Examining the Relationship Between Student Test Anxiety and Webcam Based Exam Proctoring

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Abstract

With increased pressures on maintaining a stellar academic performance for future academia or occupational possibilities, students may suffer test anxiety at some point in their higher education journey. For decades, empirical, observational, research has been conducted to determine the psychological and physiological effects of test anxiety. This exploratory research examines the in-situ behaviors displayed by students while taking online course exams through use of a virtual proctor and how that relates to student self-reported indications of test anxiety. While the top ten behaviors observed to occur most frequently (e.g., directional change in gaze, furrowed eyebrows) do not align with reported physiological responses of test anxiety, the findings of this exploratory research can prepare instructors for what behaviors they can expect to see from their students while taking virtual proctored exams. In interviews, students self-identified behavioral coping skills used while taking their exams. This unexpected finding was consistent with the behaviors demonstrated by students and invites the opportunity for instructors to incorporate material within their eLearning courses that will help students become calmer while taking their online exams.

Introduction

Across the span of their education, students have taken examinations as an evaluation of their abilities and accomplishments, often with increased pressures to have superior performances for future academic admissions or occupational possibilities. As a result, 38.5% of students will suffer from test anxiety at some point over the course of their higher education career (Gerwing, Rash, Gerwing, Bramble, & Landine, 2015). Test anxiety is a multidimensional construct that has been defined as “a set of phenomenological, physiological, and behavioral responses during an evaluation situation” (Zeidner, 1998, p. 17) that invoke "an unpleasant feeling or emotional state that has physiological and behavioral concomitants” (Dusek,1980, p. 88). The Test Anxiety Inventory (TAI), a self-report instrument, measures worry and emotionality (Ali & Moshin, 2013) and has been used to assess test anxiety in high school and college-aged students with the intention of helping develop effective coping skills.

Along with an increasing awareness of test anxiety, the prevalence of eLearning (also referred to in literature as “online learning” or “web-based distance education”) has become an accepted means of delivering quality, accessible education to students (Li & Irby, 2008) while allowing education providers to increase efficiency and retain students (Wolff, Wood-Kustanowitz, & Ashkenazi, 2014). In the eLearning environment, virtual proctoring of exams is more prevalent (Sanjoe, n.d) and can

provide a level of security for exam integrity similar to a human proctor in live proctoring locations (Bedford, Gregg, & Clinton, 2009).

The research is deep in identifying test anxiety in primary and secondary education students (Ergene, 2003; Talbot, 2016); it is less so in reporting the prevalence of test anxiety among college students (Gerwing et al., 2015), particularly in online learning settings. With 13 consecutive years of growth in students taking eLearning courses, and yearly increases of 3.9% (Allen & Seaman, 2016), this is problematic. Therefore, in this exploratory study, we seek to explore the connections between higher education students' behaviors during recorded virtual exam sessions and text anxiety with the aim of developing pedagogical recommendations for online instructors.

Literature Review

In this literature review, the focus will be on three areas. The first will review test anxiety in students with an emphasis on the physiological behaviors identified in clinical trials consistent with test anxiety. The second area will discuss the use of the Test Anxiety Inventory in measuring students' self-report of test anxiety. The third area will examine the purposeful use of virtual proctoring in the eLearning academic environment.

Test Anxiety in Students

Students who experience test anxiety likely do not develop this condition once they are in college. Between 10% to 30% of students started to experience physical, emotional and behavioral indications of test anxiety when they were in elementary school (King & Ollendick, 1989). Often treatment is not sought (Ergene, 2003) until reaching high school when students may come to understand that their behaviors are related to test performance and seek help (Hill & Wigfield, 1984). Still, many learners struggle with test anxiety into their college years (Gerwing et al., 2015).

Both the psychological and physiological effects of test anxiety on academic performance are wide-ranging and have been found to lower motivation and impair cognitive performance as well as inhibit academic performance (Chapell et al., 2005; Chin, Williams, Taylor, & Harvey, 2017; Peleg-Popko, 2004). Studies on cognitive anxiety and exam performance showed that an increase in anxiety can have either a positive or a negative effect on students' academic performance—a small increase in anxiety could increase performance, whereas a large increase in anxiety could lower the students' performance levels drastically (Humara, 1999). Examining 188 senior high school students from New Zealand, Chin et al. (2017) concluded that "test anxiety accounts for approximately 5–10% of the variance in exam grades" (p. 1). Several factors can influence a student's test anxiety including perception of understanding content, lack of time management skills, academic pressures, and other personal factors including self-efficiency and self-control of thoughts, actions, and emotions (Duraku, 2016). Additionally, exam taking can become a major source of anxiety when the scores serve as gate-keepers to future opportunities and career pathways (Peleg-Popko, 2004) because of greater student expectations and pressures from their parents and schools to perform well.

Physiologically, anxiety can negatively affect academic performance; "the emotional component describes the tension that students have during the test, which is manifested through muscle tension, accelerated heart rate, nervousness, or sweaty palms" (Asghari, Abdul Kadir, Elias, & Baba, 2012, p.4), as well as experiencing perspiration, dry mouth, and muscle spasms (Harris & Coy, 2010). In addition, anxious students may experience nausea, dizziness, and panic before, during, and even after a test (Talbot, 2016). Weinberger, Schwartz, & Davidson (1979) conducted research on the behaviors displayed in a college classroom by 201 undergraduate male students and concluded the following physiological reactions occurred when a student reported experiencing test anxiety: forehead tension (as evidenced by furrowed eyebrows), perspiration or sweating, shortness of breath/irregular breathing, pursed lips, clenched jaw, and motor agitation (gross or minor as

evidenced by restlessness or fidgeting).

Test Anxiety Inventory (TAI)

Test anxiety has been studied formally since George Mandler and Seymour Sarason (1952). Throughout the decades, psychologists have continued researching the symptomology, causes, and treatments of test anxiety, predominantly conducting studies in clinical, experimental designs. The TAI is a self-reporting questionnaire measuring the degree of test anxiety a person experiences as a situation-specific personality trait (Spielberger, 1980) and is one way that test anxiety can be quantified. While there are at least eight other inventories for self-assessment of test anxiety, Ali and Moshin (2013) conducted a meta-analysis of the TAI, concluding that the TAI was considered a valid and a reliable measure of test anxiety when used with high school students, undergraduate college students, and graduate college students.

Exam Proctoring in eLearning

To meet the needs of today's college students, many institutions are incorporating eLearning courses into their program offerings. Even when overall higher education enrollment is declining, eLearning enrollment has continued to grow (Allen & Seaman, 2016). With this increase, educators question how to maintain academic rigor while holding all students to the same standards of academic integrity, particularly within online course exams. Many institutions offering eLearning programs are concerned about academic security and are implementing virtual proctoring software because of its low cost, functionality, and protection against academic dishonesty behaviors of their students when taking online exams (Baron & Crooks, 2005; Bedford et al., 2009; Karim, Kaminsky, & Behrend, 2014).

Few studies have examined the effect of virtual proctoring on students when taking exams. Karim et al. (2014) found that remote proctoring did not directly affect test-taker reactions and performance, but it did decrease instances of cheating. Research by Romero-Zaldivar, Pardo, Burgos, & Delgado Kloos (2012) on second-year engineering students at a Madrid university identified how virtual recording tools can capture the minutiae of an event taking place within the students' learning experience. Their research outcomes supported that using virtual proctoring tools makes the online exam-taking environment an ideal forum to observe student test-taking behaviors, stating, "the detailed observation of the student activities in their course workspace offers a reliable framework to predict their academic achievement" (Romero-Zaldivar et al., 2012, p. 1065).

In using a virtual proctor, the webcam focuses on just one student and is more neutral, detached, and uninterrupted than a human proctor (Marcus, Raul, & Ramirez-Velarde, 2008). Respondus Monitor, one such virtual proctor option, requires that students' complete exams in front of a computer-mounted or manufacturer-installed webcam and provides the instructor with live streaming images of the student and their environment while taking the assessment ("Respondus", n.d.). Knowing that the instructor will be reviewing their recorded exam session can affirm for the students the importance of academic integrity and being ethical in their exam-taking efforts. St. Clair (2015) suggested the use of a sample test to model the use of virtual proctoring software, to address problems, and reduce eLearning student anxiety.

There is scant research on the relationship between test anxiety and behaviors, particularly in online learning. Having been well researched in clinical trials, there is little empirical research on test anxiety and test-taking behaviors during human proctored exam sessions. Much of the research conducted on student behavior during online exams has examined behaviors in the context of large standardized tests such as the ACT, LSAT, or GRE (Camara, 2002) and not classroom contexts. In addition, the research has focused primarily on issues of cheating and exam security, rather than on student exam-taking actions or non-cheating-related behaviors (Kerton & Cervato, 2014). Additionally, there is no research to date that captures in situ behaviors of students taking a virtually

proctored exam or any correlation between behaviors during these exams and indicators of test anxiety.

As more students enroll in eLearning courses, the need for exam proctoring to provide a quality educational experience and maintain academic rigor rises in importance. With the pressures felt by higher education students that perpetuate increased amounts of worry and emotionality, as well as the additional stress of the unfamiliar proctoring of exam sessions for academic integrity reasons, higher learning students could experience greater test anxiety reactions than is reported in the literature.

Methodology

To address the lack of research on test anxiety and virtual proctoring, this exploratory study investigates the following research questions:

1. How do the behaviors displayed by higher education students during their web invigilated proctored exam session align with their Test Anxiety Inventory outcome score?
2. Was there a correlation between the higher education students' observed exam scores and the Test Anxiety Inventory outcome score?
3. How do eLearning students' perceptions regarding physiological test anxiety reactions parallel with their observed behaviors during the web invigilated proctored exam session and their Test Anxiety Inventory outcome score?

Participants and Setting

The participants were eLearning students from a large public four-year university in the Midwest and a community college in the Midwest (a two-year institution). All students were enrolled in one of Author One's 2014-2017 undergraduate psychology courses (14 courses total) that had concluded prior to the exam-taking sessions being viewed for this research. Each course included four or five exams. After each course ended, written consent was obtained from participants to include their recorded exam sessions and their TAI results in the study, as well as participate in an interview. Participants were advised, as a part of their consent, that partaking in this study would not compromise their academic standing at either institution. Student demographic data was removed from all recordings and reportings and each was assigned a random number for identification of the participant. The actual names of students were replaced with fictitious names.

Tools and Instruments

Test Anxiety Inventory. This study utilized the Test Anxiety Inventory (TAI) as a self-report measure of text anxiety. Consisting of 20 questions, students responded to each question based on a 4-point Likert type scale consisting of four options: (1) Almost Never, (2) Sometimes, (3) Often and (4) Almost Always. The completed Test Anxiety Inventory (TAI) surveys were calculated for the total and the two subscales (Worry and Emotionality) scores.

Virtual Proctoring System. Both higher education institutions in this study had a contract with Respondus, Inc. for use of Respondus Monitor as a virtual proctoring tool. All Respondus Monitor recordings of the participants' exam-taking sessions were embedded within the LMS used by the institutions for course delivery. At the start of each exam, during the mandatory setup steps prior to the exam being activated, the student acknowledged the use and purpose of Respondus Monitor. The next steps validated student authentication, requested a 360-degree environment scan and a webcam check, and finally required an acknowledgment that the student understood the parameters of the web invigilated exam session, including the institutions' policies on academic integrity.

Observation Matrix. The observational protocol was developed prior to this study (Kolski & Weible, in review). The observation matrix consisted of behavioral indicators of test anxiety (e.g., furrowed eyebrows, perspiration, deep breathing, pursed lips, motor agitation) found in traditional college classrooms (Weinberger et al., 1979). In addition, student behaviors (e.g., rubbing lips with fingers, reading exam questions, shifting eye gaze, propping of the head) were added based on Author One's four years of experience with reviewing recorded exam sessions, plus the ability to document unexpected behaviors that were displayed.

Interview. Structured interviews with students were conducted using open-ended questions designed to understand the students thinking about their recorded, virtual proctored, exam-taking experience. Included were questions about their perceptions of behaviors displayed while taking exams as well as their insightfulness regarding test anxiety.

Data Collection

At the start of each course, students were given the opportunity to choose either a human proctor or a virtual proctor for completing their course exams with 88% (238 out of 272) of these students selecting the Respondus Monitor tool for virtual proctoring of each of their course exams. Students who made the decision to use an approved testing center location and/or a human proctor were excluded from this research population. From consented students (n=37), approximately 60 hours of video was obtained and stored. Video recordings of exam sessions were assigned a number for data entry and analysis purposes. Following the course's conclusion, all consented students (n=21) completed the TAI survey and five interviews were completed with students who had high, middle, and low TAI scores.

Observational data was collected by examining 25.43 hours of archived video recordings of students as they took their virtual proctored exams; the recording of the first exam for each student and a second randomly selected recording of one of the subsequent exams. When initiating the virtual proctoring, 100% of the students acknowledged understanding the purpose and use of Respondus Monitor as a form of securing exam integrity. 82% of the students showed pictured identification which was consistent with the person seen on the recording; others neglected to show identification. 84% completed the environmental scan slowly so a clear visualization of the student's workspace being free from books, notes, or electronic devices was obtained.

Data Analysis

For the video analysis, the observational protocol was used to quantify observed behavioral data. The frequency counts of observed behaviors from the coding matrix, exam scores, and the TAI scores were statistically analyzed using descriptive statistics, parametric inferential statistics, and correlation procedures to examine the relationships between the quantified observational data, exam scores, and the TAI scores. Of the 40 behaviors included on the observational protocol (see Table 1), the most prevalent 23 behaviors (indicated in bold font) were included in the data analysis.

Table 1

Behaviors Included on the Observational Protocol

***Audible Sigh**	Coughs	Leans Backward from Camera	**Reads Question Out Loud**
Chews on Clothes	**Cracks Knuckles/Neck/Back**	Leans Inward Toward Camera	Relaxed Posture
Chews on Fingers	**Deep Breathing**	Leans Sideways	Rigid Posture
Chews on Objects	**Eyebrows Furrowed**	**Lip Licking or Lip Biting**	**Rubs or Picks at Lips with Fingers**
Chews or Smokes	**Eyebrows Raised**	**Lip Reads**	**Scratches Some Part of Head/Face**
Chews Other	Eyes Squinted	**Moves Head Left/Right**	**Smiles or Smirks**
Clears Throat	Eyes Widen	**Moves Head Up/Down**	**Squirms or Shifts in Seat**
Closes Eyes	**Gaze Shifts to Left**	Perspires	**Stretches**
Consumes a Beverage	**Gaze Shifts to Right**	**Props Head with Hand(s)**	**Twists or Plays with Hair**
Consumes Food	**Gazes Upward**	**Pursed Lips**	Yawns

* Behaviors in bold font were included in the descriptive statistical analysis.

The interviews were transcribed and coded using a priori codes based on test anxiety literature as well as allowing for emerging codes. These coded segments were compared with the student's observed behaviors and their TAI results.

Results

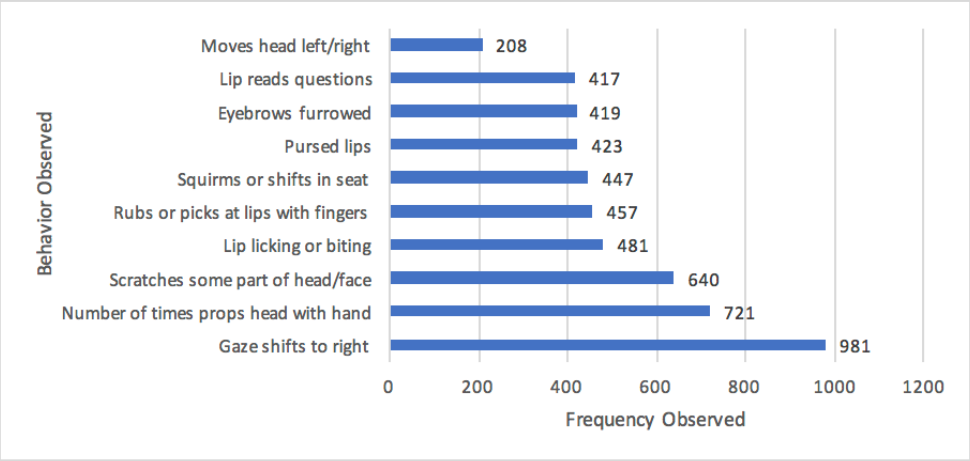
Of the 37 participants in this study, 92% were female (n=34) and 8% were male (n=3). Students were from both a two-year community college (n= 13, 35%) and a four-year university (n=24, 65%) who completed their eLearning course exams using the Respondus Monitor virtual proctor technology. The length of time a student took to complete their exam ranged from 10 minutes to 49 minutes, with the average length of time being approximately 23 minutes (M=23.17 minutes, SD=8.84).

Relationship Between Behaviors, TAI Score, and Exam Score

The ten most frequently observed behaviors were: eye gaze shifting to the right, propping their head with their hand, scratching some part of the head or face, lip licking or lip biting, rubbing or picking at the lips, shifting or squirming in their seat, pursed lips, eyebrows furrowed, lip reading the exam questions, and moves head left/right (See Figure 1). The behaviors of overt perspiration, chewing or smoking tobacco, and demonstrating a rigid posture, as noted by Weinberger, Schwartz, & Davidson (1979), were not observed in any of the students' recorded exams.

Figure 1

Ten Most Frequently Observed Behaviors



To examine the relationship between the participants' TAI total score and the top ten most frequently observed behaviors, a Pearson correlation coefficient was conducted (see Table 2).

Table 2

Relationship Between the Participants' TAI Total and Each of the Top Ten Observed Behaviors

Correlations

		Total TAI score	Gaze shifts to right	Props head with hand	Scratches some part of head/face	Pursed Lips	Rubs or picks at lips	Lip licking or biting	Squirms or shifts in seat	Eyebrows Furrowed	Moves head left/right	Lip Reads Questions
Total TAI score	Pearson Correlation	1	0.172	0.038	0.273	-0.086	0.179	.600**	-0.198	0.144	0.186	0.248
	Sig. (2-tailed)		0.456	0.870	0.232	0.711	0.437	0.004	0.389	0.534	0.420	0.278
Gaze shifts to right	Pearson Correlation		1	0.041	-0.040	0.114	0.057	0.230	0.208	-0.015	-0.136	.332**
	Sig. (2-tailed)			0.758	0.764	0.386	0.666	0.078	0.110	0.912	0.298	0.010
Props head with hand	Pearson Correlation			1	.582**	-0.072	.569**	-0.021	.359**	0.226	-0.066	0.161
	Sig. (2-tailed)				0.000	0.584	0.000	0.876	0.005	0.082	0.616	0.218
Scratches some part of head/face	Pearson Correlation				1	-0.034	.470**	0.208	0.231	0.173	-0.010	0.224
	Sig. (2-tailed)					0.798	0.000	0.111	0.076	0.186	0.942	0.085
Pursed Lips	Pearson Correlation					1	0.048	-0.029	0.233	.496**	0.167	-0.035
	Sig. (2-tailed)						0.717	0.827	0.073	0.000	0.202	0.791
Rubs or picks at lips	Pearson Correlation						1	0.133	.379**	.345**	0.225	.257*
	Sig. (2-tailed)							0.312	0.003	0.007	0.084	0.047
Lip licking or biting	Pearson Correlation							1	-0.019	0.043	0.191	.602**
	Sig. (2-tailed)								0.886	0.742	0.144	0.000
Squirms or shifts in seat	Pearson Correlation								1	0.207	0.059	0.159
	Sig. (2-tailed)									0.113	0.654	0.225
Eyebrows Furrowed	Pearson Correlation									1	.302*	0.109
	Sig. (2-tailed)										0.019	0.409
Moves head left/right	Pearson Correlation										1	0.229
	Sig. (2-tailed)											0.078
Lip Reads Questions	Pearson Correlation											1
	Sig. (2-tailed)											

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

A moderate, positive correlation was found between the TAI total score and the behavior of lip licking or biting [$r(19) = .600$, $p<.01$], indicating a moderately significant association between the behavior of lip biting or licking and a moderate total score on the TAI. Of the ten behaviors that were used for data analysis, no other behaviors showed to have a significant correlation at the $p=0.05$ (2-tailed) level when compared to the TAI total score.

Table 3

Furrowed Eyebrow Behaviors as a Predictor of Increased TAI Total Score

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	750.243	1	750.243	5.238	.034[b]
	Residual	2721.567	19	143.240		
	Total	3471.810	20			

a. Dependent Variable: Total TAI score
b. Predictors: (Constant), Eyebrows Furrowed

Model		Unstandardized Coefficients		Standardized Coefficients	
		B	Std. Error	Beta	t
1	(Constant)	41.783	3.739		11.176
	Eyebrows Furrowed	1.236	.540	.465	2.289

A one-way ANOVA was also calculated by comparing the participants' total TAI score based on each of the 23 observed behaviors used for data analysis (see Table 3 and Table 4). A significant difference was found among the furrowed eyebrow behavior [$F(1,19) = 5.238$, $p<.05$] and the behavior of lip licking or biting [$F(1,19) = 8.043$, $p<.05$] and the student having an increased TAI total score.

Table 4

Lip Licking or Biting Behaviors as a Predictor of Increased TAI Total Score

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1032.553	1	1032.553	8.043	.011[b]
	Residual	2439.257	19	128.382		
	Total	3471.810	20			

a. Dependent Variable: Total TAI score
b. Predictors: (Constant), Lip licking or biting

Model		Unstandardized Coefficients		Standardized Coefficients	
		B	Std. Error	Beta	t
1	(Constant)	40.017	3.722		10.753
	Lip licking or biting	.602	.212	.545	2.836

To examine the relationship between the participants' observed exam score and their TAI total score a Pearson correlation coefficient was conducted. A moderate, negative correlation was found between the observed exam score and the total TAI score [$r(19)= -.503$, $p<.05$] indicating the higher the exam score is moderately associated with lower values of the TAI total score.

A final Pearson correlation was calculated examining the relationship between the participants' observed exam score and the 23 observed behaviors that were used for data analysis. A weak positive, statistically significant correlation was found between the observed exam score and the behavior of eyebrows furrowing [$r(58)= .326$, $p<.05$] indicating a slight association between the behavior of furrowed eyebrows and a higher score on the observed exam score. A weak negative, statistically significant correlation was found between the observed exam score and the behavior of

lip biting or licking [$r(58)= -.324$, $p<.05$] indicating a slight association between the increased behavior of lip licking or biting and a lower score on the observed exam score. A moderate, statistically significant negative correlation was found between the observed exam score and the behavior of clearing their throat [$r(58)= -.499$, $p<.01$] indicating that the increased behavior of clearing the throat was associated with a lower score on the exam. No other behaviors were found to have a significant correlation at the $p=0.05$ (2-tailed) level compared to the observed exam score.

Student Interviews

Of the five students who partook in structured interviews regarding their perceptions of test anxiety and behavioral indicators for test anxiety, two students' TAI total (T) score were at the 92nd percentile rank or higher ($T > 61$); two students' TAI total (T) score were at the 36th percentile rank or lower ($T < 35$); and one student's TAI total (T) score was at the 57th percentile rank ($T = 39$). When asked if the students were self-aware about test anxiety, each responded congruently with what their TAI total score represented. Both TAI high scoring students (Val and Emily) identified "knowing since being young" that they felt anxious when taking tests. Per Emily, "as I got older [middle school or early high school] I put a label of test anxiety on it".

Connections Between Behavior and Test Anxiety

By examining the interviews, behaviors, and TAI scores, connections between behaviors, TAI scores, and perceived test anxiety of students were found. From this analysis, several themes emerged:

- Test anxiety more often appeared as motor agitation;
- Behaviors can indicate cognitive processing;
- Students are self-aware of the behaviors they exhibit while taking tests; and
- Instructors can incorporate strategies within their courses to help students reduce anxiety.

Motor agitation as an indicator of test anxiety. Five of the top ten behaviors observed are classified as a form of motor agitation (propping their head with their hand, scratching some part of the head or face, rubbing or picking at the lips, shifting or squirming in their seat, and moves head left/right). Val, who self-reported experiencing test anxiety responses (TAI=62), shared "I'm sure there are many things I do without even acknowledging them". Emily, who also self-reported experiencing test anxiety (TAI=76), offered the greatest insight about her physiological responses of test anxiety, "I would scratch my head or face or neck, I would pull up at my shirt collar or if I was wearing a necklace I'd fidget with the necklace. If I had a clicky pen I'd click it". These results indicate that some form of motor agitation as an observed behavior can happen in response to test anxiety.

Behaviors indicate cognitive processing. During the interviews, two students – both who scored low on the TAI indicating a lack of test anxiety - acknowledged they were likely to be seen reading the exam questions. Robin, who did not self-report experiencing test anxiety responses (TAI=27), stated "[you saw] me thinking, [meaning] me reading questions to myself". Bethany, who did not self-report experiencing test anxiety responses (TAI=28), stated "you probably saw me talk to myself. I talk to myself a lot. I'll read the questions and think out loud through reading the questions". These results indicate that the observed behavior of lip reading questions is a cognitive processing behavior more than a behavioral indication of test anxiety.

In addition, Bryan acknowledged the shifting of his gaze as "I probably had a lot of eye motions … it's my way of thinking. If I'm looking away from the screen for a bit, it is likely because I don't know the answer very well to that question or it calms me down to answer the question better." When queried further, Bryan stated, "I know the software is good at detecting if you were to do stuff so there isn't anything more I could do [in front of the camera] than what wouldn't be done in front

of the teacher." These results indicate that a directional change in the students' gaze while taking their exam can be used as a cognitive processing or visual distraction coping skill rather than a behavioral indicator of academic dishonesty.

Self-awareness in students. When all students were queried if there were specific behaviors they recalled having demonstrated during their virtual proctored exam, their responses were consistent with what was observed on their individual exam recordings. Per Bethany, "I'll lip read or actually read the questions out loud." Val stated, "I take a deep breath or stretch." Also, Bryan said, "I probably shifted my eyes from the screen to look out the window beside me". Students were also asked if they used any coping mechanisms for staying calm while taking exams. Bethany, who scored low on the TAI (28), stated, "I talk through my thinking". Robin, who also scored low on the TAI (27), shared, "if I know it, I just answer and move on. If I don't, I'll make a note of that question number and then move on and come back once I reach the end. If I still don't know it, well then I don't". Bryan, as noted above, who had a middle TAI score (39), commented, "If I'm looking away from the screen … it calms me down to answer the question." Both Val and Emily, who had high TAI scores (62 and 76 respectively) acknowledged "taking a deep breath" to help calm themselves down, with Emily adding, "my coping was to fidget".

Teacher strategies to reduce test anxiety. During the analysis, a final theme emerged: teacher pedagogical strategies such as allowing behavioral coping skills and including content to familiarize students with virtual proctoring technology can lessen students' anxiety while taking online exams. First, flexibility in allowing students to identify problematic behaviors and suggest solutions can reduce their anxiety. The behavioral coping mechanisms students demonstrated while taking their virtually proctored exams could be identified by the instructor as problematic. Understanding and allowing these, however, were found to support the students while taking their exams. The students interviewed identified the following exam-taking coping skills, which were also observed to have been demonstrated in their recorded exam sessions: per Emily, "my coping was to fidget"; per Val, "take a deep breath, stretch and just try to slow down my thinking as I read the question"; and per Robin, "taking notes on questions and writing down questions". Considering the students were not to have any notes, books, or electronic resources near their computer when taking the exam, the two students interviewed (Robin and Emily) who referenced taking notes had communicated with Author One prior to taking the first exam about what could be done to allow this behavior. A plan was discussed that the student would show the blank paper to the camera at the start of the exam to ensure that no additional material was available to the student.

Second, implementing clear directions and routine procedures were also effective pedagogical strategies. Two of the students stated that content embedded into Author One's eLearning course was helpful for reducing their anxiety. Emily, who self-reported experiencing high test anxiety, stated, "I am not technology savvy, but you gave us simple directions to follow and that made me less nervous". Or per Bryan, "you made it smooth and it was easy to set up … with Respondus I didn't have to [download] each time. When I was ready to take a test, I could just enable the lockdown browser and take the test. I loved the convenience." These statements indicate how instructors can implement measures to help students reduce test anxiety when utilizing virtual proctoring for assessments within online courses.

Discussion

Empirical research indicated that overtly perspiring or shortness of breath/irregular breathing were primary indicators of test anxiety (Weinberger, Schwartz, & Davidson, 1979). In this study, these indicators were not found. However, lip licking and biting, motor agitation, and eyebrows furrowed, previously identified as signs of test anxiety (Asghari et al., 2012; Harris & Coy, 2010; Weinberger et al., 1979), were prevalent. In addition, students reported that these behaviors were consistent with their feelings of test anxiety. For example, Emily, who scored high on the TAI, further supported this finding when she was observed, and she also stated, that she consciously engaged in multiple

behaviors consistent with motor agitation while taking her exams. Although we found a moderate, positive correlation between elevated TAI score and the behavior lip licking or biting, more research is needed in this area for generalization to a larger population.

In alignment with Lufi, Okasha, and Cohen (2004), our outcomes indicated that higher TAI scores correlated with lower test scores. In addition, we found a connection between furrowed eyebrows and increased exam scores, while lip licking or biting and clearing the throat were correlated with lower exam scores. While the TAI has been studied in experimental or observational classroom settings (Ali & Mohsin, 2013; Chapell et al., 2005; Ergene, 2003; Gerwing et al., 2015; Lufi et al., 2004; Peleg-Popko, 2004), others have not examined the relationship between exam scores and the TAI in eLearning, specifically with the use of virtual proctoring. Our study expands the range of its use with findings that are consistent with prior research.

With the behavior most frequently observed in this study being the student's gaze shifting to the right, an assumption could be made that any change in the student's gaze (e.g., right, left, upward, or downward) might suggest they were cheating. However, the review of each student's 360-degree environment scan revealed no electronic devices or print material nearby that may have provided assistance in answering their exam questions. Additionally, Bryan's comments indicate that the virtual proctor is an incentive to not cheat. Furthermore, his observed gaze shifting behaviors were indicators of cognitive processing and coping mechanisms. Although changes in the direction of gaze could indicate academic dishonesty, instructors need to investigate fully before drawing conclusions. While no academic integrity violations were found in this study, the purposeful use of virtual proctoring is to secure academic integrity standards (Baron & Crooks, 2005; Karim et al., 2014). These can best be achieved when instructors follow through on behavioral indications consistent with cheating taking place.

Implications

Instructors within eLearning courses using virtually proctored exams can use multiple tactics to help address students' needs and best support their exam-taking abilities. Some suggested strategies are:

1. Early in the course, develop open lines of communication between the instructor and students about exam-taking concerns (e.g. wanting to use paper and pencil while taking an exam);
2. Include opportunities for students to become comfortable with the virtual proctoring software in advance of the first course exam (e.g., use of a no-risk quiz); and
3. Discuss behaviors with students prior to assuming that academic impropriety has occurred.

As noted by Bryan and Emily, having prior practice and protocols about the use of virtual proctor technology helped reduce their anxiety and provided them with a better exam-taking experience. This aligns with previous findings (St. Clair, 2015) in which the use of a sample-quiz was found to be an easy, yet effective, best practice for reducing eLearning students' test anxiety. In addition, building into eLearning courses simple instructions for using virtual proctoring software or websites can help reduce technology concerns for students that could foster higher levels of anxiety. This emerging finding of behaviors demonstrated by students that are consistent with self-identified coping skills while taking exams invites the opportunity for instructors to incorporate material within their eLearning courses that will help students become calmer while taking their eLearning course exams.

Conclusions

With college students having to cope with academic performance pressures, it is of interest for instructors and educational researchers to understand what behaviors students are demonstrating

while taking virtual proctored exams. The use of virtual proctored exams allows researchers to observe for indications of test anxiety through a different lens compared to what is offered in the existing literature. To help students who display behaviors consistent with test anxiety cope better, instructors can incorporate effective test-taking strategies into their eLearning courses that can positively influence the students' academic performance (Talbot, 2016).

For the instructors questioning if virtually proctored exams would increase anxiety in eLearning students, the results of this study do not support that assumption. Instead, a greater case can be made that virtual proctoring best meets the convenience, cost, and flexibility needs of eLearning students identified by Shea and Bidjerano (2014). As more students are enrolling in eLearning courses (Allen & Seaman, 2016), the time is ripe for dialog about resources that could be included to educate students on strategies for decreasing anxiety reactions while taking their virtually proctored exams.

References

Allen, L. E., & Seaman, J. (2016). Online report card: Tracking online education in the United States. Retrieved from http://onlineLearningsurvey.com/reports/onlinereportcard.pdf

Ali, M. S., & Mohsin, M. N. (2013). Test Anxiety Inventory (TAI): Factor analysis and psychometric properties. IOSR Journal of Humanities and Social Science, 8(1), 73-81.

Asghari, A., Abdul Kadir, R., Elias, H., & Baba, M. (2012). Test anxiety and its related concepts: A brief review. Education Science and Psychology, 3(22), 3-8.

Baron, J., & Crooks, S. M. (2005). Academic integrity in web based distance education. TechTrends, 49(2), 40-45. doi:10.1007/bf02773970

Bedford, W., Gregg, J., & Clinton, S. (2009). Implementing technology to prevent online cheating: A case study at a small southern regional university (SSRU). MERLOT Journal of Online Learning and Teaching, 5(2), 230-238.

Camara, W. (2002). Examinee behavior and scoring of CBTs. In C. N. Mills, M. T. Potenza, J. J. Fremer, & W. C. Ward (Eds.), Computer-based testing: Building the foundation for future assessments. Mahwah, NJ: Erlbaum.

Chapell, M. S., Blanding, B., Silverstein, M. E., Takahashi, M., Newman, B., Gubi, A., & McCann, N. (2005). Test anxiety and academic performance in undergraduate and graduate students. Journal of Educational Psychology, 97(2), 268-274.

Chin, E. C., Williams, M. W., Taylor, J. E., & Harvey, S. T. (2017). The influence of negative affect on test anxiety and academic performance: An examination of the tripartite model of emotions. Learning and Individual Differences, 54, 1-8.

Duraku, Z. H. (2016). Factors influencing test anxiety among university students. The European Journal of Social and Behavioural Sciences, 18, 2325-2334. doi.org/10.15405/ejsbs.206

Dusek, J. B. (1980). The development of test anxiety in children. Test anxiety: Theory, research, and applications, 87-110.

Ergene, T. (2003). Effective interventions on test anxiety reduction: A meta-analysis. School Psychology International, 24(3), 313-328. Gerwing, T. G., Rash, J. A.,

Gerwing, A. M., Bramble, B., & Landine, J. (2015). Perceptions and incidence of test anxiety. The Canadian Journal for the Scholarship of Teaching and Learning, 6(3), 1-14.

Harris, H. L., & Coy, D. R. (2003). Helping students cope with test anxiety. Eric Digest. Retrieved from ERIC database. (EDO-CG-03-06).

Hill, K. T., & Wigfield, A. (1984). Test anxiety: A major educational problem and what can be done about it? The Elementary School Journal, 85(1), 105-126.

Humara, M. (1999). The relationship between anxiety and performance: A cognitive-behavioral perspective. Athletic Insight, 1(2), 1-14.

Karim, M., Kaminsky, S., & Behrend, T. (2014). Cheating, reactions, and performance in remotely proctored testing: An exploratory experimental study. Journal of Business & Psychology, 29(4), 555-572.

Kerton, C., & Cervato, C. (2014). Assessment in online learning--it's a matter of time. Journal of College Science Teaching, 43(4).

King, N., & Ollendick, T. (1989). Children's anxiety and phobic disorders in school settings: Classification, assessment, and intervention issues. Review of Educational Research, 59(4), 431-470.

Kolski, T., & Weible, J. (In Review). Do community college students demonstrate different behaviors from four-year university students on virtual proctored exams? Peer Reviewed Journal.

Li, C-S., & Irby, B. (2008). An overview of online education: Attractiveness, benefits, challenges, concerns and recommendations. College Student Journal,42(2), 449-458.

Lufi, D., Okasha, S., & Cohen, A. (2004). Test anxiety and its effect on the personality of students with learning disabilities. Learning Disability Quarterly, 27(3), 176-184.

Marcus, A., Raul, J., & Ramirez-Velarde, R. (2008). Addressing secure assessments for Internet-based distance learning: Still an unresolvable issue? Retrieved from http://www.ufrgs.br/niee/eventos/RIBIE/2008/pdf/adressing_secure.pdf

Mandler, G., & Sarason, S. (1952). A study of anxiety and learning. Journal of Abnormal Psychology,47(2), 166-73.

Peleg-Popko, O. (2004). Differentiation and test anxiety in adolescents. Journal of Adolescence, 27(6), 645-62.

Respondus. (n.d.). Retrieved from https://www.respondus.com/

Romero-Zaldivar, V. A., Pardo, A., Burgos, D., & Delgado Kloos, C. (2012). Monitoring student progress using virtual appliances: A case study. Computers & Education, 58(4), 1058- 1067.

Sanjoe, J. (n.d.). Online proctoring is trending: Here is all you should know about it. Retrieved from http://blog.talview.com/a-complete-guide-to-online-remote-proctoring.

Shea, P., & Bidjerano, T. (2014). Does online learning impede degree completion? A national study of community college students. Computers & Education, 75, 103-111. doi: 10.1016/M.compedu.2014.02. 009

Spielberger, C. D. (1980). Test Anxiety Inventory: Preliminary professional manual. Palo Alto, CA: Consulting Psychologists Press.

St Clair, D. (2015). A simple suggestion for reducing first-time online student anxiety. Journal of Online Learning and Teaching, 11(1), 129.

Talbot, L. (2016). Test anxiety: Prevalence, effects, and interventions for elementary school students. James Madison Undergraduate Research Journal (JMURJ), 3(1), 5.

Weinberger, D. A., Schwartz, G. E., & Davidson, R. J. (1979). Low-anxious, high-anxious, and repressive coping styles: Psychometric patterns and behavioral and physiological responses to stress. Journal of Abnormal Psychology, 88(4), 369-380.

Wolff, B. G., Wood-Kustanowitz, A. M., & Ashkenazi, J. M. (2014). Student performance at a community college: Mode of delivery, employment, and academic skills as predictors of success. Journal of Online Learning and Teaching, 10(2), 166.

Zeidner, M. (1998). Test anxiety: The state of the art. New York: Plenum Press.
