Detecting and Addressing Remote Proctoring Security Issues in High Stakes Exams: Overview and Case Studies

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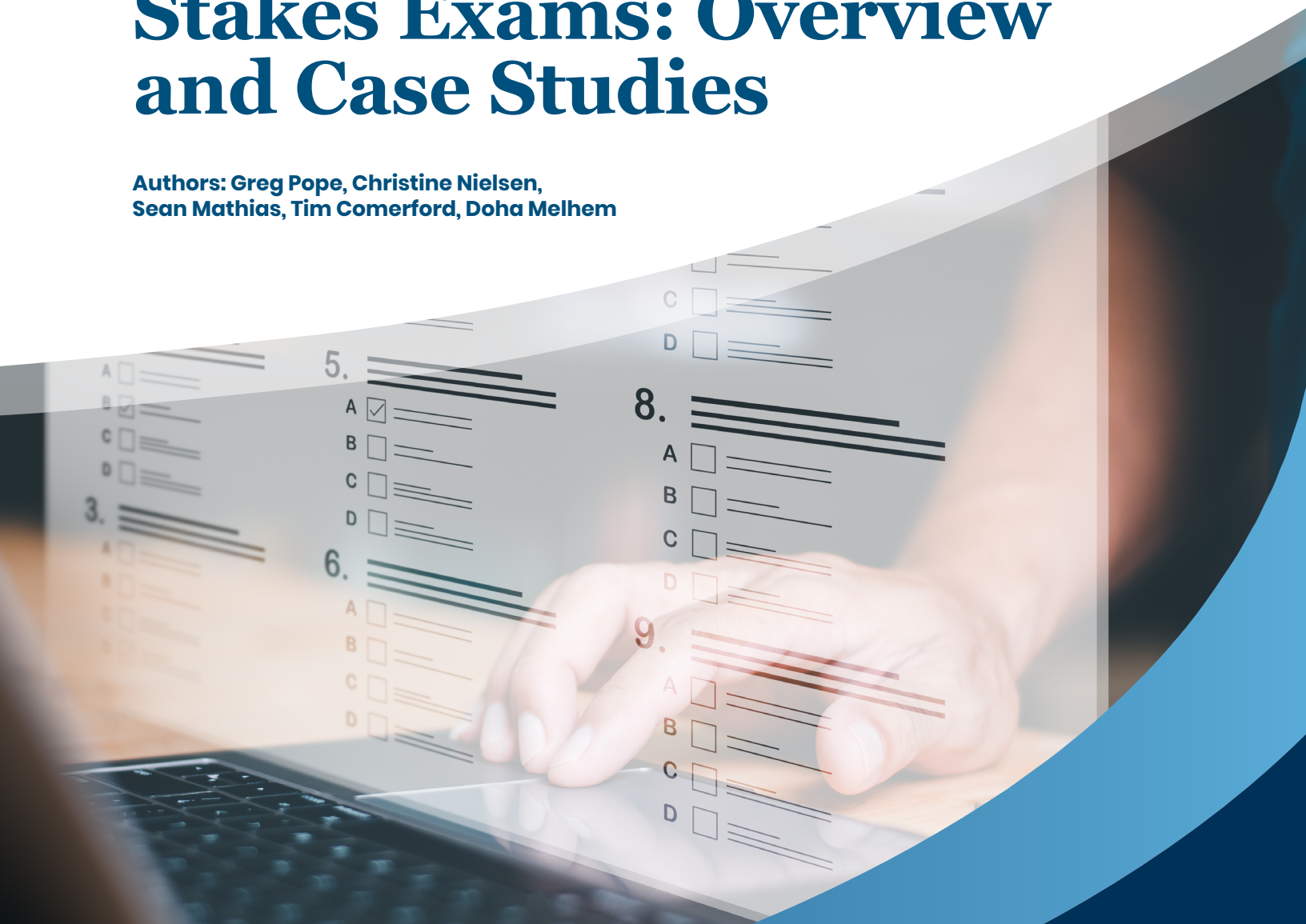

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Chapter 1
Introduction

Remote proctoring is similar to an in-person test centre exam - oversight of candidates is done in a remote manner to ensure the security of the exam being administered. In an in-person brick-and-mortar test centre candidates are guided through the pre-exam processes with the proctor face-to-face, whereas in a live remote proctored context, the candidate is guided through the process via webcam, microphone, and chat box. In a test centre - when candidates take their exam, the proctor supervises many candidates in a room. In a remote proctored context, the same model is followed but the remote proctor supervises candidates remotely via webcam and microphone, with specially designed anomaly detection software assisting the proctor during the exam session to flag cases where a candidate is engaging in suspicious behaviour. When the exam session is completed, proctors in a test centre collect any scratch paper used and help the candidate close out the exam session. In a remote proctored context, the remote proctor follows similar procedures remotely in terms of helping the candidate close out the exam session. Generally, if note taking is permitted for the remote proctored exam, instead of physical scratch paper a notepad feature built into the exam taking interface is available for the candidate.

The CNAR white paper released in September 2021 entitled “An Introduction to Remote Proctoring” covered many aspects of remote proctoring including:

- Models of exam proctoring.
- Stakes of assessments and matching stakes to proctoring models.
- Strength and weaknesses of proctoring models.
- Equivalence of remote proctoring to test centre candidate performance.
- Detailed descriptions of how remote proctoring works.
- Key considerations when using remote proctoring.
- Common remote proctoring vendor products and services.

Readers interested in obtaining a primer covering the above topics on remote proctoring are encouraged to read “An Introduction to Remote Proctoring” white paper.

This paper focuses specifically on detecting and addressing remote proctoring exam security issues. An overview of current features available in remote proctoring software will be provided along with how those features are currently used to address security issues. Case studies of Canadian professions using remote proctoring are featured, including how they have leveraged remote proctoring capabilities to detect and address security incidents. Finally, this paper will explore the potential future direction of remote proctoring in the context of high stakes credentialing assessment.

Chapter 2

Current security features of remote proctoring and how test administrators use them

High stakes exam security products and services used by remote proctoring vendors to ensure the security of the exam program often mimic what is offered at brick-and-mortar test centres. These include:

- **Identity authentication** where a candidate must provide government issued identification to confirm they are who they claim to be

  This ensures that the appropriate candidate is taking the exam and that someone else is not taking the exam for the candidate (proxy). At a test centre, a proctor would check a candidate's government issued ID in person comparing it to the identification information on file. In a remote proctored context, the candidate presents their ID via a webcam and the proctor checks the ID against the information on file. If the information does not match then the candidate is prevented from taking the exam ensuring that the exam content is not exposed.

- **Candidate authenticity checks** to ensure that candidates are the same person if they take a washroom/comfort break and need to continue with the exam

  Exam administrators that allow candidates to take comfort breaks during the exam generally require that the candidate re-confirms their identity when they return to avoid a proxy taking the exam for the candidate. Whether the candidate is in a test centre or taking the exam via remote proctoring the proctors verify the candidate's ID similarly to how their identity was confirmed when they started the exam session.

- **Locked down browsers** that ensures that candidates cannot access unauthorized web sites or take screen shots of the exam item content

  The candidate is required to install software on their computer that prevents them from accessing anything that they should not be such as other websites, software, or their local hard drive while the exam is being taken. These locked down browsers usually require administrative privileges to install the software on the candidate's computer. In a test centre the test centre IT department is responsible for installing locked down browsers and other software required for testing candidates.

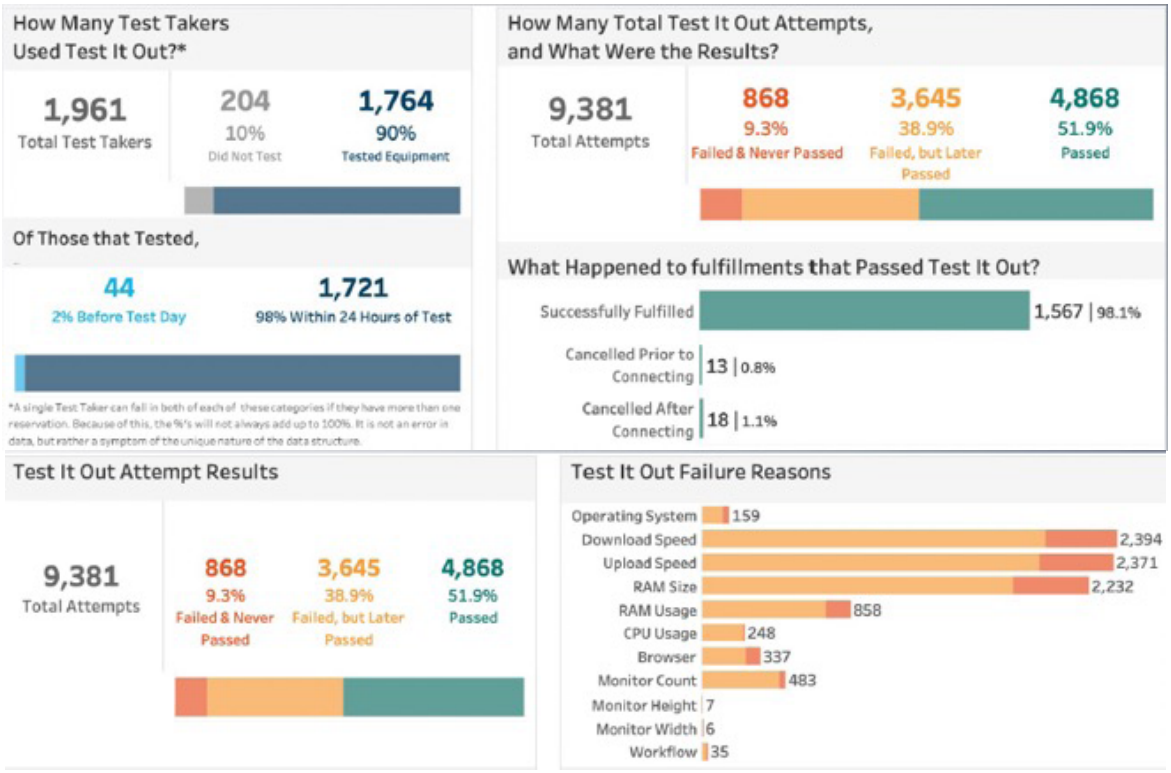
- Real time **Artificial Intelligence (AI) software** and human proctor interventions for candidates who read question content to themselves or consume food/beverages during the exam that are not permitted

In a test centre with many candidates in the room, candidate behaviour such as reading questions aloud or eating/drinking can be disruptive to other candidates as well as pose a potential security concern. In a test centre proctors ask these candidates to stop the behaviour immediately. The same happens in a remote proctored context where the remote proctor can hear and see the candidate. Although in a remote context there are no other candidates around to disturb, reading questions aloud is a security risk as listening devices could record the exam content being read. Eating and drinking during the exam may be permitted but often exam administrators will place limits on what can be consumed to ensure security breaches are minimized (e.g., water can be consumed but must be in a clear bottle so that notes cannot be written on the bottle).

- **Compatibility tests** (compliance of testing equipment also sometimes referred to as "test it out features") that candidates can use to ensure that their computer and internet is compatible with the proctoring software to help reduce technical issues and ensure the security of the exams

Encouraging or requiring candidates to test out their computer and internet configuration prior to the exam administration reduces surprises for the candidate and remote proctoring provider prior to the exam administration. Exam administrators can use the test it out summary reports to make improvements to upcoming exam administrations by improving instructions to candidates in advance of each administration. Figure 1 shows an example of administrator test it out results for a national high stakes exam administration. In a test centre the test centre IT department is responsible for

Figure 1. Example of administrator test it out results for a national high stake exam administration



ensuring the compatibility of computer-based testing software on the test centre computers and can use the compatibility tests as well.

Remote proctoring features and services can offer some advantages over traditional in-person brick-and-mortar test centre testing:

- Candidate to proctor ratios are often lower in remote proctored contexts and can be varied depending on the stakes of the exam.
- Live proctor monitoring and intervention where a remote proctor can observe and interact with the candidate in real time without disrupting other candidates taking the exam.
- Incident reporting where an assessment owner (e.g., a resource from the credentialing and testing organization) can review videos of incidents to make decisions regarding the administration.
- 360-degree environmental scans to ensure that no electronic devices, textbooks, or other non-permissible materials are around the candidate's testing area.
- Anomaly detection software that screens for behaviour such as candidates talking, moving their heads or bodies in ways that are not expected (e.g., frequent turning of head in one direction, not staying in frame), or anomalous computer mouse clicks or keystrokes.
- Video, audio, and proctor chat recording to maintain a record of the candidate's assessment session that can be reviewed for cases where cheating is flagged (e.g., if a pair of candidates are flagged via statistical collusion detection algorithms).

As cheating tactics evolve, so too do new technological advancements. Many high stakes testing programs have faced issues with tactics such as proxy testing, seat switching, or more advanced technology-driven measures, such as wireless Bluetooth earbuds being used to communicate with a third-party. With the list of threats ever-growing, it is vital that testing providers have the proper technology in place to provide supplemental protection to the human line of defense to combat these emerging threats. Artificial Intelligence (AI) tools and techniques such Linear on the Fly Testing (LOFT), facial recognition, keystroke detection, ID verification, etc., have long been leveraged across each stage of the exam development and delivery lifecycle. When used correctly, these tools and techniques can prove to be valued resources that provide additional layers of exam security, enhancing the accuracy and efficiency of exams. While such tools have been utilized by many programs for some time, ongoing advances in technology continue to enhance and evolve measures credentialing organizations can implement to stay current and relevant. Evolving capabilities such as eye or head movement detection, identifying changes in lighting on faces or eyeglasses, enhanced candidate authentication, and prohibited device exposure are just a few of the evolving tactics credentialing organizations can leverage to provide enhanced security measures.

Although remote proctoring AI has many benefits to enhance live proctoring, utilizing an AI-only solution often comes with its own set of pros and cons. While an AI-only approach may streamline the initial testing process, it also requires time for a human reviewer, which may result in a delay of testing, score delivery, etc. By ensuring video and audio recording capabilities are available in real time, proctors are able to provide timely review of escalated incidents, misconduct, or other related anomalies. It is important to note that remote proctoring for high-stakes exams currently involve a remote proctor who is trained to ensure that they are able to monitor candidates and intervene

appropriately when incidents occur. In the absence of training there is greater opportunity for human error or variations in standards amongst proctors. All testing programs rely on the reproducibility of results, and proctor variation can jeopardize this goal. There is no single "one-size-fits-all" approach to proctor training; it is vital that rigorous training measures are upheld to properly ensure the success and credibility of testing programs. All proctors should complete the same initial training and certification to ensure the highest of proctoring standards are upheld, regardless of global location. Implementing consistent proctor recruiting and training measures provides a uniform approach for vetting proctors through an initial certification and, subsequently, an annual recertification process. By design, this ensures the same experience for all test-takers, regardless of their testing location.

Initial training should be followed by a certification and annual recertification process to accredit the individual proctor. Without passing this certification, the individual should not be able to proctor an exam. In addition, weekly quizzes on policies and procedures, client specific changes, and security questions, can provide added value for testing organizations to ensure the security of their program is maintained throughout the entire exam process. Remote proctoring vendors should also conduct regular auditing and training of staff to ensure proper procedures are consistently implemented, as well as remote monitoring to ensure compliance with security protocols.

While it is vital to ensure proctors are well-trained, it is also of equal importance to ensure proper proctoring support is available to mitigate issues that arise, while providing a seamless testing experience for the candidate. As a best practice, three levels of live proctoring support should be considered: check-in agents, in-exam proctors, and security personnel.

The check-in agent's main goal is to protect the exam content and secure the test-taker's environment. This should be done by confirming the candidate's identity, prohibiting any restricted items in the testing location, and ensuring the right candidate receives the correct exam. The check-in agent is also the test-taker's first encounter as they prepare to take their exam, making it important that the agent is connected to the candidate in a timely manner. To achieve this, a 1:1 candidate to agent ratio is recommended. This prompt response time not only alleviates any additional stress for the test-taker, but also ensures higher turnaround times, leading to higher testing capacity for test owners, while adding an additional layer of security. Although many test delivery organizations may offer a service such as this, it is important to consider each specific component that is checked during this stage.

For example, during one remote testing check-in by a large well respected remote proctoring vendor, a reflection of another individual who was not the test-taker was seen in the mirror on the candidate's wall. Although the candidate insisted that there was no one else in the home, the check-in agent instructed the candidate to disconnect their exam and return when it was clear they were testing alone. In addition to this instance, there have been similar incidents where a third-party individual was seen in other reflective surfaces of the room such as a window, a lamp, or fireplace mantle. It is vital the check-in agent is aware of all surroundings, conducting a thorough readiness check.

Once the check-in process is complete, the test-taker is met with a live remote proctor who will facilitate the exam. The main goal of the exam proctor is to protect the exam environment from start to finish, upholding rigorous standards that have been taught in their training and certification process by actively monitoring the exam session and reporting any anomalies as

they might arise. Should a security issue present itself, the proctor may escalate the case to a live security agent.

Utilized as an extra layer of nonvisible security when a proctor suspects a candidate may be attempting to cheat, security agents are on standby to provide overarching attention to potential security risks. If a proctor identifies any suspicious candidate behavior, they should follow a robust, well-established escalation process. It is then the job of the security agent to observe the suspected candidate to ensure a fair experience for all, acting only if necessary. Having a 1:1 candidate to security agent ratio, is also an important requirement.

Security agents are on stand-by to provide timely support, should a potential security threat arise. In one specific instance, a remote proctor identified lights from a candidate's cell phone in the reflection of their glasses, with the candidate frequently looking off camera towards the direction of the light. While the candidate insisted that they did not have a prohibited device, the proctor escalated the session to a security agent who observed the issue and terminated the exam. While this specific instance was caught by a live human proctor, the advances of new and enhanced technologies may also assist with identifying threats such as this moving forward, making the technology element of exam security just as important as the human element.

Now that the context of remote proctoring has been reviewed, case studies of how remote proctoring has been used by organizations to detect and address security issues will be presented.

Chapter 3
Case studies of using remote proctoring to detect and address security issues

This chapter presents case studies from Canadian organizations that have used remote proctoring for their high stakes exam program(s).

Case Study A: High stakes certification exam for health care practitioners

This testing organization operates a high stakes certification exam for health care practitioners via computer based testing (CBT). In the move to CBT in 2019, the security enhancements that are inherent with the platform became apparent and allowed the organization to imagine the possibilities of global testing, linear on the fly (LOFT) testing, video elements in test questions, and remote proctoring.

When the global pandemic hit, the organization knew that certification could not be the bottleneck stopping practitioners from entering the workforce at a time when Canada needed them most. The organization immediately negotiated for remote proctoring and more test sessions with the CBT vendor. The organization committed to psychometric review prior to release of results, as is consistently the case, allowing for careful analysis of candidate results, to ensure that the in-person test-takers were not advantaged or disadvantaged compared to the at home test-takers (remote proctored). The organization found no advantage or disadvantage to either group, a finding consistent with the research literature in the area.

Candidate choice is one of the benefits of remote proctoring. During in person gathering restrictions, there was not room for everyone for in person testing and some test centres closed, while some candidates were afraid to go to test centers due to the risk of contracting COVID. Remote proctoring allowed access to certification testing and continues to do so.

Some challenges of remote proctoring included ensuring that candidates have the correct equipment, suitable test environment, stable internet connection, and not having paper and pen available to write down notes (remote proctored candidates can only use a virtual scratch pad for notes).

The global pandemic led to last minute changes in test location for candidates during an exam session. The organizations' staff and the vendor had to be available, seemingly 24/7, to allay client fears and find alternative testing options.

One of the largest benefits of remote proctoring has been test security. During a testing session, both in person and remote proctored, the organization is contacted by security agents

to discuss a client and provide next step requirements if there is 'unusual activity'. Unusual activity noted can be anything from having to change computer stations, taking unscheduled breaks (including agents noting a change in appearance on return from a break), talking to others, talking to self, unusual eye movements, unusual key stroke patterns (answering much quicker on test questions flagged for review, following a break). Remote proctoring provides video and audio clips so that the organization's staff can audit candidate files and review video content. This moves the investigation of security issues from the 'she said, he said' days of paper and pencil testing to actual video footage. The organization's legal counsel can (and has) reviewed and provided their expert opinion on the incident and advice on next steps. The organization can produce transcripts if needed which helps to reliably assess situations of possible cheating or collusion. The organization has been able to authorize the vendor to shut down the exam and minimize content exposure for egregious remote proctoring candidate conduct.

All told, the move to remote proctoring in a crisis was the boost the organization needed to ensure a secure, reliable testing environment, focusing on the safety and exam setting preferences of test-takers.

Case Study B: Pan-Canadian health organization national entry to practice exam

In response to the COVID-19 pandemic, a pan-Canadian health organization adopted remote proctoring to deliver the high stakes entry to practice exam for a regulated health profession. The primary initial benefit to remote proctoring was continuity in services to enable potential practitioners to meet the regulatory requirements to enter the profession during a time when the health care industry is facing immense pressure in human resources.

The organization has now administered 10 exam sessions, each with hundreds of candidates, using remote proctoring. Benefits to remote proctoring include increased accessibility for candidates located outside of urban centres, where test centres are typically located, ability for the candidate to write in a relaxed environment such as their home, and the ability to accommodate candidates who need to access the exam from outside Canada. The limitations of remote proctoring include the inability to support some testing accommodations such as text-to-voice software, the challenge for candidates to secure the appropriate computer hardware and internet connection to meet technical requirements, and the onus on the candidate to have sufficient computer literacy to launch the remote proctoring software or troubleshoot technical issues.

From the perspective of exam security, this organization has identified both strengths and limitations in remote proctoring. Candidates must be in a private room with the screen facing away from any clear door that would enable someone else to view the exam. Virtual proctors complete a visual check for unauthorized material such as paper and calculators and require such materials be removed. Candidates are not permitted to wear smartwatches, use an extra monitor, or have any other internet browsers or programs open during the exam. A benefit to remote proctoring is the ability to conduct a thorough audit using video recordings to review the behaviour of both candidates and proctors. In comparison, when the exam occurs in a physical test centre, the organization must rely solely on the documentation and reports provided by the test centre staff, with little ability to review or investigate situations. The staff audit a minimum 10% of exams for each administration and includes a review of any issues that were flagged on exam day. The audit can also include any suspected integrity issues reported by the remote proctor.

The audit process has enabled the organization to identify proctor error and inconsistency, which the provider has used for employee training and coaching. By working together, proctor error has decreased significantly.

When a potential integrity issue is noticed, the video recording enables staff to carefully review the incident, consult internally, and collaborate with the service provider. When necessary, potential incidents can be escalated to the provider's compliance team for further review and investigation. The ability to access video for each candidate provides a level of confidence to an investigation not previously available in a test centre.

In a recent administration, unusual activity was noted by the proctor when a candidate took an authorized break. While the candidate was out of the room, the mouse icon moved on the screen, suggesting that someone else was viewing the exam. Once the candidate returned from the break, the proctor allowed the exam to continue and filed an incident report. Staff reviewed the video audit and were able to corroborate the findings in the incident report. A thorough investigation was completed by both the testing organization and the remote proctoring provider's compliance team. The testing organization was able to withhold the exam results until the investigation was complete. The detailed investigation involved several members of the compliance team and determined that, while on break, the candidate retrieved a wireless mouse and put it in their pocket. Upon returning to the exam, the candidate put the mouse on the desk and began to use that instead of the laptop touchpad that was being used prior to the break. The actions during the break caused the mouse icon to move. The ability to use the video to investigate this incident in detail resulted in confirmation, with a high degree of confidence, that exam integrity was not breached. The candidate was cleared of any potential breach and results were released.

Despite the benefits, limitations to exam security exist. In a remote setting, it is challenging to confirm that a candidate has not set up an audio or video recording device in the room, despite a thorough camera pan of the room by the test-taker for the proctor. In addition, candidates who must leave the room to take a comfort break cannot be supervised, although breaks are limited in number and duration.

Case Study C: Canadian national licensing jurisprudence-type exam

In the context of a national exam for non-health related professionals, all applicants must take and pass a high stakes jurisprudence-type exam administered to approximately 10,000 candidates per year. Passing the exam is a requirement for licensure in most Canadian jurisdictions and the exam assesses applicant knowledge of professional practice, law, ethics, and regulation via a multiple-choice format administered in a 2.5 hour testing period offered in English and French. The exam is held during multiple exam session windows distributed every few months.

Prior to the COVID-19 pandemic, candidates were provided the option of taking the exam in either brick-and-mortar test centres or via remote proctoring using the highest tier of remote proctoring security available (live human proctoring plus AI monitoring and recording). The vast majority of candidates took the exam in brick-and-mortar test centres but where brick-and-mortar test centes were not available, in isolated locations for example, those applicants would take the exam using remote proctoring. With the COVID-19 pandemic closing brick-and-mortar test centres across

Canada, in early 2020 the decision was made to expand remote proctoring for all candidates to ensure that applicants were able to continue testing. Since the spring of 2020, over 20,000 applicants have completed the exam via remote proctoring, progressing their application for licensure.

During this time many of the benefits of remote proctoring have become clear to the testing organization. Using the highest security tier of remote proctoring provides a wealth of information for each exam candidate that was not available when candidates were taking the exam at physical test centres. For example, every candidate taking the exam using remote proctoring is video and audio recorded with the candidate's activity on their screen matched to their web camera recording of their behaviour during their testing session. In a remote proctored context, every candidate has this recorded evidence of their testing session, compared to test-centre exam administration where video surveillance was not always available and if recording was available, it was only of a high level view of the entire testing room. This recorded information for every exam candidate using remote proctoring has been invaluable for exam administrators who are investigating suspected cases of security breaches, providing much more than just proctor witness accounts of the event.

Remote proctoring has not been without its challenges. Monitoring technical issues and making improvements to processes and communication has been essential to providing a smooth testing experience for candidates and reducing workloads on remote proctoring vendors and exam administrators. Figure 2 provides an example of reporting from a remote proctoring vendor that is used by exam administrators for the exam program to monitor start times and rates of technical issues for each exam administration session.

Monitoring the metrics provided through remote proctoring software provides the testing organization with program management tools to ensure that during each session unpermitted resources are removed appropriately, proactive interventions occur, integrity incidents are reported, and candidate satisfaction rates with remote proctoring are captured.

Figure 2. Example of start time and technical issue reporting for a remote proctored exam administration

Figure 3 provides an example of a summary report highlighting these metrics used by testing organizations.

Other challenges that have occurred with remote proctoring are remote proctors being inconsistent regarding allowable materials or comfort breaks (which could happen in physical test centres also). These issues have been addressed via improved training of the remote proctors. Another challenge has been sorting through automated alerts from the remote proctoring software regarding candidate head turning, speaking out loud or moving their head out of frame. Typically test administration organizations can modify the preferences of the remote proctoring software to receive less automated alerts.

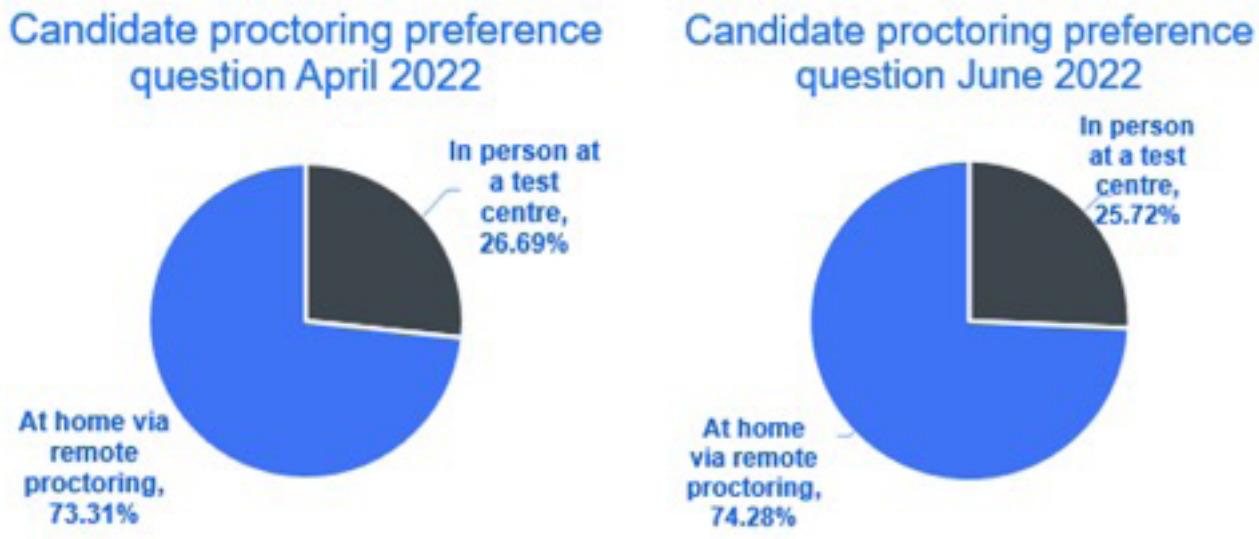
An example of a specific security incident that was detected during a remote proctored exam session for this national exam program is provided below. In this case the remote proctoring vendor did not have a locked down browser in place and so the candidate, whose first language was not English or French, was observed by the live human proctor to be using Google translate during the exam. The candidate appeared to be trying to understand the question content by typing in the question content into Google translate and getting the translation in their first language. In addition, the candidate was observed opening a screen capture tool and attempting to take screenshots of the exam content to save on his computer. Upon witnessing the behaviour the live proctor notified an intervention specialist, who terminated the exam and advised the candidate to contact their testing organization for further instruction. The remote proctoring vendor then notified the exam owners regarding the incident so that an investigation could be initiated. The exam administrators collected the details from the notes left by the live proctor and intervention specialist about what happened with the candidate as well as reviewing the recorded video and audio footage of the event. Where the breaches of security occurred the time indexes

Figure 3. Example of remote proctoring summary metrics for a remote proctored exam administration

on the video were noted and the evidence was submitted to the candidate's admissions departments to proceed with denying the candidate's application for licensure based on not demonstrating good character. This case highlighted the ease of collecting the evidence of a security breach in a remote proctoring environment as all the information needed was contained in the remote proctoring software available for the exam administrators to access. In addition, the damage that the candidate did in terms of content theft was limited to only one question as the live proctor and intervention specialist terminated the candidate's exam very soon after the behaviour was observed.

The national exam described in this case study administers an end of exam candidate survey which asks candidates what method of proctoring they would prefer (remote or in-person test centre-based). Survey results have consistently shown that close to 75% of candidates would prefer the exam to remain in the remote proctored format as seen in Figure 4.

Figure 4. Survey results asking candidates whether they would prefer remote proctoring or in-person test centre-based proctoring



Chapter 4: Future direction of remote proctoring

With the rapid advancement of technologies, such as AI, there are opportunities for remote proctoring vendors to incorporate even more advanced proctoring features into their software in the not-too-distant future. This chapter explores some examples of possible features that could be incorporated into remote proctoring software in the future to enhance the capabilities of remote proctoring platforms and the security of exam programs.

Some remote proctoring and exam delivery platforms currently incorporate forensic analysis approaches to detect collusion and plagiarism. It is likely that these features will be expanded and become more sophisticated as advances in AI would allow new approaches to deter fraud and cheating. For example, there could be real time candidate response pattern analyses that can flag situations where candidates are colluding even when physically not in the same location. Advanced real time analyses of candidate time spent per question and how a candidate moves through questions on the exam could flag candidates that are memorizing content or attempting to circumvent remote proctoring security features.

Research in the area of mobile phone authentication have produced interesting results which may be applicable to remote proctoring. For example, researchers have found ways to use standard phone sensors to authenticate users with 90% accuracy simply by how the user holds their phone and the vibrations that occur based on the user's hand vibrations.[1] It may be feasible in the future to provide real-time ongoing authentication during a remote proctored exam by leveraging similar techniques on the data collected from mouse movements or other computer interactions by the candidate. These types of movement data to identify a person are difficult to mimic, as the data is not exposed to others and even if exposed - mimicking another person's movement is challenging even for trained professionals. As mobile phones become more advanced, it may be possible for candidates to take higher stakes exams on their mobile devices, which would open an array of possibilities for analyzing user/device interaction data to help ensure that the person taking the remote proctored exam is the same person who is supposed to take the exam.

Advances in facial recognition have made the authentication of individuals ubiquitous by many mobile phones utilizing the facial recognition approach to unlock people's phones. It is likely that advances in facial recognition will permeate into areas like high stakes testing and remote proctoring with greater frequency. These advances may not only reduce the need for live human proctors to initially authenticate and reauthenticate candidates when they leave their computer to take a comfort break, but potentially the automated authentication

1. Jiokeng, K., Jakllari, G., & Beylot, Andre-Luc (2022). I Want to Know Your Hand: Authentication on Commodity Mobile Phones Based on Your Hand's Vibrations. Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies Volume 6, Issue 2 (https://hal.archives-ouvertes.fr/hal-03655873/).

approaches could do so with greater accuracy than a live human proctor (i.e., the algorithms could be less easily fooled than a human proctor if a proxy exam candidate tried to disguise themselves).

In a similar manner advances in voice recognition or voice authentication could provide another layer of biometric based security that would fit well with a remote proctored context. With more frequency, voice recognition is being used by banks, insurance companies, and other organizations to authenticate customers prior to the customer speaking to a live customer service agent. Samples of the candidate's voice could be gathered before a remote proctored exam in a similar manner to other biometric information such as iris or facial recognition to provide another layer of remote proctoring security.

Body temperature monitoring could be another area where remote proctoring could gather information about candidates to help ensure the security of the exams being administered. Smart watches track several biometric pieces of information about users including heart rate with research indicating that body-temperature based authentication via galvanic skins response (GSR) and skin temperature information can be extracted for user authentication.[2] Infrared (IR) sensitive webcams could potentially be used in a remote proctored context to monitor candidate skin temperature variations which could coincide with cheating or other deceptive behaviour.[3]

Human emotional state detection using AI has not yet been incorporated into remote proctoring software, but research is making significant steps towards applications in sectors like sales and customer service. Customer service and sales companies have been reported developing products that use AI to help people understand and respond to human emotion.[4] These companies sell software that attempts to detect whether a potential customer is interested in what a salesperson is saying during a video call, a context in which it is challenging to build a rapport with prospects. One such software system alerts the salesperson in real time during a virtual meeting if the prospect seems engaged in the topic being discussed. The software utilizes "computer vision, speech recognition, natural-language processing and emotion AI to pick up on the behavioral cues associated with someone's tone of voice, eye and facial movements or other non-verbal body language, then analyzes that data to assess their emotional attitude." A competitor company uses AI to analyze people's moods during a call.[5] A highly popular virtual meeting software solution is also exploring the use of emotion AI in its platform, which has raised concerns from human rights groups.[6] Should the benefits outweigh controversy, it may be possible to use these types of features to identify candidates that are more stressed/anxious than the average candidate. These analyses could be used to generate a flag for a live proctor to investigate before and during an exam session to ensure that the candidate is not lying about their identity or engaging in behaviour such as cheating, which could result in higher stress and anxiety responses.

As a new generation of learners enter their professional world adept at seamless internet connectivity through various personal and

2. https://ieeexplore.ieee.org/document/8123790
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3590493/
4. https://www.protocol.com/enterprise/emotion-ai-sales-virtual-zoom
5. https://www.protocol.com/enterprise/driver-monitoring-ai-infrastructure-bill
6. https://www.protocol.com/enterprise/zoom-emotion-ai-aclu-rights

home devices, consideration needs to be made on the types of devices -that extend beyond laptops and mobile phones - to most effectively deliver education and assess competency and proficiency. As such, remote proctoring software would need to continue evolving to adapt to the rapid changes in hardware, operating systems, and consumer tastes. Software engineers and web designers will need to continue engaging through user experience research with various consumer segments such as youth, mid-career learners, low-technology proficient learners, and learners with visible and invisible disabilities, to build user experience interfaces and operating systems that are intuitive, easy to use, and accessible in order to ensure remote proctoring is facilitating pathways to licensure for all. More research is needed to ascertain the effectiveness of remote proctoring with offline testing. Some features of some providers allow for switching off all web access during remote testing to ensure the integrity and honesty of exam taker. However, more needs to be done to gather evidence of this strategy.

The future of remote proctoring offers many fascinating possibilities, while raising questions regarding privacy and unintentional consequences of knowing too much about the candidates that take high stakes exams.

Chapter 5: Conclusion

Remote proctoring for high stakes exams has come a long way in the last decade with rapid advancements and uptake occurring during the COVID-19 pandemic. In a similar manner to how remote working has become more widespread, the advantages of remote proctoring have remained post-pandemic. Measuring the success of remote proctoring for organizations is important to ensure that the uptake of remote proctoring is working for the exam candidates and the organizations administering the exams.

When measuring the success of remote proctoring security measures, the obvious method is to analyze the number of confirmed cheating cases in comparison; although, there are additional outcomes that should also be taken into consideration. By testing vendors strictly enforcing and upholding stringent security efforts and processes, testing organizations can more accurately measure candidate success by analyzing the consistency of testing outcomes. A large well respected testing vendor, in partnership with Dublin City University (DCU),[7] has conducted initial studies comparing candidate outcomes, across test center and remote proctored testing, with both modalities conducting the same proctor training and security processes. The study concluded that the average passing rates across exams conducted across test centres and remote proctoring were almost identical. In addition, the reliability and consistency of candidates passing or failing their exam across both test centre and remote proctored assessments were high. While there may be multiple factors at play that contributed to these outcomes, by ensuring a consistent security experience – regardless of testing modality – testing providers can maintain a high level of confidence in the security measures being implemented.

This correlation also paints a larger picture around the importance of ensuring exams are accessible to all test-takers. Post-pandemic, many testing providers are opting for a hybrid testing approach, allowing candidates to decide if they would prefer a remote or test centre exam. This candidate-centric approach provides more flexible testing capabilities, allowing candidates the flexibility to test wherever, whenever fits their schedule (at the discretion of the testing organization). In addition, this gives organizations the consistency required to ensure the credibility and value of the credential remains intact. Surveys of candidates by a large well respected vendor between August 2021 – December 2021 showed that over 90% of candidates were pleased with their testing experience across both modalities, proving that offering candidates the ability to test however works for their schedule provides valuable outcomes. Consistency of test centre and remote proctored assessments has proven to be a key factor in supporting test owners and test-takers, as a hybrid modality approach also provides support and fairness to all candidates.

7. https://www.dcu.ie/carpe/research-1

About the Authors

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Greg Pope is a psychometrician and the Director of Examinations at the Association of Professional Engineers and Geoscientists of Alberta (APEGA), the largest regulator in western Canada. He is responsible for all examinations administered to APEGA applicants and members including the National Professional Practice Examination (NPPE) a requirement for licensure that is taken across Canada and abroad by thousands of candidates annually through both brick and mortar test centres and remote proctoring. Prior to working with APEGA, Greg worked as a psychometrician with the Alberta government in the area of large-scale high stakes provincial educational assessment (grade 12 Diploma Examinations and grades 3, 6, 9 Achievement Tests). Greg then gained experience in the private sector working with Canadian and international assessment companies developing and managing high stakes assessment programs and psychometric consulting services. In these roles Greg designed software and reporting approaches in many areas of high stakes assessment such as item bank composition visualization reports, results reporting, collusion detection and test security, Classical Test Theory item and test analysis, non-parametric item response modeling, and group difference reporting. Over his two-decade long career Greg has gained extensive experience in the area of certification/licensure testing having worked with dozens of associations and regulators on improving the defensibility of their high-stakes assessment programs.

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Christine Nielsen is the CEO for the Canadian Society for Medical Laboratory Science (CSMLS), with education in medical laboratory science, not for profit management, association management, health administration and business. She is currently a board member with the Oakville & Milton Humane Society, The Michener Institute of Education at UHN Alumni and former chair of CNAR. The CSMLS administers a high stakes certification exam for the medical laboratory science professions in Canada, and during the pandemic, delivered exams in proctored test centres and remote proctored testing (at home).

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As Vice President of Account Management, Sean Mathias leads a team of Account Directors, and is responsible for overseeing Prometric's North American client portfolio, including North American-based multi-national clients who have significant business or growth plans outside of North America. He is focused on developing and maintaining profitable partnerships and maximizing client revenue, ensuring the longevity of these revenue streams through the achievement of favorable contract renewals and client satisfaction. Sean has more than 15 years of experience in client growth, relationship management, and managing successful operations. Sean has a Bachelor's degree in Marketing from Ryerson University.

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