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Perceptions of Cheating on In Person and Online Mathematics Examinations

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Abstract :*Academic dishonesty covers a long list of unsanctioned behaviors. Cheating on examinations is one form of academic dishonesty that is particularly problematic since results from assessments often form the basis for assigning course grades and promoting students to more advanced courses. And cheating occurs at all levels of schooling, including in higher education. Many university students admit to cheating on in person examinations by copying from another student during the examination, using crib notes, or helping someone else cheat. However, the changing landscape of instructional environments has also changed the face of academic dishonesty. Online education now provides additional avenues for cheating both in general and on examinations. In particular online courses may allow students to take examinations in remote locations without being supervised, thereby perhaps increasing the temptation to cheat while simultaneously decreasing the likelihood of being caught. The major research question addressed in this study is whether student perceptions of cheating differ depending on instructional context. In particular, do university students rationalize cheating on a mathematics examination differently if the examination is online and supervised, online and unsupervised, or in person? Ratings of the acceptability of cheating were gathered from an online survey showing illustrated scenarios depicting various justifications.*
Keywords: *academic dishonesty, online education, perceptions of cheating, motives for cheating, mathematics education*

I. INTRODUCTION

Academic dishonesty is a longstanding and critical issue in higher education [1-4]. Academic dishonesty, often referred to as "cheating," covers a long list of unsanctioned behaviors (such as plagiarizing the work of others and working collaboratively on individual assignments) and encompasses any "transgression against academic integrity which results in a misinterpretation of a student's ability and grasp of knowledge" [5]. Cheating on examinations is oneform of academic dishonesty that is particularly problematic since results from assessments often form the basis for assigning course grades and promoting students to more advanced courses in their pursuit of a diploma or degree, and ultimately perhaps lucrative employment. Yet, a meta-analysis of 107 studies of academic cheating by college students showed that 43.1% of students have cheated on examinations [6] by such means as copying from another student during a test, using crib notes, or helping someone else cheat [7]. These transgressions occur despite the fact that, in traditional instructional environments, a proctor is generally physically present to supervise students during the testing period in order to discourage cheating and enforce policies pertaining to academic dishonesty.

However, the changing landscape of instructional environments has now changed the face of academic dishonesty. Online education now provides additional avenues for cheating, both in general and on examinations [5], [8-9]. In particular, online courses may allow students to take examinations on a computer in remote locations, and even sometimes without being proctored, thereby perhaps increasing the temptation to cheat while simultaneously decreasing the likelihood of being caught.The major research question addressed in this study is whether university students rationalize cheating on a mathematics examination differently if the examination is administered online and proctored, online and unproctored, or is administered in person in a classroom setting.

Understanding students' attitudes toward cheating on examinations in various instructional contexts is critical for the development of strategies or policies aimed at prevention. Indeed, incentives (conversely pressures) and rationalizations are two elements of the fraud triangle conceptual framework [10]. For instance, passing a course could serve as an incentive for a student to cheat, and the belief that no one else will suffer as a result could serve as a rationale for cheating on an examination. Incentives and rationalizations are often grouped together and characterized as explanations that underlie cheating behaviors. Research has highlighted

many different explanations for why students engage in cheating behavior. These justifications for cheating include the need for a particular grade, lack of time to prepare, the view that others are cheating, desire to help a fellow student, and the feeling that the assessment is unfair [11-14], and are largely to both online and in person contexts.

The opportunity to cheat, the other vertex of the fraud triangle conceptual framework, on the other hand, may differ substantively depending on the instructional context. Indeed, students believe that cheating is much more common in online courses and that it is much easier to cheat in an online context [5], [15]. As one way of addressing the unique challenge of mitigating academic dishonesty in online learning environments [16], some instructors monitor students during examinations using recording software [17, 18]. The intent is to emulate an in person testingenvironment to the extent that a student has the perception of being watched while taking an examination. These proctored online examinations belong therefore to a hybrid of in person and online instructional contexts.They have characteristics of both in person contexts (such as the "presence" of a monitor during the examination period) and online unproctored contexts (such as being physically distant from the instructor).The purpose of this study was to explore the relationship between student perceptions of the acceptability of cheating on mathematics examinations that take place in online proctored, online unproctored, and in person settings.

II. METHODS

This study used an online survey instrument and quantitative methods to explore the relationship between perceptions of cheating in different instructional contexts and for various justifications. The three instructional contexts in which the hypothetical mathematics examination was staged were online proctored, in person, and online unproctored. Within each context, students rated the acceptability of cheating for eight justifications.

2.1 The instrument

An online survey was sent to former students by select mathematics instructors at the authors' university. The survey collected ratings on a Likert scale of 1 to 4 (ranging from totally unacceptable to totally acceptable) regarding the acceptability of cheating on a high stakes mathematics examination when a student did not know the answer to several of the questions. The situation took place in three instructional contexts as shown in Table 1.

Table 1. Instructional contexts and situation.

Instructional Context	Situation
Online proctored	A student was taking an ONLINE PROCTORED CLOSED NOTE MATH EXAM that would determine the final course grade. The student did not know the answer to several of the questions.
In person (proctored)	A student was taking a CLOSED NOTE MATH EXAM IN CLASS that would determine the final course grade. The student did not know the answer to several of the questions.
Online unproctored	A student was taking an ONLINE UNPROCTORED CLOSED NOTE MATH EXAM that would determine the final course grade. The student did not know the answer to several of the questions.

In order to mitigate possible confusion between the two most similar contexts (online proctored and online unproctored), the instructional contexts were presented to each student in the same order: the online proctored context was followed by the in person context, and this was then followed by the online unproctored context. Within each of these three instructional contexts, students were presented with eight scenarios in a random order. As seen in Table 2, each scenario represents a justification for cheating on the examination.Although it would have been preferable to include many more scenarios, the within subjects design of the study prohibited including a large number of justifications. In particular, the number of justifications used in the study wasrestricted to increase the likelihood that students would complete the survey, given that they were being asked to rate the acceptability of cheating for each scenario within each instructional context (e.g., three times

the number of scenarios). The eight scenarios that were included pertained to a diverse range of moral and psychological issues (such as redressing perceived inequity, conformity, and helping others) and also timely issues relating to nationality (such as fear of being sent home and language barriers). These select motives were generated by a review of the literature on academic dishonesty, in general [19], and as it relates to international students [20].

Table 2. Eight justifications for cheating and motive type.

Motive Type	Scenario	Justification
Redressing perceived inequity	The class didn't prepare me for this.	1
Conformity	Everyone else is cheating.	2
Psychological	Oh no! I can't remember how to do this	3
Prosocial	I need to get my degree so I can help out my family.	4
No harm to others	It's not graded on a curve so this won't hurt anyone else.	5
Other	I can't afford to take this course again.	6
Nationality	I won't be allowed to stay in the country if I fail.	7
	English is my second language so I didn't understand the honor code.	8

Most surveys use verbal descriptions to communicate the situation that is being rated. For example, Jensen, Arnett, Feldman, &Cauffman[19] used the following description, followed by a list of various rationales, to collect ratings on the acceptability of cheating on an in person exam:

> Jennifer [Jim] was taking a math exam which would determine her [his] final grade in the class. She [he] did not know the solution to several of the questions so she [he] looked at a classmate's answers. Rate how acceptable this behavior is if…

However, ratings in the present study were prompted using illustrated, rather than verbally described, scenariosto paint the picture of the context in which the cheating was taking place. In the illustrations, the rationales for cheating were shown in thought bubbles to signify that this was what the cheater was thinking at the time of the examination. The reasons for appealing to visual information processing [22] in this context, included encouraging survey participation and completion, providing a consistent image of each instructional context across students, avoiding having to counterbalance female and male students with female and male protagonists in the cheating scenarios, obscuring the nationality of the protagonist (by not using names such as Jennifer and Jim), and, finally and perhaps most importantly, encouraging students to identify with eachscenario[23]and thus provide judgments that closely reflect their own personal beliefs.

Fig. 1 shows one of the eight visual scenarios (for the rationale "This class didn't prepare me for this") within each of the three instructional contexts: online proctored (left), in person (middle), and online unproctored (right). The illustrations were deliberately constructed to capture critical features of the instructional context and also to be gender and race neutral. For example, the illustration of cheating inthe online proctored instructional context (Fig. 1 left) shows a green character in gender neutral attire sitting in a living space at a computer with a camera signifying remote camera-based proctoring attached to the top of the screen.

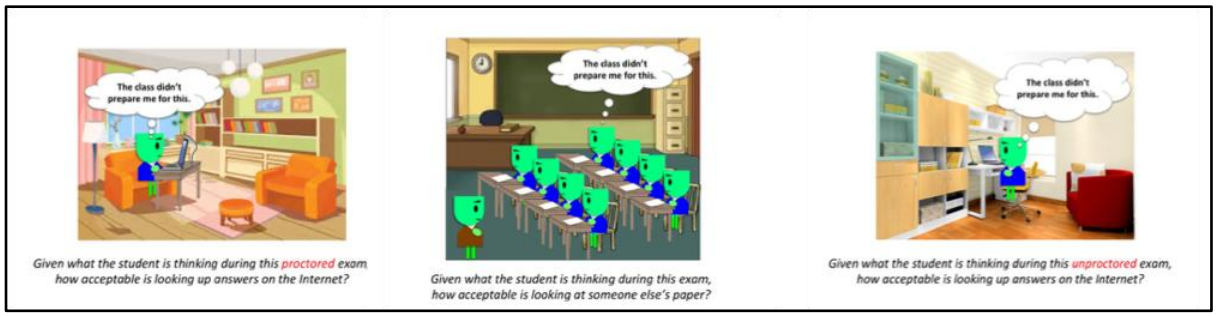

Figure 1. One rationale for cheating illustrated in each of the three instructional contexts.

2.2 Quantitative analyses

The data consisted of 24 ratings contributed by each participating student. A natural and popular way to study this ordinal data is to use the Proportional Odds Model introduced by McCullagh [23]. TheProportional Odds Model is one member of the family of cumulative logisticregression models, designed for studying the effect of covariates on anordinal responses variable [24]. This model uses cumulative probabilitiesupto a threshold, thereby making the whole range of ordinal categories binary at that threshold:

$$\log\left(\frac{P(y_i \leq c)}{1-P(y_i \leq c)}\right) = \theta_c - x_i\beta \qquad (1)$$

wherey_i are the ordinal responses, x_i are the covariates, θ_c is the threshold parameter, c is the ordered category, andβ is an unknown regression parameter. Notice that intercepts can differ, but that slope for each variable stays the same across different equations. One maythink of this as a set of parallel lines (or hyperplanes) with different intercepts. The proportional-odds condition constrains the lines corresponding to each cumulative logit to be parallel. Since the data in this study come from a repeated measure design, the Mixed-effects Proportional Odds Model is needed. We define $y_{ij} = x_{ij}\beta + u_i + \zeta_{ij}$, where u_i is the unknown random effect for each student and ζ_{ij} are the model residuals that follow a logistic distribution, and then propose the Mixed-effects Proportional Odds Model as follows:

$$\log\left(\frac{P(y_{ij} \leq c)}{1-P(y_{ij} \leq c)}\right) = \theta_c - (x_{ij}\beta + u_i) \qquad (2)$$

As noted by Peterson and Harrell [25], violation of the proportional odds assumption of parallel lines is not uncommon. In this case, instead of the Proportional Odds Model, the Partial Proportional Odds Model should be considered:

$$\log\left(\frac{P(y_{ij} \leq c)}{1-P(y_{ij} \leq c)}\right) = \theta_c - (x_{ij}\beta + u_{ij}\alpha_c + u_i) \qquad (3)$$

Whereu_{ij} is a vector containing the observation ij on the set of covariates for which proportional odds is not assumed, and α_c is a vector of regression coefficients associated with these covariates. Notice that the effects of these covariates are allowed to vary across the number of cumulative logits minus one. These terms are often referred to as threshold interactions. A given model that includes covariates in both *x* and *u* would be a Partial Proportional Odds Model, whereas one with only *u*variables would be a Non-proportional Odds Model [26].

III. RESULTS

The online survey received responses from 731 students. Because there is no way to confirm how many students actually received the invitation to participate in the survey, it is not possible to specify an accurate response rate. For this reason, and because the survey was sent out by select instructors, potential response bias should be kept in mind when interpreting these results.

Fig. 2 shows the average acceptability rating for each of the three instructional contexts.In general, students rated cheating as unacceptable regardless of context. However, although cheating was generally viewed as unacceptable, students rated cheating as least acceptable when the examination took place in-person and lessunacceptable when it took place in an online unproctored context. The Mixed-effects Partial Proportional Odds Model revealed a significant effect of instructional context on ratings of the acceptability of cheating, but no significant difference between ratings of acceptability inthe online proctored and online unproctored contexts ($\delta = 0.035, \sigma_\delta^2 = 0.006$).

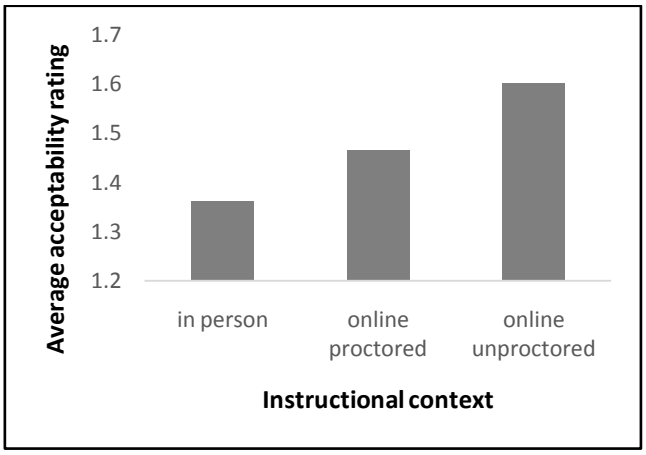

Figure 2. Average acceptability of cheating by instructional context.Larger values represent ratings of higher acceptability.

Fig. 3shows the average ratings of cheating acceptability across instructional contexts and justifications for cheating. First, students view cheating as unacceptable regardless of rationale; average ratings were between 1 (totally unacceptable) and 2 (somewhat unacceptable). Second, students judge cheating in online unproctored examinations as being more acceptable for each of the eight rationales. However, the view of cheating in online proctored examinations was not consistently aligned with the other online context or the other proctored context (in person). Instead, views on the acceptability of cheating in online proctored exams resembled that of cheating in a face-to-face context for some of the rationales (e.g., because everyone else is cheating), and that of cheating in an online unproctored context for others (e.g., not being allowed to stay in country as a consequence of failing the examination). Third, the acceptability of cheating depends on the rationale; cheating was most acceptable if permission to stay in the country was at stake, if the outcome of the exam affected being able to help family members, or if the fault lay in how the class prepared the student for the exam.

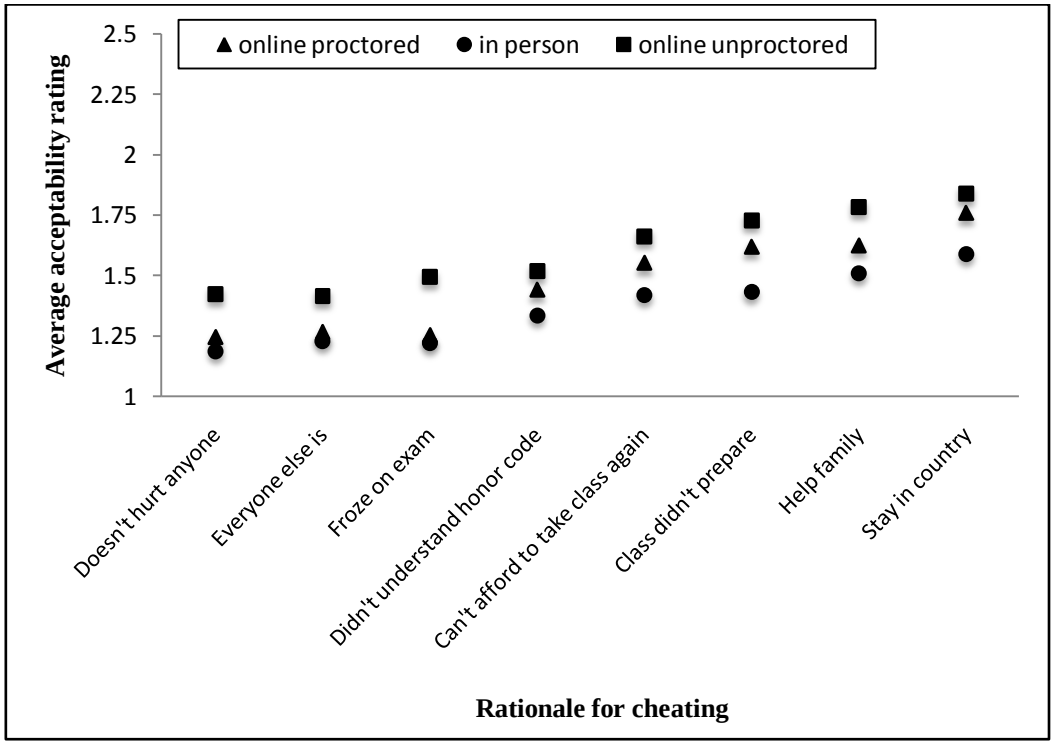

Figure 3. Average acceptability of cheating by instructional context for each rationale. Larger values represent ratings of higher acceptability.

Table 3 shows the results of the Mixed-methods Partial Proportional Odds Model that includes each justification (Justification 1 was used as the comparison factor.) The effects of all of the justifications were significant, and, furthermore, we can order the degree to which students found the various justifications for cheating acceptable as seen in Fig. 2.

Table 3. Mixed-effects Partial Proportional Odds Model

	Estimate	**Std. Error**	**z value**	**P(>|z|)**	**Significance level**
Intercept	-2.135051	0.144958	-14.7288	2.2e-16	***
online proctored	0.584272	0.041897	13.9456	2.2e-16	***
onlineunproctored	1.247534	0.030817	40.4818	2.2e-16	***
Justification 2	-1.584240	0.065360	-24.2387	2.2e-16	***
Justification 3	-1.466464	0.070699	-20.7424	2.2e-16	***
Justification 4	0.222411	0.066150	3.3622	0.0007732	***
Justification 5	-1.690753	0.081696	-20.6956	2.2e-16	***
Justification 6	-0.190511	0.072655	-2.6221	0.0087379	**
Justification 7	0.620011	0.059150	10.4819	2.2e-16	***
Justification 8	-0.753955	0.056368	-13.3757	2.2e-16	***
Random (Intercept)	10.984977	1.026140	10.7051	2.2e-16	***
Threshold 2	2.166670	0.019900	108.8753	2.2e-16	***
Threshold 3	4.182269	0.025503	163.9912	2.2e-16	***

IV. CONCLUSION

This study compared perceptions of cheating on a mathematics examination in various instructional contexts using illustrated scenarios to evoke ratings. In order to better inform the ways in which we address cheating on examinations in modern education, more work is needed to address the limitations of this study. For instance, it would certainly be desirable to include a larger selection ofincentives and rationalesfor cheating that are relevant for university students, and to gather data from multiple institutions (cf., [27]). This study was constrained by access to students to survey and by the number of ratings that were collected from each individual student. Also, the online delivery of the survey lends itself to self-selection bias. Another limitation is that the instrument used in this study did not specify whether the act of cheating was premeditated or impromptu. It may be that students view the acceptability of cheating differently depending on whether or not there was the intent to cheat before, rather than during, the examination based on research showing that students think that cheating is more likely to stem from panic rather than being planned in advance [28]. In addition, there is a need to more specifically address issues of gender, culture, nationality, and experience with online (mathematics) courses, and how these factors relate to the perception of cheating in various instructional contexts. What counts as cheating in one culture may be regarded as collaboration in another, and citizenship status may be a central and growing concern for many of today's students. Also, this study specifically examined cheating on a mathematics examination. Mathematics is a subject that is known to instill fear and dislike in many students [29], so further work should examine whether students perceive cheating on examinations differently depending on the subject area. Finally, this study pioneered an innovative instrumental design by using illustrated scenarios to elicit ratings from students. Much more research needs to be done to investigate how the use of illustrated scenarios compares with the use of purely verbal descriptions to elicit responses in surveys, particularly when the goal is to collect information on personal beliefs.

This study is a first step toward exploring more deeply how students view cheating on examinations in various instructional contexts. First, students realize that cheating is wrong, regardless of instructional context, and this is consistent with other research showing that students' acceptance of cheating stands in stark contrast with self-reported incidences of cheating [3], [30-31]. Also, the view of cheating as more acceptable for online examinations is consistent with the finding that social issues influence cheating behaviors [1]. Students are less likely to cheat if they feel personally connected with the instructor, and students may not feel the presence of their instructor as strongly in online courses (see Gibbons et al. [32]). Furthermore, the higher acceptability of cheating in online unproctored examinations may be a reflection of student beliefs that an unsupervised examination means that the instructor does not care whether students cheat [7]. Finally, students appear to be more tolerant of cheating for the sake of fulfilling family obligations or out of fear of being sent out of the country. The students who participated in this study were not exclusively international students so this attitude of tolerance under these circumstances may reflect an empathetic mindset toward the welfare of others.

This work points to the continued need for developing and employing possible strategies to discourage cheating in online examinations [33-35], while also taking into account timely politically instigated fears and concerns that might lead students to engage in academic dishonesty.

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