

The Relationship between Academic Dishonesty and Ethical Behavior in Engineering Practice

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Introduction

Academic dishonesty, known more commonly as cheating, has been a consistent problem for many years at all educational levels. However, several studies indicate that the level of cheating among students in college has increased steadily over the past 40 years. Of direct importance to engineering educators is the fact that the students in engineering are among those most likely to participate in academic dishonesty. In 1964 Bowers, in the largest study to date, found that 58% of engineering students self-reported cheating in college (Bowers 1964). In comparison McCabe found that by 1996 82% of engineering students self-reported cheating (McCabe 1997). In both cases, students in engineering reported the second highest rates of cheating, behind only business students.

The consequences of these high rates of academic dishonesty among engineering students are clear. For students who cheat there are personal consequences such as missing out on the opportunity to develop a deep understanding of the content material. They also develop a sense over-time that every one else cheats, that it is easy to do and a normal part of life. In essence they become desensitized to the academic cultural norm of integrity in learning. It is not just academia, but also society, who must deal with the consequences of student cheating. These same students are evaluated by their faculty on the basis that their falsely completed work is in fact a valid assessment of their knowledge and capabilities. This provides prospective employers with an inaccurate impression of the students' abilities. Perhaps more serious, however, is the idea that the behaviors which lead to a rejection of academic integrity could well extend into professional practice with significant consequences for the individual, the company, customers and society in general.

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We might consider cheating at the collegiate level a deviant behavior since it varies from the cultural norm of academic integrity. Likewise, violating work-place policies, whether internally or externally mandated, might also be considered a deviant behavior. The question then becomes, is participation in deviant behavior, notably cheating, a predictor of participation in deviant behavior in future settings such as the workplace?

In a study based on their Theory of Planned Behavior, Beck and Ajzen (1991) pointed out that prior and future behavior are only correlated to the extent that the underlying determinants, such as attitudes, subjective norms, perceptions of behavioral control and intentions, have not changed over time. Thus, if a correlation exists between high school cheating for example and college cheating, one must presume that influences other than situational factors must be at work in the student's decision to cheat. In such a case, there should be, and are, correlations between academic dishonesty and other deviant behavior including risky driving (Blankenship and Whitley 2000), theft from employers (Hilbert 1985), shoplifting (Beck and Ajzen 1991), alcohol abuse (Kerkvliet 1994), and cheating on income taxes (Fass 1989).

These findings suggest that there are certain common factors that influence an individual's decision to participate in deviant behaviors, including academic dishonesty regardless of the situation. It is possible that the same factors may influence decision-making patterns at the professional level. If true, then the disciplines with the highest rates of self-reported academic dishonesty, such as engineering, are matriculating graduates who have a higher likelihood of engaging in unethical behavior during professional practice.

Our research is driven by a hypothesis that there are similarities in the decision making processes students use when considering cheating at college to those they may (or currently do) use in professional practice. To investigate this question, we have developed an exploratory survey, which asks respondents' about *decisions* during

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opportunities to "cheat" in each of two contexts: college coursework and workplace settings. For each context, respondents were asked to consider specific instances in which they had been *tempted* to cheat, what pressures they felt to cheat or not to cheat in this specific instance, and ultimately what decision they made. This paper will present both qualitative and quantitative data from the survey but will consider this data in the aggregate. Further analysis examining the context, responses and decisions of specific individuals will be discussed in future publications.

Methodology

Sample Description

A total of 130 students enrolled at two technically-oriented private universities responded to the survey. Students were asked to complete the survey in their classes to maximize the response rate (85.9%). Because we wished to examine the relationship between unethical behavior in college and the workplace, first year students were not included in the sample due to their lack of experience in either setting. The sample consisted of 2nd year (7%), 3rd year (42%), 4th year (33%) and 5th year (16%) undergraduate students. Participants reported working full-time an average of 6.78 months ($\sigma = 2.97$) during the last academic year, and an average of 38.7 hours per week ($\sigma = 10.8$) during this time. This experience is crucial to our study given that we are interested in collecting data from individuals exposed to both work-place and academic settings within recent memory.

During the survey respondents were asked to consider a specific instance during which they were tempted to violate their company's policies. Of the sample under investigation, 40% considered a situation related to an engineering occupation, 10% indicated retail/restaurant/service and 10% indicated trades/construction. Respondents who did not work for pay during the last year were asked to skip over this section of the

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survey, which accounted for 30% of participants. This does not mean that 30% of students did not work during the last year. If this were true, the average reported number of hours worked per week should have been considerably lower than 40 hours. Since this was not the case, we suspect that most respondents had worked during the past year, but a substantial number chose not to complete this portion of the survey for other reasons.

Survey

Participants completed a 13-item questionnaire consisting of three sections. The first section contained questions related to the respondents' background including GPA, extent to which they worked in the past year and how frequently they cheated in high school. The second section dealt with issues relating to college cheating and what factors influence a respondent's decision to cheat. Likewise, the third section of the questionnaire dealt with decisions regarding deviant behavior in the workplace.

As with any study on deviant behavior that uses a self-report questionnaire approach, underreporting due to social desirability is a concern (Edwards 1957). Despite this possible source of error, there is evidence that in many situations self-reports of dishonest behaviors can be accurate (Himmelfarb and Lickteig 1982). Care was taken to develop protocols that assured respondent anonymity. Participants filled out the questionnaire in their classrooms. The questionnaire was distributed by one of the authors of this paper who briefly discussed the nature of the research and the participants' rights. The proctor left the room while participants completed the questionnaire. Respondents were asked to place completed surveys into a large plain envelope. The envelope was sealed and returned to a department administrative assistant who delivered the surveys to the proctor for entry into the data set. These protocols and the survey itself were approved by an institutional review board for the behavioral sciences.

Academic Dishonesty

Table 1 presents the self-reported frequency of respondent cheating during a given term in high school. The majority of respondents indicated cheating at least a few times per term, and 79.2% of the respondents indicated that they cheated at least once per term. We did not collect similar data from this survey in regards to cheating frequency in college; however, from a previous study we estimate that 96% of engineering students within our sample had cheated at least once while in college (Carpenter, Harding et al. 2002). Data is not available for a comparison by term in this case.

Table 1: Self-reported frequency of high school cheating during an average term

Frequency	
Never	20.0%
Once	15.4%
A Few Times	53.8%
Frequently	10.0%

Because we were specifically interested in *decisions* during opportunities to cheat, respondents were asked to indicate how frequently they were *tempted* to cheat on various forms of assessment during their most recent term in college. Frequency data is presented in Table 2. Average scores for these assessments, based on a 5-point Likert scale, are shown in the far right column. Respondents indicated that they were most frequently tempted to cheat on homework, followed by lab reports, and then tests or quizzes. Participants reported that they were least likely to be tempted to cheat on team projects, term papers and final exams. Average scores were significantly different as determined by a Friedman non-parametric test ($\chi^2=171.3$, $df=6$, $p<0.001$).

Table 2: Frequency respondents were *tempted* to cheat on various assessments during their last college term

Assessment	Never (%)	Once (%)	2-5 Times (%)	5-10 Times (%)	10+ Times (%)	Average Score*
Homework	23.1	17.7	33.8	15.4	7.7	2.66
Lab Report	50.8	12.3	24.6	6.2	4.6	2.00
Test/Quiz	42.3	20.8	29.2	3.8	1.5	1.99
Computer Program	60.0	11.5	16.9	4.6	3.8	1.77
Final Exam	63.8	20.0	10.0	2.3	1.5	1.54
Term Paper	71.5	13.8	10.0	1.5	1.5	1.45
Team Project	79.2	5.4	9.2	2.3	1.5	1.38

* Average scoring based on: 1 = Never, 2 = Once, 3 = 2-5 Times, 4 = 5 – 10 Times, 5 = 10+ Times

Through free-response questions respondents were asked to describe the pressures that led them to consider cheating (Question 7.2). As part of the qualitative data analysis, the resulting responses were copied onto index cards by three independent evaluators. Each evaluator then categorized the responses into one of several themes. The independent evaluators then met to discuss their themes and came to a consensus. Through discussion the group arrived at the list of themes shown in Table 3. This data suggests a wide range of perceived justifications for cheating by the respondents. The single most common temptation to cheating was, by a considerable margin, not having enough time to complete assignments, reports, etc. (23.1% of valid responses). This may suggest that many students perceive cheating in school as a time saving mechanism, rather than as a means to giving themselves an advantage over others. One could argue that this is related to the second most frequent response of being unprepared for the assessment (14.1% of valid responses). Students who lack time to complete assessments are often going to be unprepared for those assessments. However, there are other potential explanations for being unprepared and these two responses remain separated for that reason. Students also indicated that not being motivated to study the material (10.9%), pressure to achieve high grades (10.3%), poor instruction (9.0%) and overly difficult material as further temptations to cheat (8.3%). All of these responses could be

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described as situational in that the respondent feels more justified in cheating because of the particularly difficult circumstances of their situation.

**Table 3: Pressures to consider cheating as reported by student respondents
(Question 7.2)**

Response	Count	Percent of All Responses (%)	Percent of Valid Responses (%)
1. Not enough time	36	20.7	23.1
2. Unprepared	22	12.6	14.1
3. Lack of motivation	17	9.8	10.9
4. Grade pressure	16	9.2	10.3
5. Professor deserved it	14	8.0	9.0
6. Material too hard	13	7.5	8.3
7. Easy to cheat	10	5.7	6.4
8. Lazy or procrastinated	7	4.0	4.5
9. Cheating works	7	4.0	4.5
10. It's not cheating	6	3.4	3.8
11. Everyone does it	2	1.1	1.3
12. Others needed it (my help)	1	0.6	0.6
13. Could not be determined	5	2.9	3.2
14. Blank or unrelated response	18	10.3	- - -
Total	174	100.0	100.0

We also asked respondents to consider what thoughts, feelings, social pressures or school policies might have made them hesitate in cheating (Question 7.3). These free-responses were categorized into emerging themes for analysis by the evaluators and are listed in Table 4. The most frequent response was associated with feelings of shame and guilt about cheating (17.7% of valid responses). This could be described as a resistance to cheating because of potential negative consequences. Arguably these responses could be grouped with responses from the themes “Fear or high probability of getting caught” and “Fear of sanctions”. This larger grouping would suggest that 37.9% of responses were about avoiding the temptation to cheat because of possible negative consequences. On the other hand, 26.6% of respondents indicated pressures to resist cheating that were of a more positive nature (“Desire to learn” and “Desire to do own work”). It should be noted that the response theme “Cheating is wrong” includes 11 responses with exactly

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this wording. The evaluators could not agree on why the respondent felt cheating was wrong, and as such, these responses were left in their own group.

**Table 4: Factors which made respondents hesitate in their decision to cheat
(Question 7.3)**

Response	Count	Percent of All Responses (%)	Percent of Valid Responses (%)
1. Shame, conscience, guilt, loss of personal respect	22	14.8	17.7
2. Desire to learn	17	11.4	13.7
3. Desire to do own work	16	10.7	12.9
4. Fear or high probability of getting caught	13	8.7	10.5
5. Fear of sanctions	12	8.1	9.7
6. No hesitation	11	7.4	8.9
7. Cheating is wrong	11	7.4	8.9
8. Cheating is against the rules	5	3.4	4.0
9. Physically too hard or time consuming	4	2.7	3.2
10. It won't get you anything	2	1.3	1.6
11. Would lose respect of others	2	1.3	1.6
12. Could not be determined	9	6.0	7.3
13. Blank or unrelated response	25	16.8	- - -
Total	124	100.0	100.0

Data from the survey also indicated that 36.2% of respondents decided to go through with their plan to cheat, while 50.0% chose not to (13.8% provided no response). Table 5 presents a comparison of the frequency of respondents who decided to cheat as a function of the type of assessment they were considering when asked to think of one specific assessment in which they were tempted. Since respondents were asked to consider only one scenario, we cannot infer how any one individual might respond under a different scenario. However, in the aggregate we can make comparisons on the decision to cheat for different scenarios. As indicated in Table 2 respondents were most frequently tempted to cheat on homework and tests/quizzes. However, 45% of respondents tempted to cheat on homework decided to go through with their decision to cheat, while only 33% of those tempted to cheat on tests/quizzes went through with it. As a further comparison, only 14% of respondents who were tempted to cheat on a final exam actually went

through with it. An interesting observation is that more students than not were willing to cheat on lab reports (66.7%) and computer programs (58.3%). These results are not surprising as our previous data has shown that respondents' perceptions of cheating are influenced significantly by the nature of the assessment (Finelli, Harding et al. 2003).

**Table 5: Frequency of the decision to cheat based on assessment type
(number of respondents shown in parentheses)**

Assessment Type	Students Decision to Cheat	
	Yes	No
Lab Report	66.7% (6)	33.3% (3)
Computer Program	58.3% (7)	41.7% (5)
Homework	45.2% (19)	54.8% (23)
Test/Quiz	33.3% (11)	66.7% (22)
Team Project	33.3% (1)	66.7% (2)
Final Exam	14.3% (1)	85.7% (6)
Term Paper	0%	100% (1)
Other	0%	100% (1)

Workplace Behavior

Respondents were asked to estimate how frequently they were *tempted* to consider violating workplace policies within several different scenarios. This data is presented in Table 6. From this table it is apparent that respondents were most frequently tempted to use company supplies or equipment improperly. This is in agreement with research indicating that employee theft is the primary source of crime-related losses to businesses (Nonis and Swift 2001). As many as 48.8% of respondents indicated that they were tempted to use company supplies or equipment improperly at least once while working at their company.

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Table 6: Frequency of respondents who were tempted to violate workplace policies

Scenario	Never (%)	Once (%)	2-5 Times (%)	5-10 Times (%)	10+ Times (%)	Average Score*
Improper Use of Company Supplies	51.2	14.4	25.6	3.2	5.6	1.98
Falsify Records	64.6	6.9	17.7	2.3	4.6	1.70
Ignore Quality Problems	77.6	7.2	12.8	1.6	0.8	1.41
Lie About Work Quality	79.2	5.4	6.2	3.8	1.5	1.37
Ignore Safety Problems	84.8	8.0	5.6	1.6	0.0	1.24
Accept Improper Gifts	88.8	5.6	4.8	0.8	0.0	1.18
Take Credit of Other's Work	90.4	4.8	4.0	0.8	0.0	1.15

* Average scoring based on: 1 = Never, 2 = Once, 3 = 2-5 Times, 4 = 5 – 10 Times, 5 = 10+ Times

The second most frequent scenario respondents reported was that of being tempted to falsify records (31.5%) such as time sheets, expense reports and quality assurance documents, at least once during the past year. This was followed by ignoring quality problems (22.4%), lying about the quality of one's work (16.9%), ignoring safety problems (15.2%), accepting improper gifts (11.2%) and finally taking credit for someone else's work (9.6%). Average scores were significantly different as determined by a Friedman non-parametric test ($\chi^2=111.0$, $df=6$, $p<0.001$).

As with cheating, respondents were asked to indicate what pressures tempted them to consider violating the workplace policies of their employer (Question 11.3). The same procedure was used here to group the various responses into themes. Table 7 presents the results of this analysis. Overwhelmingly, the largest theme was that of the respondent indicating they wanted or needed something and were tempted to take or use it without permission (21.8% of respondents). This is not a surprising finding given that improper use of company supplies or equipment was the most common scenario under which respondents were tempted to violate work-place policies. The second most common response was that the activity would be a victimless crime and that there would be no harm if the student participated (10.3%). This is followed by a sense that the company

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deserved to be cheated because of how they treated their employees (8.0%) and that there was a lack of time, money and/or equipment to complete the job as required (8.0%).

Respondents were also asked to indicate what had made them hesitate in their decision to violate their employer's policies (Question 11.4). Themes from this analysis are presented in Table 8. Somewhat surprisingly, an equal number of respondents said they felt no hesitation to violate policies (13.8%) as indicated hesitating because of their own positive personal standards and because they might get fired. A fear of getting caught and the statement "It (violating work place activities) is wrong" were also common responses.

Table 7: Pressures to violate workplace policies as reported by student respondents (Question 11.3)

Response	Count	Percent of All Responses (%)	Percent of Valid Responses (%)
1. I wanted/needed it	19	13.7	21.8
2. Inconsequential/seemed harmless	9	6.5	10.3
3. The company deserved it	7	5.0	8.0
4. Lack of time/money/equipment to do job correctly	7	5.0	8.0
5. Wanted to seem better than I was	5	3.6	5.7
6. Others needed my help	4	2.9	4.6
7. Didn't want to put forth the effort	4	2.9	4.6
8. Everyone does it	4	2.9	4.6
9. It's easy or easy to get away with	3	2.2	3.4
10. Not confident in my abilities	3	2.2	3.4
11. Wanted to avoid conflict with others	3	2.2	3.4
12. Someone told me to do it	3	2.2	3.4
13. No one would care	2	1.4	2.3
14. No pressures or it isn't wrong	1	0.7	1.1
15. I didn't know it was wrong	1	0.7	1.1
16. Could not be determined	12	8.6	13.8
17. Blank or unrelated response	52	37.4	- - -
Total	139	100.0	100.0

Table 8: Factors which made respondents hesitate in their decision to violate workplace policies (Question 11.4)

Response	Count	Percent of All Responses (%)	Percent of Valid Responses (%)
1. No hesitation	11	7.7	13.8
2. Personal standards (pride/integrity)	11	7.7	13.8
3. I might be fired or get in trouble	11	7.7	13.8
4. Fear or high probability of getting caught	8	5.6	10.0
5. It is wrong	8	5.6	10.0
6. Would lose respect of others	5	3.5	6.3
7. Shame, conscience or guilt	5	3.5	6.3
8. There would be negative consequences for customer	4	2.8	5.0
9. Work had to get done	3	2.1	3.8
10. Could affect product quality	3	2.1	3.8
11. Is or could be illegal	2	1.4	2.5
12. Could be more work/money later	2	1.4	2.5
13. Could not be determined	7	4.9	8.8
14. Blank or unrelated response	62	43.7	- - -
Total	142	100.0	100.0

Overall, of the respondents who indicated that they had been tempted to violate company policies in some way, 30% went through with their plan, 15.4% opted not to go through with their plan and 10.8% followed some other course of action. An additional 43.8% of respondents chose not to provide a response to this question. Such a large number of missing responses would indicate the possibility of substantial bias in the responses. However, a review of earlier questions in this portion of the survey shows that 30.0 - 36.2% of responses are missing in these questions. This suggests that a smaller number of respondents may have refused to answer the question regarding their ultimate decision to violate workplace policies due to social desirability bias than initially apparent.

Table 9 provides a comparison of the decision to violate company policies on the basis of what scenario the respondent was considering when they indicated whether or not they went through with their plans. Though sample size is quite small in some instances, it is apparent that more respondents were willing to improperly use company supplies or equipment than not. This is also true of falsifying records. A review of free-

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response comments from respondents indicates that these records were typically time sheets that co-op students must turn in to their employers.

Table 9: Frequency of the decision to violate company policies based on workplace scenario (number of respondents shown in parentheses)

Workplace Scenario	Action Taken at Work Situation		
	Went through with plan	Decided not to go through with plan	Other
Improper use of company supplies	73.1% (19)	19.2% (5)	7.7% (2)
Falsify records	53.8% (14)	19.2% (5)	26.9% (7)
Accept improper gifts	50% (1)	50% (1)	0%
Ignore quality problems	42.9% (3)	57.1% (4)	0%
Take credit for other's work	33.3% (1)	33.3% (1)	33.3% (1)
Lie about work quality	25% (1)	50% (2)	25% (1)
Don't report safety problems	0%	50% (1)	50% (1)

Comparisons Across Context

Because we are interested in investigating the connection between prior behavior and future decision making, it is instructive to examine the relationship between self-reported levels of cheating in high school and whether or not the respondents went through with their decision to cheat and/or violate workplace policies.

Table 10 contains a comparison of self-reported levels of cheating in high school to the decision of whether to cheat in the specific situation the respondent was considering when completing the survey. Though statistical significance cannot be established due to small sample sizes, there is a clear trend in the data. Respondents who indicated that they had cheated more frequently in high school, were more likely to indicate a positive decision to cheat in the scenario they were considering. For example, 31.6% of respondents who reported never cheating in high school indicated that they did decide to cheat in the scenario they were considering in college. 68.4% indicated that they decided not to cheat. On the other hand, of the respondents that reported frequently

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cheating in high school, 61.5% went through with cheating in the specific situation in college, while only 38.5% chose not to.

Table 10: Decision to cheat in college situation as a function of self-reported cheating frequency in high school

Frequency of high school cheating	College Cheating Decision	
	Decided to cheat	Decided <u>not</u> to cheat
Never	31.6%	68.4%
Once	47.1%	52.9%
A few times	40.3%	59.7%
Frequently	61.5%	38.5%

Similar observations can be made when comparing the self-reported frequency of high school cheating to the decision to go through with plans to violate work-place policies, as shown in Table 11. Only 37.5% of respondents who reported never cheating during an average term in high school decided to violate their workplace policies, whereas, 63.6% of respondents who frequently cheated in high school decided to go through with their plans. There is a clearly increasing trend in the number of students indicating that they did violate the workplace policies as the frequency of high school cheating increases. Together the data presented in Table 10 and Table 11 seem to confirm that when it comes to cheating in college and violating workplace policies, past behavior, in this case cheating in high school, can be a strong indicator of future behavior.

Table 11: Decision to violate workplace policies as a function of self-reported high school cheating frequency

Frequency of high school cheating	Workplace Policies Violation Decision		
	Decided to violate policies	Decided <u>not</u> to violate policies	Other
Never	37.5%	50.0%	12.5%
Once	44.4%	44.4%	11.1%
A few times	56.8%	25.0%	18.2%
Frequently	63.6%	9.1%	27.3%

Examination of the qualitative responses shows a remarkable similarity in the nature of the responses, though not necessarily their relative frequency. For example, in comparing the responses to Questions 7.2 (pressures to cheat) and Question 11.3 (pressures to violate workplace policies) we see that most responses are common across the two questions as shown in Table 12. The extent of commonality in the responses

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suggests that there are substantial similarities in the decision making processes students use when it comes to academic dishonesty and workplace behavior. Each pair of common responses are relabeled with a new variable name that attempts to capture the intent of the response pairs. It should be noted that some responses could not be grouped across the two questions. For example, in terms of the pressures to cheat, respondents indicated that being unprepared, lacking motivation and perceiving that cheating works were all temptations to cheat. No similar response could be found among those for violating workplace policies. In the case of violating workplace policies there were also several responses that did not match up with those for cheating, including: I wanted or needed it, inconsequential/seemed harmless, wanted to avoid conflict, someone told me to do it and no one would care. Despite the lack of matching pairs for these responses, it is quite likely that these are important variables in the decision making process and that they did not show up in our limited data set.

Table 12: Common responses to pressures to cheat and to violate workplace policies

Name for Common Responses	Pressures to Cheat (Question 7.2)	Pressure to violate workplace policies (Question 11.3)
Insufficient resources	Not enough time	Lack of time/money/equipment to complete job
Importance of success	Grade pressure	Wanted to seem better than I was
Projection of blame	Professor deserved it	The company deserved it
Perceived chance of success	Material was too hard	Not confident in my abilities
Perceived risk of detection	It's easy to cheat	It's easy to do/get away with it
Industriousness	Lazy or procrastinated	Didn't want to put forth the effort
Attitude	It's not cheating	It isn't wrong/I didn't know it was wrong
Perceived norms	Everyone does it	Everyone does it
Peer influence	Others needed my help	Others needed it/my help

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Similarly, we might examine what commonalties exist in the responses to perceived hesitations in the decision to cheat (Question 7.3) and to violate workplace policies (Question 11.4). Here again, the substantial number of common responses between academic and workplace setting suggests that there are in fact common restraints on the decision to become involved in a deviant behavior. As before, however, there are some responses that did not agree. For example, in the case of academic cheating some respondents indicated that it was physically too hard or time consuming to cheat. No common pairing could be found among the responses for the workplace setting. Likewise, among the responses for hesitations to violate workplace policies several responses were unpaired, including: negative consequences for customers, work had to get done and it could affect product quality. These responses relate to specific scenarios that are not found in academic settings. However, an argument could be made to group these responses under the common variable moral obligation.

Table 13: Common responses to pressures to cheat

Name for Common Responses	Hesitations to Cheat (Question 7.3)	Hesitations to violate workplace policies (Question 11.4)
Conscience	Shame, conscience, guilt, etc.	Shame, conscience or guilt
Moral obligation	Desire to learn/Desire to do own work	Personal standards (pride/integrity)
Perceived Risk of detection	Fear of getting caught	Fear of getting caught
Attitude	Cheating is wrong	It is wrong
Risk of formal sanctions	Cheating is against the rules	It is or could be illegal
Expected value of success	It won't get you anything	Could be more work/money later
Influence of significant others	Would lose respect of others	Would lose respect of others

Conclusions

This section will be added after all data analysis is completed.

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