Impact of Perceived Stress during Oral Examination on Student Performance Outcomes

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Abstract

Perceived stress plays an important role in student performance during examinations. There has been substantial research on how examinations impact students' emotional experiences in diverse academic contexts in connection to validity, reliability, and equity of assessment. The potential of some exams to produce increased anxiety in a portion of students has been recognized as a serious threat to these three assessment attributes. In light of this, the need for further studies on the impact of perceived stress on student performance is critical with the recent rise in interest in oral examinations as an assessment tool for large undergraduate courses. This paper reports on the perceived stress associated with written examinations and oral examinations in the same courses. Building on our prior frameworks for conducting oral examinations, we assess student perceived stress associated with written and oral examinations based on self-reported surveys from over 450 students. Methods to reduce the negative impact of stress on students in the context of oral examinations were implemented. Our results show that perceived stress for oral assessments are consistently lower than written exams for both performance-based credit and participation-based credit courses. Other contributing influences such as language proficiency were found not to significantly affect perceived stress level using Kruskal-Wallis analysis. In this work we also investigated the relationships between student background, gender, GPA and perceived stress during written and oral assessments. Overall, our work provides a strong case for oral examinations as a form of assessment in large undergraduate classrooms by addressing concerns surrounding student perceived stress levels caused by oral examinations.

Introduction

Exams play a pivotal role in the formal education process. They are utilized as instruments to measure the learning gains and attained competence level of students in any particular domain. Exams can be pedagogically designed to positively influence students' approaches to learning and facilitate their intellectual and professional development. For these reasons, the topic of examination at all levels of formal education has continually attracted research interest. Assessment validity relates to the scope and depth of examination, i.e., its comprehensiveness and probing power, while reliability concerns the consistency with which evaluation is made. The ways and measures in which exams affect the emotional experiences of different students in various academic settings has been extensively studied in relation to validity, reliability, and equity of assessment [1,2]. The potential of some exams to produce debilitating anxiety in a portion of students has been recognized as a serious threat to these three assessment attributes.

Different reasons have been put forth as to why students under various conditions may experience excessive and counterproductive anxiety in the face of exams. Such anxiety is thought to be normal due to a fear of failure and feelings of helplessness. According to appraisal theory, when a student estimates that the situational demands of an exam transcend his or her available coping resources, the student will perceive the exam as threatening [3,4]. The psychological and physiological response that naturally follows is likely due to cognitive overload and functional impairment of the student, further exacerbated at the sight of an exam. The debilitating dimension of anxiety has the potential to undermine the validity of assessment, especially in overly demanding or stressful exam situations. Assessment reliability and equity can likewise be compromised when the exam demands and stakes are high, as the behavioral responses to stress among students widely differ. That is, while some students might be able to express their knowledge or ability in stressful situations at length, others, subject to the same examination conditions, might not [1,5].

Relevant to the present study are oral exams, a class of assessments involving spoken language. Familiar examples of oral assessments include doctoral thesis defenses, clinical assessments, oral argumentation assessments, classroom presentations, and interrogative questioning. The demand of demonstrating knowledge and competence dynamically through the oral medium, as required by oral assessments, can elicit an acute stress response in many students, as has been documented in diverse educational contexts [5-7]. This is particularly true in case of interrogative one-on-one oral exams where the assessor probes adaptively a student's understanding through a sequence of individualized and follow-up questions, which are often difficult for the student to anticipate. The lack of predictability and student control over the course of questioning can exacerbate a student's feelings of unease and nervousness, giving way to the detrimental effects of anxiety on performance. Anxiousness is conceivably further amplified if the oral exam is high stakes.

Empirical research to date on the topic of academic stress as it relates to oral assessment has mostly been based on students' self-reports. In their comparative study, Huxham et al. report oral exams induced higher anxiety in their undergraduate biology students than did written exams [8]. Iannone and Simpson similarly found their mathematics students experiencing high stress before oral exams, so much so that they expressed preference for written assessments [9]. Business school students in the study by Akimov and Malin likewise confirmed experiencing anxiety and indicated preferring the traditional written mode of examination over the oral mode [10]. Their survey results indicate students' actual nervousness exceeded their anticipated nervousness. In the study by Kang et al., focusing on students' perceptions about oral exams in an undergraduate diversity course, over half of the survey respondents indicated that they found preparing for the oral exam more stressful than preparing for the written exam [11]. Goodman, who implemented group oral exams in her biochemistry course, explains that novelty, unpredictability, lack of control, and evaluative threat, typically associated with oral assessments, are recognized psychological stressors, capable of influencing students' exam experiences [12]. She suggests

that clear expectations, multiple practice opportunities, and peer support can help alleviate some of the oral exam stress. Many further recommend that examiners be provided appropriate training in best pedagogical practices to ensure positive student learning experiences and assessment outcomes. Despite the concerns over anxiety, these studies highlight many positive features of oral assessments, including their positive influence on student engagement, motivation, and learning. Such observations suggest that stress associated with oral exams for many students serve as an activating agent, rather than a deactivating one.

In another set of studies, oral exams are found to be in fact less stressful or anxiety-inducing than written exams. An older study by Morissette, involving students taking business courses, finds that students perceive oral examinations as more pleasant, less difficult, and more beneficial to their learning than written exams [13]. Several newer studies describe similar findings. In his interview-based case study, Joughin reports that a cohort of theology students' found oral presentations less demanding than written assessment, yet more beneficial to their learning and engagement. He also notes that students were less anxious about the oral assessment, though not overly relaxed, and thus motivated to adequately prepare to avoid negative consequences, such as appearing foolish. This suggests that any anxiety experienced by students was facilitative as opposed to inhibiting.

Relatively high pre-oral assessment anxiety among students appears to be commonplace across disciplines, but frequently the stress is observed to significantly drop following the first oral exam. Subsequent oral exams are often reported as being less stressful for students. In their survey study on psychological responses to public speaking assessments, Nash and colleagues found that first-year students felt less apprehensive toward public speaking once they completed oral assessments and related exercises [14]. That is, they became desensitized to public speaking, or less susceptible to experiencing negative academic emotions in relation to speaking in formal settings. Reckinger and Reckinger report that students in their undergraduate computer science courses found the first oral exam to be quite stressful, but not later ones [15]. In recounting ten years of experience with oral exams in mathematics courses at the Air Force Academy, Boedigheimer et al. observe that students feel less pressured following their experience with the first oral exam [16]. For this reason, the authors, and other oral exam advocates, recommend having more than one exam, so that students may better acclimate to the assessment modality. Mock oral exams have likewise been suggested to familiarize students with expectations and help them build confidence and resilience.

A few studies looked at whether there were any gender or other demographic differences in oral exam perceptions and performance. Based on exam scores analysis, Huxham et al. concluded that oral assessment as implemented in their study does not favor one gender over the other [8]. Reckinger and Reckinger, in their survey analysis of the impact of oral exams on motivation, stress, and belongingness in introductory computer programming courses, did not find any significant differences in stress levels between male and female students, nor in their perceptions

of the usefulness of the assessment practice for their learning [15]. However, their students from non-majority racial/ethnic groups did report experiencing higher pre- and post-oral exam stress compared to their remaining peers. Qi et al. likewise observe that female students tend to find oral exams more stressful across a range of engineering classes [17]. On the other hand, in their investigation of students' neuroendocrine stress responses to oral assessment, Schoofs, et al. found no significant differences in salivary cortisol and sAA levels (biomarkers of stress) between female and male students immediately before and after oral examinations [6].

Various solutions in the literature have been proposed to reduce the negative impact of stress on students in the context of examination. One class of solutions relates to adjusting features of assessment; e.g.: keeping stakes low [18], offering multiple opportunities to demonstrate knowledge [17], diversifying assessment methods and formats [9], laying out clear expectations and sharing rubrics [9,12,18], providing ample practice opportunities [12], personalizing exam questions [19], affording students greater control or agency during examination [19], avoiding tightly timed exams, allowing the textbook and notes to be used during the exam [19], focusing more on higher levels of Blooms' taxonomy and less on discrete memorized facts [20], implementing group assessments [12], offering encouragement and feedback to students [5,19], and treating the exam more as a student-centered 'assessment for learning' than an 'assessment of learning' [9]. Such adjustments to assessment are directed toward addressing students' basic psychological needs of autonomy, competence, and relatedness, as postulated by self-determination theory (SDT), the satisfaction of which is typically accompanied by increased well-being, higher intrinsic motivation, improved cognitive and physical performance, and greater tolerance for stress [7,21]. Other approaches to addressing the anxiety problem involve interventions targeting students themselves. Stress-reappraisal and mindset interventions, for example, train students to (re)interpret stressful situations more advantageously, as well as their consequent emotions and growth and achievement opportunities [3,4]. (Re)evaluating the ratio of situational demands to personal resources more favorably and adopting a growth mindset, whereby anxiety is seen as functional and facilitative rather than adverse and debilitating, have been shown as effective approaches in mitigating the negative consequences of stress (*ibid*.).

In the context of existing literature and building on our prior frameworks for conducting oral examinations, we assess student perceived stress associated with written and oral examinations based on self-reported surveys from over 450 students. Methods to reduce the negative impact of stress on students in the context of oral examinations were implemented and student perceived stress were surveyed. This work adds to the body of knowledge surrounding stress during oral examinations in large undergraduate engineering classrooms and further validates this modality of examination as a viable alternative to written examinations.

Methods

Our primary research questions aim to answer the following questions: (1) Do oral examinations cause excessive stress to students in comparison to written examinations? (2) Which demographic of students are more likely to be stressed by oral exams? Thus, our surveys focused on determining if excessive stress was experienced by the students.

***Participants*:** Data from 451 undergraduate students across six courses from two engineering departments (Electrical Computer Engineering, Mechanical and Aerospace Engineering) have been collected for the analysis in this paper. Students were asked to fill out the post-class questionnaire online on a voluntary basis and therefore the retention of the student responses differed by the research topic and the time point of survey administration. A summary of the student demographic data is shown in Table 1.

Table 1. Summary of student demographics on Gender (Male, Female, Unknown), Underrepresented Minority Students and First Generation Students.

Category	**Sub-Category**	**Number of Students**	**Percentage (%)**
Gender	Male	349	77.4%
	Female	95	21.1%
	Unknown	7	1.6%
Demographic factors	Under-represented Minority Students (URM)	75	16.6%
	First-generation students (FG)	113	25.1%

Oral examination: As part of an initiative on campus, instructors implemented 15-20 minute long low-stakes online oral exams as an assessment in their respective courses. Each instructor had the flexibility to choose the format of the oral exam (e.g., extra-credit activity, a formative assessment, a summative assessment; 1:1 or group interview) based on their course needs and pedagogical goals. The content of oral exams ranged from materials that were on a previous written exam, a take-home exam, individual projects or explanation of one's codes (e.g., MATAB).

To minimize students' stress associated with oral exams, all assessors of oral exams (e.g., instructors and teaching assistants) were guided to take training and were provided with guidelines to effectively administer the oral exams. In terms of training, online modules were developed and were followed up with reflection activities on relevant topics (e.g., reducing students' anxiety; effective communication and making the student comfortable when administering the oral exams). Assessors were encouraged to implement grading rubrics and

scripts that incorporated those practices (e.g., anxiety-reducing gestures, scaffolding students with expectations, minimizing time pressure) to standardize the procedures and fully capture the students' potential.

***Materials & Design*:** To collect students' experience with both oral and written exams, several questionnaires were administered across multiple timepoints: before any exams (pre-survey), after each of the two exams (1st-post exam survey, 2nd-post exam survey) and at the end of the quarter (end of quarter survey). The questionnaires aimed at measuring the following: (1) Students' projected stress about each type of exam before taking them (oral and written, pre-survey); (2) Students' actual perceived stress after taking each exam (oral and written, 1st-post and 2nd-post exam survey, end of the quarter survey); and (3) Student's perceived benefit of oral exams (academic integrity, understanding of the subject matter, change in learning strategy, reaching out to the instructional team, motivation to learn).

The example questions are described in Table 1 below. Along with the questionnaires student demographic data were anonymized and were used to conduct analysis across different factors such as gender, student background (e.g., underrepresented minority, first-generation), language proficiency, and their academic standing (e.g., GPA). Both survey data and demographic data were de-identified and were analyzed together to understand student's perceived stress during different exam methods across different demographic variables.

Table 2. Student survey topics and example questions

Survey topic	**Example survey question and scales used**
Projected stress *(pre-survey)*	I expect stress associated with oral exam to be excessive I expect stress associated with written exam to be excessive *(5-pt scales from Strongly disagree (low stress) to Strongly agree (high stress))*
Actual perceived stress *(1st-post exam, 2nd-post exam, end-of-the-quarter survey)*	I found stress associated with oral exam stress to be excessive I found stress associated with written exam stress to be excessive *(5-pt scales from Strongly Disagree (low stress) to Strongly Agree (high stress))*
Benefits of oral exams *(end-of-the-quarter survey)*	Please indicate how much you agree or disagree with the following statement: - Interaction with a Prof/TA/Tutor/Reader during oral exams increased my motivation to learn

	- Taking oral assessments made me more comfortable (or more likely) to reach out to the instructional team for help (such as office hours, email, or other methods). - Oral assessment(s) in this course have changed my studying strategy for learning - The oral assessment(s) increased my understanding of the subject matter. - Oral assessment(s) contributed positively to the academic integrity of the course. *(5-pt scales from Strongly Disagree to Strongly Agree)*

Results and Discussion

Various cohorts of students receiving oral examinations and written examinations were analyzed in this study. Non-parametric Kruskal-Wallis test was used to evaluate the difference between each of the groups. Demographic factors such as gender, English proficiency, and prior oral exam experience were isolated among our surveyed students to determine their similarities and differences.

1. Expected Stress vs. Perceived Stress Associated with Written and Oral Examinations

As the perception of high levels of stress associated with oral examinations may deter adoption of this mode of evaluation, capturing this perceived stress is particularly important for our study. Students' anticipation of the excessive stress caused by written and oral examinations are shown in Fig. 1. Results from the pre-course survey show that a large number of students expected high stress associated with both the written exam and oral exam. 69% and 53% of the responses answered “agree/strongly agree” to the “I expect stress associated with written/oral exam to be excessive“ prompt, respectively. However, the survey results from the post-quarter survey show a very different picture. 61% of students reported that they perceived an excessive level of stress associated with the written exam. This number was consistent with the pre-course survey. On the other hand, the number of students who perceived an excessive level of stress associated with the oral exam dropped drastically to 25%. Despite the common belief that oral exams could be more stressful for students than traditional written exams, our findings indicate that, with the instructional team's thoughtful approaches in providing suitable stress management strategies for reducing perceived stress, oral exams may actually result in lower levels of stress in students than written exams.

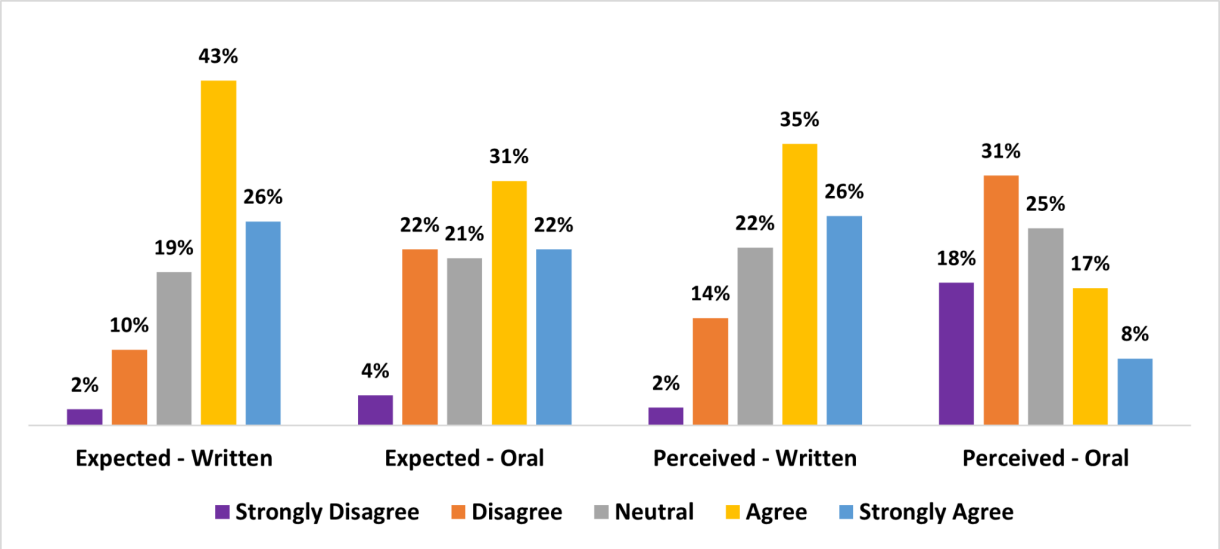

Fig. 1. Distribution of students' scores on expected stress (pre-course survey) and perceived stress (end-of-quarter survey) associated with written exam and oral exam. Students indicated whether the stress associated with the four measures above were excessive or not on a 5-point Likert scale from *Strongly Disagree* (low stress) to *Strongly Agree* (high stress).

We also considered the effects of some other factors on anticipated and perceived stress associated with written/oral exams. First-Generation (FG) students were more likely than non-FG students to anticipate a high level of stress associated with oral exams ($p < 0.0001$). Different cumulative GPA students displayed various attitudes about exams. Post-hoc analysis used to compare the different GPA student groups pairwise, more middle-performance (B and C range GPA) students anticipated experiencing high levels of stress from oral exams than high-performance (A range GPA) and lower performance (below C GPA) students ($p < 0.001$ for A and B students and $p < 0.0001$ for A and C students). We observed the same trends of responses among these groups with regards to written exams.

2. Impact of Prior Experiences on Anticipated and Perceived Stress Associated with Oral Exams

In this section, we study how students' earlier experiences with oral exams impact their expected and perceived stress associated with oral exams. The students were asked how many times they had taken oral exams in the past, and the responses ranged from "never," "yes, but not for credit," "once or twice," "several times," and "many times." For analysis, the four student groups who had any experience with oral exams (from "yes, but not for credit", to "many times", n = 293) were merged into a group with some experience, in comparison to those who did not have any prior experience in oral exams ("never", n = 158).

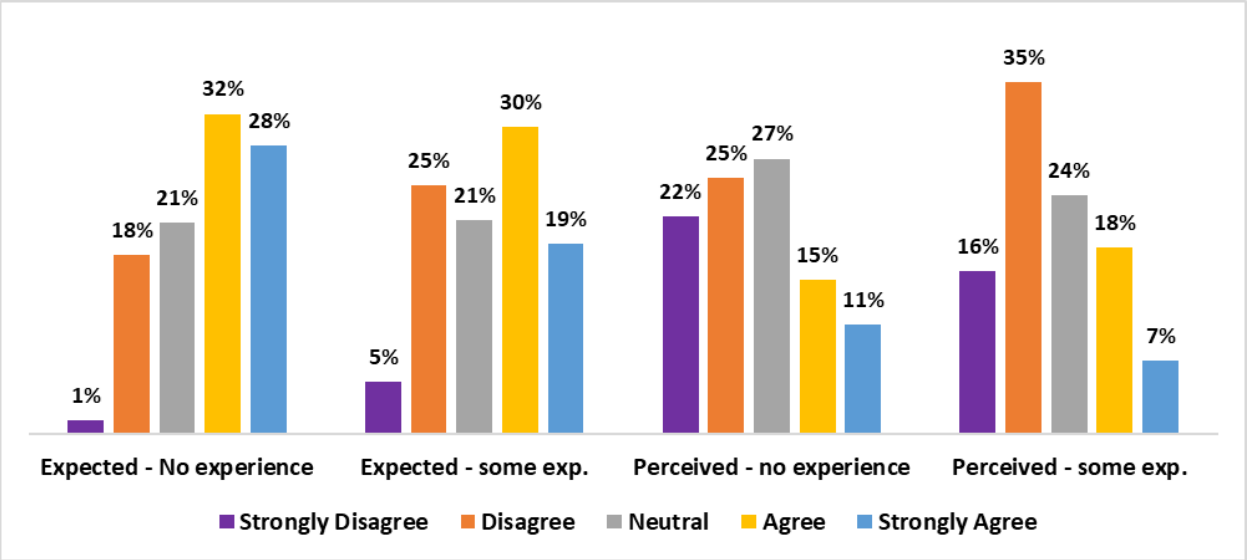

Fig. 2. Distribution of students' scores on expected excessive stress (pre-course survey) and perceived excessive stress (end-of-quarter survey) associated with oral exams. The first and third panels show results from students who have never had an oral examination before (n = 158) and the second and fourth panels show results from students who have at least had one oral examination before (n = 293).

Based on the Kruskal-Wallis test, our pre-survey indicated that students who did not have any previous experience in oral exams anticipated significantly more stress than students who had some experience in oral exams ($p < 0.005$). This suggests that some of the students' anxiety about oral exams is related to their inexperience from earlier academic experiences. However, our end-of-the-quarter survey indicated no difference in perceived stress between the two groups after getting guidance from our instructional team throughout the class and having taken the oral exam (*n.s.*).

3. Male vs. Female Students' Perceived Stress in Oral Examinations

We also analyzed whether we observe gender differences in the anticipated (pre-survey) or perceived (end-of-the-quarter survey) amount of stress. We found that on average, male and female students expected similar levels of stress but the distribution vastly differed as shown in Figure 3. As part of an exploratory analysis, a numerical trend of higher anticipated stress level was observed in female students than in male students but overall, perceived stress was lower for both groups in the end-of-the-quarter survey. We aim to conduct further analyses beyond this exploratory analysis.

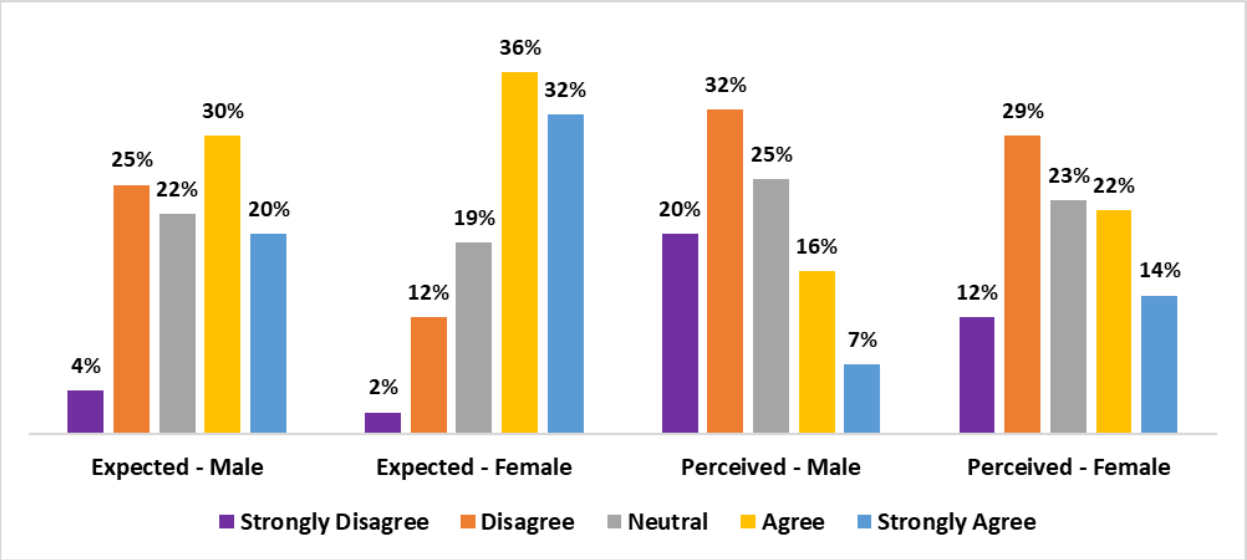

Fig. 3. Distribution of students' scores on expected excessive stress (pre-course survey) and perceived excessive stress (end-of-quarter survey) associated with oral exams by gender (Male, Female). The first and third panels show results from male students (n = 349) and the second and fourth panels show results from female students (n = 95). There were additional 7 students whose gender was reported to be 'unknown.'

4. English Proficiency Impact on Perceived Stress (Pre-survey vs. End-of-the-Course Survey)

Students' English competence is also correlated with the anticipated stress for oral exams. In the *pre-survey*, students self-reported their spoken English skill level, which ranged from "no proficiency" (level 0) to "elementary proficiency" (level 1), "limited working proficiency" (level 2), "professional working proficiency" (level 3), "full professional proficiency" (level 4), and native/bilingualism proficiency (level 5). Table 3 shows the number of students, the average perceived stress associated with oral exams, and the difference score in perceived stress in oral exams versus written exams. Figure 4 shows that students with limited working proficiency anticipated higher levels of stress associated with oral exams compared to written exams. This suggests that oral exams might put students with lower language proficiency at a disadvantage. To mitigate this stress, we found it helpful to provide students thorough explanations of the oral tests, including how they are assessed, how to prepare for them, and possible oral exam samples. Furthermore, emphasize that, while oral tests may improve their communication abilities, the grade will be based on comprehension rather than linguistic proficiency.

Table 3. The self-reported English proficiency from students and perceived stress measures

English Proficiency Level	1 Elementary proficiency	2 Limited working proficiency	3 Professional working proficiency	4 Full professional proficiency	5 Native/bilingualism proficiency
Number of students	1	16	43	47	344
Average Perceived Stress Associated with Oral Exam	-	0.1875	0.046512	-0.34043	-0.39826
Difference in Perceived Stress in Oral Exam vs. Written Exam	-	-0.875	-0.7907	-1.23404	-1.04942

Analysis of the *end-of-course survey* showed that the perceived stress associated with both written exams and oral exams were found to be correlated with the English proficiency of the students (Figure 3). As expected, students with better self-reported English proficiency perceived slightly lower stress associated with exams ($p < 0.05$ when comparing level 2 vs. level 5 for oral exam). However, it is important to note that the perceived stress level associated with oral exams is significantly less than that of written exams across all levels of proficiency. When comparing the differences in perceived stress between the two types of exams, there are no significant differences between the different levels of English proficiency (*not significant* when comparing level 2 vs. level 5). These results suggest that the oral exam, in fact, does not put students with lower language proficiency at a more disadvantage than written exams when it comes to stress.

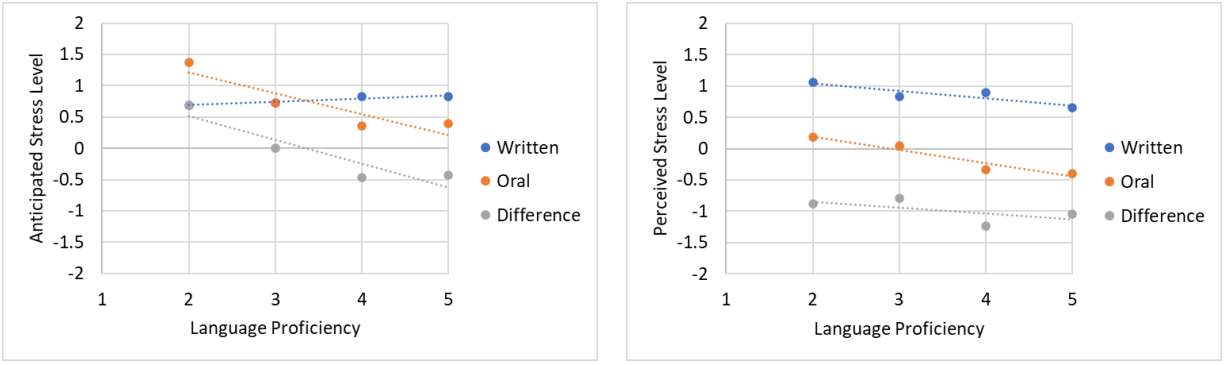

Fig. 4. Anticipated and perceived stress in oral and written exams as functions of English proficiency. The x-axis shows the levels of language proficiency self-identified by our students (1: elementary proficiency to 5: native/bilingual proficiency) and the y-axis shows the perceived level of stress from Strongly disagree (-2) to Strongly Agree (2) as responses to the question on anticipated/perceived excessive stress in oral/written exams.

5. Perceived Stress and Logistics of the Oral Examinations

Perceived stress associated with oral exams recorded for the same courses (one lower division and one upper division from the department of MAE) with different instructors administering oral examinations were compared and found to have no significant differences. For the upper division course (Solid Mechanics) statistical analysis scores were as follows: differences in the anticipated stress associated with oral and written exams: not significant between the two instructors (p= .0601), differences in the perceived stress associated with oral and written exams: not significant between the two instructors (*n.s.*). For the lower division course (Statics and Dynamics) statistical analysis scores were as follows: differences in the anticipated stress associated with oral and written exams: not significant between the two instructors (*n.s.*), differences in the perceived stress associated with oral and written exams: not significant between the two instructors (*n.s.*).

6. Perceived Stress Results for Performance-Based Credit vs. Participation-Based Credit

Course credit was also considered in the analysis to determine if performance-based credit versus participation-based credit impacted students' perceived stress associated with oral exams. Unsurprisingly, the results show participation-based credit showed significantly less perceived stress from students. Statistical analysis results were as follows: from the pre-quarter survey, the differences in the anticipated stress associated with oral and written exams were not significant between performance based and participation based (*n.s.*), from the end-of-quarter survey, the differences in the perceived stress associated with oral and written exams were significant between performance based and participation based ($p < .00001$). These results highlight the importance of choosing an appropriate amount of class credit for an oral exam, particularly when this mode of evaluation is a relatively new experience for many undergraduate students.

7. Perceived Stress on Different Weights of Oral Exam (same course and instructor)

We further investigate how different weights of oral exams might affect students' perception of stress. For this analysis, we looked at survey data from two cohorts of the same course with the same instructor that used different weights on the oral exam grading (10% and 25% of the overall course grade). Interestingly, the statistical analysis shows no significant differences in the perceived stress associated with oral and written exams (n.s.) between the two cohorts. When we consider these results together with the results from the previous section (performance-based vs. participation based), there seems to be a range in which instructors can adjust weights of the oral exam without causing an excessive amount of stress.

Conclusion

This paper studied the effect of oral examination on student perceived stress on two questions: Are oral examinations more excessively stressful to students compared to that of written examinations; and which student demographic groups are more likely to be stressed by oral

examinations. Our findings from surveying 451 undergraduate students showed that oral examinations were not any more stressful than written examinations to students when proper preparation strategies and transparent expectations were implemented by the instructional team. Moreover, we found that students' language proficiency did not drive higher levels of stress in oral examinations. In fact, students of all language proficiency levels reported lower stress in the end-of-the quarter survey compared to that of anticipated stress in the pre-survey. We also report analyses of intersections of student demographic factors and their experience in oral and written examinations. For future studies to mitigate logistical challenges with oral exam implementations, we report our overall student experiences with assessment criteria and that examination weight/credit can help minimize stress associated with oral exams. Overall, oral examinations are a viable approach to assessment, even in large engineering undergraduate classrooms. Despite the common perception that oral examinations may cause more stress than traditional written exams, our results show that with the instructional team's mindful approaches in providing proper stress management strategies for mitigating perceived stress, oral examinations may lead to even less stress levels in students compared to that of written exams.

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