), and some arithmetic statements.

The same eye tracker measures and records eye and reading behavior. At the conclusion of the test, the ocular-motor measures and test question responses are combined by means of a logistic regression equation to compute the probability of deception to the relevant issue.

The test format includes a pre-test explanation of the topics. That preamble is followed by a practice session that is used to familiarize the examinee with the testing process. Then, the test is administered for about 15 minutes. During the test, the examinee must read the T/F statements on-screen and respond using a mouse, computer keyboard or other device. There are 30 versions of the RQ and 30 of the CQ (directed lie) presented. Each question is allocated a specific response time. Examinees must respond quickly — this is to extract the best reaction in the event the examinee is deceptive.

Examinees that intentionally delay in responding, those that respond randomly, or those that attempt to use countermeasures are considered non-cooperative and will be considered having not passed the test.

During the DLC test, the examinee will be asked to confirm or deny participation in the relevant issue 30 times. At the conclusion of the test, a Converus Credibility Score is calculated in less than 5 minutes. In the case of the DLC, an additional test result has been introduced: *inconclusive*. Where the probability of credible or deceptive response is high, a score will be indicated. Where examinee responses are too weak to reliably predict, the outcome of "Inconclusive" will be given.



Credible scores are shown in the range of 60 to 99 and deceptive scores are shown as 1 to 40. The closer to 99, the higher the probability of correctly classifying the subject as credible. The closer to 1, the higher the probability of correctly classifying the person as deceptive.

Also, a summary report is generated and saved in PDF or HTML format. Test results and scores are available from any web browser that has two-level encryption for access. Each test requires a test license.

Our observation is that during diagnostic and screening tests with the DLC test, examinees normally obtain scores on the ends of the spectrum. Most guilty examinees score closer to "1" and most innocent examines score closer to "99". If eye behaviors and other measures are atypical, *Converus would rather indicate "inconclusive" to warrant a post-test interview or follow-on polygraph exam*.

Multi-Issue Comparison Test

This new testing protocol was announced in June 2019. The MCT protocol supports three RQ and 1 CQ in a general screening test wherein each issue is treated independently of the others and is scored separately.

At the University of Utah, Andrew Potts' doctoral dissertation focused on testing this protocol in a lab study. The results were made available in April 2020. In that lab study, the MCT protocol achieved 88% accuracy.[7]

For example, the RQ could address the examinee's participation in target behaviors or activities such as (a) illegal drug use, (b) acts of crime, (c) unreported work-related discipline, as well as a CQ with a lower prior probability of guilt such as (d) terrorism. Unlike the current RCT, the MCT is able to question the examinee about each relevant issue separately.

[7] Potts, A. (2020). "1, 2, 3 Crimes You're Out: Ocular-Motor Methods for Detecting Deception In a Multiple-Issue Screening Protocol." Doctoral dissertation, University of Utah, Department of Educational Psychology.

When the test is scored, there will be an overall score, whether Credible or Deceptive, and information and a score will be provided for each issue to indicate how the examinee reacted. (See image.)

This innovative new protocol allows organizations to screen examinees for up to four target behaviors in a test that takes approximately 28 minutes.

In the MCT, up to three RQ and one CQ are presented to the examinee. Any type of target behaviors, such as sexual assault, criminal history, drug use, stealing, association with known criminals, weapons trafficking, falsifying a police application, etc.

When considering the target behaviors to address with the test, it is important to be as specific as possible to eliminate any uncertainty for the examinee.

In addition to the RQ, the MCT includes a secondary relevant issue (CQ). Like the RCT, this issue must meet the following criteria:

- Must be a crime more serious than the relevant issue
- No cross over with the primary relevant issue (should not be a related topic)
- Must have face validity for the examinee; the examinee must believe the issue is important
- Expected prior probability of guilt of 1-3%

During an MCT, the examinee responds to a series of true (T) and false (F) statements regarding the issues, as well simple math statements. A high-precision eye tracker measures and records eye movements and reading behavior. The eye tracker takes up to 60 measurements per second and records the data while software records aspects of the subject's responses to all T/F statements.

At the conclusion of the test, the ocular-motor measures and test question responses are combined by means of a logistic regression equation to compute the probability of deception to the RQ and CQ questions.

The MCT test includes a set of pre-test instructions of the topics using an audio-visual presentation and may include mind maps.

The pre-test instructions are followed by two short practice sessions that are used to familiarize the examinee with the testing process. For better test results, it is important the examinee become familiar with the testing process during a practice test rather than during the "real" test.

After the pre-test instructions and practice test, the test is administered for about 10 minutes.

During the test, the examinee must read T/F statements on-screen and respond using a computer keyboard or mouse. Each question is allocated a specific response time.

Questions are asked every 6 to 9 seconds. To extract the best reaction in the event the examinee is deceptive, examinees must respond quickly. Examinees that intentionally delay in responding, those that respond randomly, or those that attempt to use countermeasures are considered non-cooperative and will be given a Not Credible score in the test.

At the conclusion of the test, a Converus Credibility Score is calculated in less than 5 minutes. Credible scores range from 50 to 99 and deceptive scores range from 1 to 49. The closer to 99, the higher the probability of correctly classifying a subject as credible. The closer to 1, the higher the probability of correctly classifying a subject as deceptive.

Also, when test data is scored, a summary report is generated and saved in PDF or HTML format. Test results and scores are available from any web browser that has two-level encryption for access. Each test scored requires a test license.

Comparison of Protocols

The chart below shows a simple comparison of the RCT, DLC and MCT protocols. The RCT and MCT protocols are used as screening tests. Each is similar in length of time required for the test, as well as comparable accuracy. The RCT allows for one RQ and the MCT allows for 3. Both tests use a CQ. The DLC is a diagnostic testing tool and focuses on specific issues.

	Use	Time	Accuracy	Topics
RCT	screening	30 min	86%	1R, 1C
MCT	screening	28 min	89%	3R, 1C
DLC	diagnostic	15 min	90%	1R, DL

More on the Algorithm

The science behind the EyeDetect credibility score is a logistic regression equation, which is, as mentioned, a statistical method for analyzing a data set with one or more independent variables.

$$Pr(Deceptive) = 1 / (1 + \exp (b0 + b1X1 + b2X2 + \ldots + bkXk))$$

where X is an ocular-motor characteristic (variable)
where b is an optimal weight

Decision Rule
If Pr(Deceptive) < .50, then “deceptive”
If Pr(Deceptive) $\geq$ .50, then “truthful”

The resulting calculation yields a binary outcome. In the case of EyeDetect, the two possible outcomes are 1) truthful or 2) deceptive. In the case of EyeDetect, the possible outcome is either “deception” or “truthfulness.” The definition of the variables and the use of a logistic regression equation were devised by the science team after years of research and lab testing.

Some of the independent variables considered by the EyeDetect algorithm include pupil dilation, response accuracy, response time, gaze fixation, and reading behavior, among others. The purpose of a logistic regression equation is to find the best fit for the subject matter such as (1) Have you used illegal drugs in the past 2 years? (2) Have you stolen money, products or confidential information from your previous employer? (3) Have you asked for or taken bribes in exchange for preferential treatment of a supplier?

The aim of the equation is to obtain an answer that is reasonable and measurable and that will accurately describe the relationship between the two characteristics of interest (deception or credibility) based on the set of those independent variables considered — pupil dilation, precision response, gaze, response time, fixation, etc.

For EyeDetect, the estimate used in the logistic regression equation chooses one of two parameters that "maximizes the probability" of the classification of deception or credibility. The result is a credibility score. The Converus Credibility Score represents the probability of belonging to the “Credible” or “Not Credible” group of scores for the test administered. A higher score means it is *more probable* that the score came from the Innocent distribution.

Scores from 50 to 99 are considered Credible and scores from 1 to 49 are considered Not Credible. The closer the Converus Credibility score is to 1, the greater the probability of deception. On the contrary, the closer to 99, the more likely it is the person is telling the truth. But a 55 and a 95 are considered “passing” scores while a 5 and a 45 are considered “failing” scores. Essentially, a score of 51 is as good as a score of 99. This is because the decision model (algorithm) establishes “50” at the point where errors are balanced. With the decision model set this way, the test sensitivity is .83 (TP) and specificity is .89 (TN) with a mean average accuracy of .86.

This concept is similar to taking a written test on a computer in which you have “passed” the test when a certain percentage of correct responses are given. If you reach that point, the computer stops presenting questions because you are placed in the passing group.

Personal Information

The information gathered by the eye tracker during a test includes:

1. Measurements of the X and Y coordinates of eye movement, pupil diameter and dilation. These are not photographs, are not biometrics and cannot be used to identify any person.
2. The examinee’s true/false responses to the test questions.

If an organization wishes to protect the identity of any examinee for purposes of reporting testing results, during registration prior to taking a test, the Test Proctor can provide an identifying number rather than a person’s name. A person’s name can be used, but it’s not required.

In addition, the Test Proctor can choose to take a photo of the person being tested. If no photo is taken, the organization will need to find test results for a person based on the assigned ID number–after the test is taken, saved, and scored.

EyeDetect Station and Software

The EyeDetect solution is a combination of computer hardware and software.

<u>Hardware – EyeDetect Station</u>
The primary hardware components of the EyeDetect Station include an eye tracking device (infrared camera), a Windows-based laptop computer, wireless keyboard and mouse, chin rest and noise-cancelling headphones.

The eye tracker is a high definition, infrared camera that operates at 60 frames per second. Therefore, the eye tracker takes up to 60 measurements per second of the examinee’s eyes. Changes as small as 1/10th of a millimeter are detected. During the test, hundreds of thousands of eye measurements are recorded, as well as the examinee’s responses to the true/false statements. The eye tracker has a tracking range of 32 x 21 cm at a distance of 60 cm. It also has a +/- 20° horizontal and + 20° / - 40° vertical range.

During a test, eye measurements and test responses are temporarily stored on an encrypted drive on the EyeDetect Station. When the EyeDetect Station is synchronized with the web server, all test and eye data are uploaded to the server for scoring.

Software

The following software programs are used to administer and score EyeDetect tests and to view and analyze the test results:

1) **EyeDetect Software** (computer-based) – software used for test administration; runs on a Windows-based computer (tablet) provided by Converus.
2) **EyeDetect Admin** (computer-based) - software used to configure the computer to record tests and data for specific accounts (called sub accounts).
3) **EyeDetect Manager** (computer-based) – software used by a test administrator to monitor up to four EyeDetect stations running examinations simultaneously.
4) **Dashboard** (web-based) – a web-based dashboard or portal used to see and review test results, to run reports and to manage test licenses, users, and sub accounts.
5) **Test Manager** (web-based) – software used for test creation; it is available to those who pass the certification test and can be found as a component within the Dashboard

Security

In terms of system security, each EyeDetect station includes either a secure external hard drive provided by DataLocker or a secure internal disk enabled by Microsoft BitLocker. Both are 256-bit AES encrypted.

All test data are encrypted and can only be accessed by users that enter the key or password to unlock the drive. Test data are encrypted using a unique key per customer before being transferred to our secure data center. Once the data are transferred to the data center it is deleted from the DataLocker or BitLocker drive.

The Converus Dashboard web application is accessible using two-factor authentication. All access to the dashboard is done through SSL. Only authorized users of an account with applicable rights can access the dashboard.
With respect to its Data Center, to store and process user data collected during testing, Converus uses standalone (non-hosted) servers owned by Converus, not the data center. 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 SSAE 16/ISAE 3402 certified data center. Access to the data center floor is controlled by key card and biometric scanners and is monitored 24/7.

Process

The examinee is seated in front of the EyeDetect Station monitor. The examinee is asked to quickly and accurately respond to a series of true/false statements for approximately 30 minutes. Responses are given with the computer keyboard. During the test, the eye tracker takes measurements of eye behavior.

Countermeasures

Corrupt examinees may attempt to “cheat” to avoid detection. Additionally, truthful examinees may attempt to influence the test outcome to show they are truthful. Preliminary validation studies indicate that these efforts do impact the testing outcome. EyeDetect monitors subtle deception cues that are impossible to control. Even highly motivated subjects cannot simultaneously control their reading behaviors, response speed, response accuracy, or pupil dilation. Examinees must answer questions rapidly and have little time to attempt physiological countermeasures.

Some examinees may attempt to cheat using makeup (eye liner) and/or eye drops (pupil dilation drugs). These measures are easily detected during the pretest eye-tracking calibration. When this happens, the test can be postponed until the examinee has cleaned off the make-up and/or the effects of the drugs or stimulants have worn off.

Some examinees may attempt to cheat by closing their eyes or squinting. This measure is easily detected in real time by the test proctor via the EyeDetect Manager application or during the test when the calibration screen appears after each brief rest period showing that data loss is significant.

Some examinees may attempt to cheat by answering all questions randomly or by answering all questions with the same response (either all true responses or all false responses). These measures are also detected and a "Not Credible" score will result, either based on "Random Responses" or "Low Reading Comprehension."

Training

The administration and use of EyeDetect requires basic training. The skills required to evaluate test responses and eye measurement data used to derive a test score have been turned over to an algorithm developed by top scientists in the field. The two types of testing roles and training are described as follows:

1) Test Proctor Training – the test proctor will administer EyeDetect tests to examinees. The basic function or role of the test proctor is to welcome the examinee, escort them to the testing station, adjust and calibrate the examinee's eyes to the infrared camera, start the test and monitor the examinee's behavior during the test. Test proctor training takes 3 hours, includes a practical exercise and can be administered remotely using Skype. If desired, there is a Test Proctor certification exam.

   Topics covered in this training include: EyeDetect Station hardware, configuring hardware, performing initial calibrations, overview of EyeDetect Software menus and options, testing room preparation, test preparation, examinee preparation, administering the test, taking a test (such as the acquaintance test, also called a blind number test, or a demo test), submitting test data, and use of EyeDetect Manager.

2) Dashboard Administrator – the administrator manages test results, individual test reports, user access, test licenses, and sub accounts. This training takes 2 hours and can be administered remotely using Skype. If desired, there is a Dashboard Administrator certification exam.

   Topics covered in this training include: accessing the Converus Dashboard, managing and reviewing test results, user login management, account and subaccount management, test licenses management.

There are also two advanced courses, described as follows:

1) Screen Test Writer – any interested person can be trained to write screening tests. The class focuses on the MCT protocol and refers to the RCT protocol. Practical exercises are required to show competence. This class can be taken remotely or in-person. This training takes one-day when attended in person.

2) Diagnostic Test Writer – any interested person can be trained to write diagnostic tests. The class focuses on the DLC protocol. Practical exercises are required to show competence. This class can be taken remotely or in-person. This training takes one-day when attended in person.

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).

In the past, polygraph test construction and proper questioning for such sex offenders has been done improperly. According to expert polygraph examiners, at least 70% of sex-offender polygraphs performed in the United States are improperly administered and scored.[8]

In states where treatment providers contract with government agencies, these providers subcontract for and direct the services of a polygraph examiner. In other states, supervising officers contract with and direct the polygraphist.

Treatment providers and supervising officers 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, so rather than insist on proper test question construction, they routinely use inappropriate questions.

Also, there is wide variability in polygraph examiner training, temperament, competence and bias. Examiners can look at the same physiological charts and have different opinions on whether deception is indicated.

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 cannot be altered on-the-fly by an examiner, treatment provider, or supervising officer.

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

PCSOT

In the United States, post-conviction sex offender tests (PCSOT) are widely used to test convicted sex offenders now on parole or persons on restrictions or probation. There are dozens of EyeDetect tests written for the following testing scenarios:

- Instant offense (first offense) – Did you commit the crime?
- Monitoring – Have you committed the crime again?
- Maintenance – Have you violated the conditions of treatment, probation or parole?
- Sex History – Did you previously disclose all of your past victims?
- Domestic violence – Have you assaulted your spouse or partner?

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[9] 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

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

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

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.

Suitability for EyeDetect Testing

The following are basic guidelines to indicate the characteristics of suitable examinees.

1) As with any other psychophysiological test, examinees should get a good night's rest and have a meal prior to testing.
2) Functional maturity as it relates to reading and comprehension skills are considered more important than age. Examinees must be able to read and comprehend standard test questions. Note: Examinees with reasonable reading skills as young as 11 years old have been successfully tested.
3) Examinees must be able to see well enough to read a computer monitor unassisted or with single magnification glasses, including readers. Bifocal and trifocal lenses should not be used as they may cause a mismeasurement of pupil size by the eye tracker. We also recommend that progressive lenses be avoided, if possible, to reduce the likelihood of misreading.
4) Examinees observed to be impaired by alcohol or drugs should be asked to return at a later date for testing.
5) Examinees that have used eye drops such as tropicamide, an antimuscarinic drug that produces short-acting pupil dilation, should be asked to return at a later date for testing. If such examines are tested, the eye tracker and algorithm will more than likely determine their pupils are reacting atypically and will be given a failing EyeDetect test score for use of a countermeasure.
6) Examinees with excessively dry eyes related to the use of antihistamines, age, or other eye conditions may be difficult to test due to calibration issues with the eye tracker. However, lubricating eye drops have been shown to resolve the issue sufficiently for testing. As long as the EyeDetect software calibrates to the eyes during the process, testing may proceed.
7) Examinees wearing excessive mascara, eye liner, or false eyelashes may be difficult to calibrate with the eye tracker. However, removal of such make-up usually resolves the issue.
8) EyeDetect does not measure heart rate, respiration, blood pressure, or skin conductance and conditions that affect those physiological measures do not generally impact EyeDetect test results.

As a matter of information, the following conditions should not negatively impact examinee suitability as long as the condition does not have a significant or dramatic impact on examinee mental acuity or physical functionality.

1) Attention Deficit Disorder (ADD)
2) Post-traumatic Stress Disorder (PTSD)
3) High functioning autism or Asperger's Syndrome
4) Mild atrial or ventricular arrhythmia or premature ventricular contraction (PVC)
5) Asthma or other breathing disorder
6) Hyperhidrosis (excessive sweating)
7) Mild anxiety
8) Pregnancy
9) Typical use of medications such as antidepressants
10) Examinees as young as 11 years old have been successfully tested

The following eye or vision-related conditions may impact testing. The table below indicates the condition and possible impact, as well as potential remedies (see “Notes.”)

Condition	EyeDetect is OK	Potential Problem	Notes
• Amblyopia		Yes	
• Astigmatism	Yes		OK with glasses
• Blepharitis		Yes	
• Blepharospasm		Yes	
• Cataracts	Possible		Depends on severity
• 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		Use lubricating drops
• Presbyopia or tired eye	Yes		OK with glasses
• Eyelid ptosis		Yes	
• Keratitis		Yes	
• Keratoconus	Yes		OK with glasses
• Diabetic retinopathy		Yes	
• Hypertensive retinopathy		Yes	
• Sjogren's syndrome	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.

Cont.

Research

The Converus Science Team has published articles or reports about the technology underlying EyeDetect®. In the research, EyeDetect is referred to as an ocular-motor deception test (ODT). There are 9 peer-reviewed research articles on EyeDetect. (See sources 1-9 below).

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10. Osher, D. (2006). Multimethod Assessment of Deception: Oculomotor Movement, Pupil Size, and Response Time Measures. (Doctoral dissertation), University of Utah, Department of Educational Psychology. LINK
11. Webb, A.K. (2008). Effects of Motivation, and Item Difficulty on Oculomotor and Behavioral Measures of Deception. (Doctoral dissertation), University of Utah, Department of Educational Psychology. (ISBN: 9780549980032) LINK
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13. Patnaik, P. (2015). Oculomotor Methods for Detecting Deception: Effects of Practice Feedback and Blocking. Doctoral dissertation, University of Utah, Department of Educational Psychology. LINK
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