

Online Proctoring Systems Compared

David Foster

Caveon Test Security

Harry Layman

The College Board

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Introduction

Online proctoring, sometimes called remote proctoring, generally refers to proctors monitoring an exam over the Internet through a webcam. It includes as well the processes, occurring at a distance, for authenticating the examinee as the person who should be taking the exam. Adding to the definition, online proctoring includes any automated processes that help to secure a test administration event.

The term, online proctoring, is more descriptive than and preferable to remote proctoring. It emphasizes the critical use of the Internet and automated processes to produce a secure solution in monitoring test takers. Remote proctoring, on the other hand, is a term that can refer to any proctoring that occurs in a situation remote from a standard testing location (e.g., testing center or school). In particular, the popular “find your own proctor” model, which is often correctly referred to as remote proctoring, has been a less-than-ideal, non-technology-based solution for monitoring exam administration for distance education courses for several decades.

Online proctoring using human proctors in an effective way was first introduced and championed by Kryterion in 2006, and began large-scale operations in 2008. Several other organizations have following Kryterion’s lead. These include Software Secure, ProctorU, Tegrity, Respondus , ProctorCam, B Virtual, and Loyalist. These will be compared and contrasted in following sections of this paper.

What is the value of online proctoring? Why is it becoming a viable option for monitoring exam administrations?

First, many in the testing industry finally acknowledge the security weaknesses of traditional proctoring. As an example, it is hard to miss the reports of cheating from educational statewide assessment programs. This educational example illustrates that much of the cheating that occurs at the lower grades is by the proctors, usually by teachers or other school officials. Local, on-site proctors for any test may know the students being tested and therefore, have a stake in the outcome of the tests making the tests vulnerable to compromise. Standards (e.g., ISO’s 17024 standards for certification) that require proctors be independent of the testing outcomes are often ignored in favor of cost savings, convenience, and resource availability.

Second, on-site proctors are generally considered on par with “volunteers,” meaning they are not paid (or poorly paid), relatively unmotivated, and poorly-trained. There are few models in the high-stakes testing industry where attention is paid to high-quality proctoring.

A third reason is that technology-based alternatives, such as online proctoring, are becoming more capable and are gaining attention. Indeed, there are online proctors who are better trained, may be on career paths, and are able to detect cheating at least as well as onsite proctors (see research section below). Technology-based aides, such as computer/system lockdowns, keystroke monitoring, the ability to stop/start a test, and many other assistive proctoring processes have been relatively easy to integrate into the monitoring process. The following sections of this paper describe online proctoring functionality, and compare that functionality across providers. These comparisons are not meant to be exhaustive. Instead, they are a means to provide the reader with what is available for this new type of proctoring.

Vendor Information

Table 1 lists the major vendors of online proctoring as of the time of this writing. The approach and capabilities they provide in offering high-stakes security services varies widely; they cannot be considered equivalent. The differences between their products are described in some detail in the various comparative tables that follow.

Table 1 – Basic Vendor Information

Online Proctoring Organizations	Website	Description
Kryterion Inc.	www.kryteriononline.com	Launched in 1999; a Drake International company (founder of Prometric in 1990)
Software Secure	www.softwaresecure.com	Long-term provider of services; known for integrated camera a fingerprint device
ProctorU	www.proctoru.com	Founded in 2008; associated with Andrew Jackson University
B Virtual	www.bvirtualinc.com	Member of B Wyze Group, a leader in remote workplace innovation
Tegrity	www.tegrity.com	Grew out of Tegrity lecture capture technology; a CTB-McGraw Hill company
ProctorCam	www.proctorcam.com	Founded in 2007 and based in Boston. Massachusetts
Respondus	www.respondus.com	Assessment applications for elearning market; entering the online proctoring market space
Loyalist Exam Services	http://www.loyalistexams.com	A division of Loyalist College in Ontario, Canada

It is important to know that some of the vendors have more than one product for online proctoring. Usually these are differentiated by the degree of security offered. For example, Kryterion Online Proctoring, or OLP, provides more security than its Proctor101 service. Software Secure has for high-stakes tests Remote Proctor Pro, but offers Remote Proctor Now for programs requiring less security or wishing to simply pay less. The other organizations offer a single service, although options or customization may be available.

Other relevant products/services:

- Software Secure offers to its clients with high-stakes programs a hardware device, called Remote Proctor, which includes a 360-degree camera and a fingerprint reader.
- Kryterion’s Konnect product wraps its Proctor101 solution around learning management systems (LMS), such as Blackboard, providing the LMS users with additional security when students are taking exams.

Features of Online Proctoring Systems: Comparison Matrices

The following sections of this document contain tables that compare the various services/products for online proctoring. Instead of a single large matrix the information has been partitioned into multiple tables to facilitate comparison and, where appropriate, detailed commentary.

A future version of this paper could add additional detail to support more comprehensive offering comparisons; here we have attempted to capture as many high level security relevant features that we could find. For example, on the topic of how programs store video information that may be gathered during testing, our high level summary indicates whether video is stored or not. A more robust comparison of the offerings could provide further detail, such as the format of the video file, where it is stored, how much is stored, how long it is stored, how it is accessed, etc.

Disclaimer

The authors have greater familiarity with Kryterion’s products than the other vendors’ products, and we have been comprehensive in disclosing Kryterion’s products’ features. Significant effort (interviews, visits to web pages, press releases, etc.) were made to gather public information on all the products listed, but we were not always successful in

obtaining comparable details on all products. When in doubt the table cells were left blank. A blank cell means that the information about a particular feature may be known, especially by representatives of the specific vendor. An additional caveat is that, for the most part this, this information represents the responses provided through interviews of vendors and their representatives, and information found on web pages and from other sources. It is possible, even likely, that not all of the information is accurate, and may instead reflect aspirational marketing messages rather than validated functionality, but we have tried to reflect accurately, in security terms, the information and capabilities claimed by the respective vendors. We invite input from vendors and other interested parties so that future versions of this document will be more accurate.

Also, we followed the rule of thumb that if a vendor provided a majority of the inherent features for the characteristic listed in the first column of each row, we put a **Yes** in the cell. If the vendor seemed to support only a minority of the characteristics, we put a **No** in the cell. From time to time, this summarization may lead to errors in some of the decisions and comparisons. We welcome any suggested corrections.

Online Proctoring

This section specifically refers to the elements relating to various aspects, both human and technology, of the proctoring process. Some of the features are broken out more specifically in later comparative matrices.

Proctoring Features	Kryterion	Software Secure	ProctorU	B Virtual	Tegrity	ProctorCam	Loyalist	Respondus
Online Proctor During Exam	Yes	No ²	Yes	Yes	No	Yes	Yes	No
Continuous Internet	Required	No	Required	Required	No	Required	Yes	No
Encryption for Data Transfer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Schedule Availability	20/7/362	24/7/365	20/7/362			15/5/?	24/7/365	
Proctor Management	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Supervised	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Training	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Career Path	Yes				No	Yes	Yes	No
Certification	Yes		Yes	Yes	No		Yes	No
Interaction with Test Taker	Yes	No	Yes	Yes	No	Yes	Yes	No
Live Chat	Yes	No	Yes	Yes	No	Yes	Yes	No
Canned Messages	Yes	No			No	Yes	Yes	No
Live Instruction to Examinee	Yes	No	Yes	Yes	No		Yes	No
Proctor Views examinee Screen	No	No	Yes	Yes	No	Yes	Yes	No
Proctor as Collusion Threat	No	No	Yes	Yes	No	Yes	Yes	No
Prevent Proctor View of Screen¹	Yes		No	No	Yes	No	Yes	Yes
Later Video Review Proctoring	No	Yes	No	No	Yes	No	No	Yes
Later Video Review Capable	Yes	Yes	No		Yes	Yes	Yes	Yes
Control During Test Session	Yes	No	No	No	No	No	Yes	No
Test Launch	Yes						Yes	
Pause Test	Yes	No	No	No	No	No	Yes	No
Suspend Test	Yes	No	No	No	No	No	Yes	No
Cancel Test	Yes	No	No	No	No	No	Yes	No
Automated Proctoring	Yes	No	No	No	No	No	No	No
Inappropriate Keystroke	Yes	No	No	No	No	No	No	No
Audio Levels	Yes	No	No	No	No	No	No	No
Real-Time Data Forensics	Yes	No	No	No	No	No	No	No
Lockdown (see separate table)	Yes	Yes	No	No	Yes	No	Yes	Yes
Authentication (see separate table)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Webcam (see separate table)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Logs/Records	Yes	Yes	No			Yes	Yes	
Video Storage	Yes	Yes	Yes			Yes	Yes	
Session Review	Yes	Yes	No			Yes	Yes	
Time-Stamped Incident	Yes	No	No			No	Yes	
Incident Logs	Yes	Yes (5 days)	No			No	Yes	
Program Customization	Yes						Yes	
Levels of Security Decisions	Yes						Yes	
Allowed/Specified Aids	Yes						Yes	
Effectiveness Research³	Yes; Published	none	none	none	none	none	Yes; Not Published	none

¹For security reasons Kryterion proctors are not allowed to view the content of examinee workstation screens. Internal laptop webcams are not able to view the screen, but at least one vendor (ProctorU) records and stores the content of screens.

²Software Secure describes its proctors as professional proctors that review the test session recording after the test has completed.

³Refers to the effect of online proctoring methods on frequency and degree of security problems. Research is presented later in the paper.

Lockdown Features

Some online proctoring systems make an effort to provide a “lockdown” program, but there are large differences in what that means and the various components involved. It may refer simply to locking down a browser, not allowing the test taker to access other URL’s. Or it may mean taking control over the examinee’s computer, controlling the operating system, detecting the use of peripheral devices or the various computer ports. It may also entail the use of more proactive security efforts such as detecting inappropriate keystrokes or function invocations (e.g., ctrl-alt-tab or prnt scrn on Windows computers). This table attempts to list the various features of lockdown programs offered by the online proctoring vendors. Since lockdown programs can be provided by third-parties, and some online proctoring system offer third-party lockdown capabilities while other vendors may use their own lockdown capability. This information is also reflected below. Some online proctoring systems do not require or use a lockdown browser. For ProctorU the proctors have a view of the examinee workstation screen (which for some might itself be a significant security risk) and may be able to tell if a person attempts to copy the screen or launch an application, or some other prohibited act. For others (B Virtual and ProctorCam) it isn’t clear how the proctor is able to know about and/or control typically locked-out features.

Lockdown Features	Kryterion ²	Software ² Secure	ProctorU	B Virtual	Tegrity	ProctorCam	Loyalist	Respondus
Owned or Third Party	Owned	Owned	NONE ¹	NONE ¹	Respondus	NONE ¹	Owned	Owned
Windows and Mac	Both	Both	Neither	Neither	Both	Neither	Both	Both
Browser	Yes	Yes	No	No	Yes	No	Yes	Yes
Prevent browser control buttons	Yes		No	No	Yes	No	Yes	Yes
Prevent navigation	Yes	Yes	No	No	Yes	No	Yes	Yes
Prevent simultaneous tests	Yes		No	No		No	Yes	
Test exit controlled	Yes		No	No	Yes	No	Yes	Yes
Operating System/Computer	Yes	Yes	No	No	Yes	No	Yes	Yes
Prevent right-click	Yes		No	No	Yes	No		Yes
Prevent printing	Yes	Yes	No	No	Yes	No	Yes	Yes
Prevent function keys	Yes		No	No	Yes	No		Yes
Prevent important key combos	Yes		No	No	Yes	No		Yes
Hide Taskbar and Desktop	Yes		No	No		No		
Hide menus and icons	Yes		No	No		No		
Prevent min/max windows	Yes		No	No	Yes	No		Yes
Prevent Copy/Paste	Yes	Yes	No	No	Yes	No	Yes	Yes
Prevent running of applications	Yes	Yes	No	No	Yes	No	Yes	Yes
Prevent launch of applications	Yes	Yes	No	No	Yes	No	Yes	Yes
Prevent communication tools	Yes	Yes	No	No		No	Yes	
Detection Support w/Alerts	Yes	No	No	No	No	No		No
Inappropriate Keystrokes	Yes	No	No	No	No	No		No
Response Capture and Use	No	No	No	No	No	No		No
Latency Capture and Use	Yes	No	No	No	No	No		No

¹ProctorU’s proctors are able to view the examinee’s screen and may be aware of some of the activities that are locked-down by other vendors. B Virtual and ProctorCam do not describe a lockdown procedure, or workaround.

²Kryterion and Software Secure both have two different products for high and moderate security needs which are not separated on their columns. Kryterion’s Proctor101 product allows proctors to view the test taker screen but does not provide the lockdown that is required as part of its OLP service. The low-security solution for Software Secure’s Remote Proctor Now has no lockdown and no online proctors who can view the examinee’s screen.

Authentication

Authentication refers to the process of making sure that the person beginning the exam—and remaining at the exam workstation until it is finished (excluding planned breaks)—is the person who is supposed to be there. There are many ways to authenticate a person, and the table below lists those ways offered by the various online proctoring systems.

Authentication in traditional testing models is the responsibility of the proctor or test administrator, often the same person. More recently, with technology-based testing, that responsibility can switch to automated processes. Authentication may be handled well automatically by the testing system without the involvement of the human proctor.

Authentication is not the same thing as identification, an important distinction. Identification is the process of determining who the test taker actually is, a much more difficult, if not impossible task for proctors—and generally not required for high-stakes testing needs. In addition, identification is a process fraught with policy, privacy and legal issues. Most methods of authentication are useful while avoiding some of these issues.

Most of these online proctoring organizations record the testing session through the webcam and store the information for later review. It is possible to use a review of the stored video to supplement the authentication process or at least evaluate whether the examinee remained throughout the exam. Storage of video information is described in the Proctoring Features matrix.

Authentication Options	Kryterion	Software Secure	ProctorU	B Virtual	Tegrity	ProctorCam	Loyalist	Respondus
Authentication	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Username/Password Login	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Government-Issued ID	Yes	No	Yes		Yes	Yes	Yes	
Photo Comparison	Yes	Yes	No	No	No	No	Yes	No
Keystroke Analytics	Yes	No	No	No	No	No	No	No
Challenge Questions	Yes	No	Yes	No	No	No	No	No
Facial Recognition	Yes	No	No	No	No	No	No	No
BioSig	No	No	No	No	No	No	No	No
Voice Recognition	No	No	No	No	No	No	No	No
Fingerprint Reader	No	Yes	No	No	No	No	No	No
Palm Reader	No	No	No	No	No	No	No	No
Iris Reader	No	No	No	No	No	No	No	No

Webcam Use and Features

All online proctoring systems rely on a webcam with an integrated microphone (these may be separate features of a laptop or tablet or a stand-alone wireless or wired camera/mic). The webcam with microphone is primarily used to monitor, to chat with and to record the behavior of the examinee during the exam, but may also be used in the authentication process. For the latter, it may be used to facilitate facial recognition software, to capture/compare a photograph of the examinee, to capture a spoken phrase for voice recognition, or to take a picture of a government-issued ID.

Webcam Features	Kryterion	Software Secure	ProctorU	B Virtual	Tegrity	ProctorCam	Loyalist	Respondus
External ⁷ or Internal camera	Both ¹	Both ¹	Internal	Internal	Internal	Internal	Internal	Internal
Internal Camera View Angle	About 45°	About 45°	About 45°	About 45°	About 45°	About 45°	About 45°	About 45°
External Camera View Angle	110° ⁵	360°	n/a	n/a	n/a	n/a	n/a	n/a
Cost of External Camera	\$40 ³	\$125 ⁴	n/a	n/a	n/a	n/a	n/a	n/a
Cost of Internal Camera	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.
Allow Panning of Room ²	Yes	Yes ⁶	Yes				Yes	

¹Both refers to the fact that external cameras are used for the high-stakes service while the internal camera is used for tests of moderate or low stakes.

²Panning using the internal camera of a laptop is possible but more awkward than using a wireless or wired external camera.

³The moderate cost per camera can be viewed as being spread out over the number of exams an examinee might take.

⁴This cost includes the cost of the fingerprint reader integrated into the Remote Proctor device. Cost was obtained from http://www.troy.edu/news/mediakits/remote_proctor.pdf.

⁵This is the viewing angle for Kryterion's recommended camera. Off-the-shelf webcams range from 58° (basic) to 80° (wide angle). Software Secure's Remote Proctor has a 360° field of view with software that "normalizes" the view.

⁶Remote Proctor Now uses panning of the room. With a 360° camera, Remote Proctor Pro doesn't need to pan the room.

⁷There is no argument that an external webcam provides a much better continuous view of the testing environment; however, is difficult to position external webcams, at least for the first time with students. I'm not sure about Software Secure's Remote Proctor, but Kryterion has developed and has been using a number of methods to help examinees position the camera correctly, including step-by-step instructions, sample screens and immediate technical support.

General Comparisons and Related Issues

The following tables came from a presentation by William Dorman and David Foster, both of Kryterion, at the European Association of Test Publishers conference in Berlin in September of 2012. (Used with permission.)

Authentication Methods

In the table below, various authentication methods are compared. Ease of Compliance refers with the ease of complying with privacy regulations. Accuracy refers to the number of false positives and false negatives that might be produced by the particular methodology. A High designation would mean that the method would produce fewer of these errors.

	Passwords	Government ID	Keystroke Analytics	Facial Recognition	Challenge Questions	BioSig ID	Fingerprints
Price	\$	\$	\$	\$	\$\$	\$\$	\$\$\$
Logistics	Easy	Easy	Easy	Easy	Medium	Easy	Difficult
Ease of Compliance	Easy	Easy	Easy	Medium	Difficult	Medium	Difficult
Accuracy	Low	Medium	High	Medium	Medium	Medium	High

Webcam Model Comparison

Various types of webcams are used today in online proctoring systems. They differ in terms of their field-of-view and whether they are integrated into the computer hardware, relevant differences for a critical component of the security procedures. The webcams are compared on resolution and cost; and some advantages and disadvantages are presented.

	Internal Webcam	70 Degrees	110 Degrees	360 Degrees
Resolution	High	High	Medium	Low/Medium
Cost	0	\$	\$	\$\$\$
Advantages	Easy to Support	Good Resolution	Good Resolution	Full-Room View (not under desk/table)
Drawbacks	Limited view	Not whole room	Not whole room	Low resolution; confusing image

Proctoring Models

The following table compares various proctoring models on cost and the ability to deal with security issues and proctoring.

	No Proctoring (honor system)	Find Your Own Proctor	Online Proctoring: No Interaction	Passive Proctoring: Review Video After Session	Online Proctoring with Online Interaction	On-Site Proctoring
Cost	0	\$\$\$	\$	\$\$	\$\$	\$\$\$
Collusion Risk	Not applicable	High	Low	Low	Low	High
Ability to Deter Fraud	Low	Low	Low	Low/Medium	High	Medium
Proctor Motivation/Training	Not applicable	Low	Medium	Low	High	Low

Effectiveness						
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Proctor Management

All test administration systems using proctors are able to manage those proctors to some degree. Many, if not most, programs utilize part-time, un-motivated and relatively un-trained proctors. Sometimes those proctors have a stake in the testing outcome. Online proctoring systems specifically work to create a highly trained and professional proctoring workforce, with certification and levels of supervision and escalation. The following table compares three broad proctoring models and indicates how easy or how hard proctor management is.

	Find Your Own Proctor	Test Center Proctor	Online Proctor
Proctor Supervision	Difficult	Moderate	Easy
Certifying Proctor Staff	Difficult	Moderate	Easy
Ongoing Training of Proctors	Difficult	Moderate	Easy
Career Path Training	None	Some	All

Conclusions, Cautions, Pricing, and Research

This paper was intended to provide a fair comparison of features of online proctoring systems currently in operation as of this date. The reader should remember that security of exams, and integrity of an assessment program more broadly, are not dependent solely on the proctors or the entire proctoring system involved in test administration. Among other test security efforts, a program should pay attention to potential item theft from employees, contractors, and partners. A program should also make a significant effort to establish rules and policies for test security and make sure that examinees and others are aware of them. It should provide clear and public information about how and where infractions and attempts to compromise the integrity of a test can be reported, including anonymous channels. Data collected need to be secured against hacking and theft. Infractions of program policies and rules should be dealt with swiftly and fairly and according to a published list of consequences. By applying these and other non-test-administration security efforts, and by securing the test administration as well as possible, a program will minimize its risks and the effects of existing and potential threats.

In the near future more and more high-stakes testing programs will consider using online proctoring as a partial or complete solution to secure test administration needs. The interest is growing for an online solution that provides high test security in unique, but necessary locations (e.g., homes, community centers, hospitals, retail stores, etc.). While several different vendors have been compared in this analysis, they differ in many ways, but especially in terms of security. Test security, like other types of security, is not effective if done piecemeal. Any remaining vulnerabilities will certainly be exploited, and test fraud will increase. With the number and capability of security threats increasing each year, and a greater focus on assessment and testing across industry and academia, test publishers and assessment program owners face a significant challenge in preventing existing levels of test fraud, item theft, and program compromise.

In our view, and as supported in this analysis, of the vendors, only Kryterion’s OLP solution has the security level sufficient for high-stakes test administration. Here is a table comparing the solutions/products/services relative to effectiveness against features targeting security threats:

Overall Security Capability	Unbiased and Trained Proctors	Lockdown of Browser and System	Interaction with Examinee	Control over Testing Session	Wide View of Testing Environment	Automated Proctoring Technology
Sufficient Security for High-Stakes Testing¹						
Kryterion OLP	Yes	Yes	Yes	Yes	Yes	Yes
Sufficient Security for Low-to-Moderate-Stakes Testing²						
Kryterion Proctor101	Yes	No	Yes	No	No	No
Software Secure Remote Proctor Pro	No	Yes	No	No	Yes	No
Software Secure Remote Proctor Now	Yes	No	No	No	No	No
Tegrity	Yes	Yes	Yes	No	No	No
B Virtual	Yes	No	Yes	No	No	No
Respondus		Yes		No	No	No
Loyalist	Yes	Yes	Yes	Yes	No	No
ProctorU	Yes	No	Yes	No	No	No
On-Site Proctoring (for comparison purposes)						
On-Site Proctoring Models	Usually No	Sometimes	Yes	Sometimes	Yes	No

¹Kryterion’s Online Proctoring has security roughly equivalent to security provided with on-site proctoring. The level of security may even be higher given the wide variability in the training and motivation of on-site proctors. In addition, in some circumstances, on-site proctors have a stake in the testing outcomes and may participate in the test fraud.

²Less capable security systems are not able to professionally prevent, detect, handle or even prepare for most security threats. These will work fine low-stakes exams, or to satisfy different government agencies’ minimal authentication requirements.

Research

There is not a great deal of published research on online proctoring. Most organizations that provide online proctoring services have not yet published or presented research as to their effectiveness. Our review has found that only Kryterion has conducted research on the security effectiveness of its online proctoring. All of the projects mentioned below researched Kryterion’s Online Proctoring service (OLP) as a case study or compared it with traditional methods of proctoring. One of the projects was conducted with the assistance of The Pennsylvania State University World Campus (Foster, Mattoon, and Shearer, 2009; found at www.ou.nl/Docs/Campagnes/.../Papers/Final_Paper_101Walker.pdf). A second paper by Case and Cabalka (2009; found at http://www.uwex.edu/disted/conference/Resource_library/proceedings/09_19933.pdf) used data from Western Governors University final exams and looked at security effectiveness, operational issues, and student satisfaction. A third study (Foster, 2010; presented at ATP) looked at proctoring “tickets,” logs of security incidents, from almost 6000 OLP test takers. The frequency results are shown in the table below:

Security Incident	Frequency	Percent
Authentication Failed	0	0%
Invalid Keystrokes	32	0.5%
Leaving View of Proctor	28	0.5%
Talking During Exam	7	0.1%
Using Unauthorized Test Aids	93	1.5%
TOTAL:	160	2.7%

In a fourth study (Foster, 2012, unpublished) used Caveon’s data forensics methodology to analyze the test results from both OLP (6,794 tests) and a testing-center-based system (2,374) delivering the same exams. This study found that the methods did not differ statistically on all data forensics target statistics (e.g., collusion, latency aberrance, score

aberrance, test similarity, perfect tests, etc.). Using Caveon’s conservative criteria for flagging security incidents, the results indicated that tests administered under OLP conditions do *not* result in a greater number of security incidents.

Pricing

As with other test administration models, pricing is affected by a number of factors including volume discounting, levels of service, competition, etc. Generally, the low-to-moderate-stakes offerings range between \$15 and \$25 per test. For high-stakes the price is higher, between \$25 and \$45.

Final Comments

One additional positive and exciting aspect of online proctoring systems, in general, is that they are connected to and incorporate a range of new technologies, many of which continue to improve over time. There are several potential sources of improvement in the near term. First, webcam capabilities will get better in both resolution and in field-of-view. Second, targeted interaction between the examinees and the test administration system will help to discourage cheating. These include efforts to better educate examinees on the security rules, to communicate actively with them during the exam, and to immediately deal with potential security problems (e.g., *during* the exam). Third, data forensics methodologies are evolving and could have greater impact in real-time testing events, statistically catching cheating “in-the-act” or just before scores are awarded. Fourth, these newer systems can take advantage of existing data sources (demographics, test stakes, testing history, etc.) to better evaluate the level of security risk, using that data to allocate additional security resources for higher risk events and examinees.

Contact Information for Authors

David Foster

david.foster@caveon.com

dfoster@kryteriononline.com

Harry Layman

hlayman@collegeboard.org