

“I’M AFRAID TO FAIL THE TEST” - MOTIVATIONAL ORIENTATION, STATISTICS ANXIETY AND ACADEMIC DISHONESTY

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ABSTRACT

The present study deals with the mediation of statistics anxiety and motivation in the relationship comprising academic dishonesty, personality traits, and previous academic achievements in three different learning environments (Face to Face – F2F, Planned Online Environment – POE, and Emergency Remote Teaching – ERT). Self-determination theory provides a broad psychological framework for these phenomena. Data were collected from 649 bachelor-degree students in Social Sciences at five Israeli academic institutions. Structural equation modelling was employed to investigate the research variables' relationships. Findings indicate that statistics anxiety mediates the relationship between personality traits and academic dishonesty in the POE and the ERT learning environments. Findings also indicate mediation of the relationship between students' achievements and academic dishonesty, but only in the ERT learning environment. In contrast, motivation mediates the relationship between students' achievements and statistics anxiety only in the POE learning environment. This study unveils that learning environments determine the mediating role of statistical anxiety. We discuss potential implications and suggest designing online courses according to student-centred approaches.

KEYWORDS

Academic Dishonesty, Statistics Anxiety, Personality Traits, Learning Environment, Motivation

1. INTRODUCTION

The COVID-19 pandemic impelled education to transform into online delivery, leading to unplanned online teaching and learning formats, coined as emergency remote teaching - ERT (Hodges et al., 2020). As mere application of traditional educational approaches to online settings has been shown to be ineffective (Badiozaman, 2021), students' performance and motivation were affected (du Rocher, 2020; Maqableh & Alia, 2021). Research has revealed that academic misconduct, like academic dishonesty, increased dramatically worldwide (Erguvan, 2021). Academic dishonesty refers to offences that include: cheating, plagiarism, fabrication, and facilitation (Etgar et al., 2019). Academic dishonesty has both moral and practical implications, as students' ethical behaviour transfers over into the job force (Walsh et al., 2021).

Statistical literacy has become an essential, sometimes mandatory, skill in science and in academic education (Trassi et al., 2022). Yet, research has revealed (Murtonen, 2015) that students experience problems with learning, understanding, and using basic statistical notions, and some are experiencing Statistics anxiety. Statistics anxiety refers to a negative emotional state or attitude provoked by any form of contact with statistically related content (O'Bryant et al., 2021). Hence, it often interferes with teaching-learning quantitative material. For some students experiencing statistics anxiety, this assignment has a negative impact on their academic experiences (Trassi et al., 2022). Previous research on undergraduate social sciences students (Steinberger et al., 2021) unveiled that students' anxiety toward statistics negatively influences learning and academic performance. Moreover, anxiety and inappropriate academic behaviours are related (Zhang et al., 2020), as negative emotions influence students' propensity to engage in unethical conduct (Tindall et al., 2021).

Likewise, research has shown a significant interrelation among attitudes toward statistics, anxiety, and performance, which are determined by students' prior statistics or mathematics education (Peiró-Signes et al., 2021). Research dealing with the influence of statistics anxiety on student academic performance is vast (O'Bryant et al., 2021), including factors which predict academic dishonesty (Roe, 2022). Studies focusing on statistics learning have also found POE instruction is less effective than F2F, as it allows learners to be more concretely exposed to their educator's attitudes and concerns. As a result, performance in POE settings is lower than in F2F ones (Cui et al., 2019).

Recent research (Etgar et al., 2019) has revealed the pivotal role of motivation in students' disposition to academic dishonesty. Motivation can psychologically strengthen and stimulate students' learning processes and activities (Becerra & Almendra, 2020). Accordingly, it predicts academic performance (Zalts et al., 2021) as it explains one's intentional behaviours (Shi et al., 2021), and is a substantial factor in conditioning anxiety (Luo et al., 2020). According to Self-Determination Theory (SDT) by Deci and Ryan (2008, 2020), motivation can either be intrinsic or extrinsic. Intrinsic motivation refers to the willingness to engage in educational activities based on inherent interest and enjoyment, as extrinsic motivation is based on external outcomes or rewards. Intrinsic motivation is positively associated with academic success, performance, and self-confidence (Foutz et al., 2021). Studies have pointed out that extrinsic motivation relates to incompatible behaviours such as anxiety and indifference towards responsibility (Lavasani et al., 2014). Students with high extrinsic motivation are driven by grades, class rank, and earnings (Zalts et al., 2021). Moreover, motivation and FFM are positively related to academic performance. While the personality trait of extraversion was found to be unrelated to motivational orientations (Arniatika, 2020), conscientiousness and openness to experiences correlate with intrinsic motivation; neuroticism correlates with extrinsic motivation (Müller et al., 2006).

Scholarly review literature (Chiang et al., 2022) has indicated that dispositional character and person-related circumstances determine statistics anxiety and academic dishonesty. Students' past academic achievements are strongly connected to academic misconduct (Koscielniak & Bojanowska, 2019) and statistics anxiety (Steinberger et al., 2021). Moreover, research has shown that traits are crucial for understanding students' disposition to engage in academic dishonesty (Peled et al., 2019). Research has shown that the Five-Factor Model of personality traits (FFM) by McCrae and Costa (1987) significantly impacts statistics anxiety (Steinberger et al., 2021) and is related to dishonest behavior (Eshet et al. 2014), with overlaps between the two relationships (Cui et al., 2019; Malesky et al., 2022). Yet, studies on statistics anxiety, academic dishonesty and pandemic circumstances are scant (Steinberger et al., 2021). Our research fills this gap by examining the relationship comprising: academic dishonesty, statistics anxiety, personality traits, and motivation among undergraduate students taking a Statistics compulsory course in different learning environments (F2F, POE and ERT). Understanding academic dishonesty profile and likelihood is key to personalising academic interventions meant to discourage and reduce it in different learning environments. Furthermore, our research enlightens the mediating roles statistics anxiety and motivation play in the relationship comprising personality traits, previous achievements, and academic dishonesty. Thus, the main research question is: To what extent does the relationship among statistics anxiety, personality traits, previous achievements, and motivation affect academic dishonesty in the different learning environments (F2F, POE, ERT)?

1.1 Hypotheses

H₁: Statistics Anxiety will mediate the relationship between Students' Personality Traits and Academic Dishonesty.

H₂: Students' Motivation will mediate the relationship between Students' Personality Traits and Statistics Anxiety.

H₃: Statistics Anxiety will mediate the relationship between Students' Previous Achievements and Academic Dishonesty.

H₄: There will be differences between learning environments in the relationship comprising Statistics Anxiety, Personality Traits, Motivation, Academic Dishonesty, and Previous Academic Achievement.

1.2 Research Model

Based on the literature above, the research model presents academic dishonesty as assumed to be influenced

by personality traits and students' previous achievements with the mediation of motivation and statistics anxiety

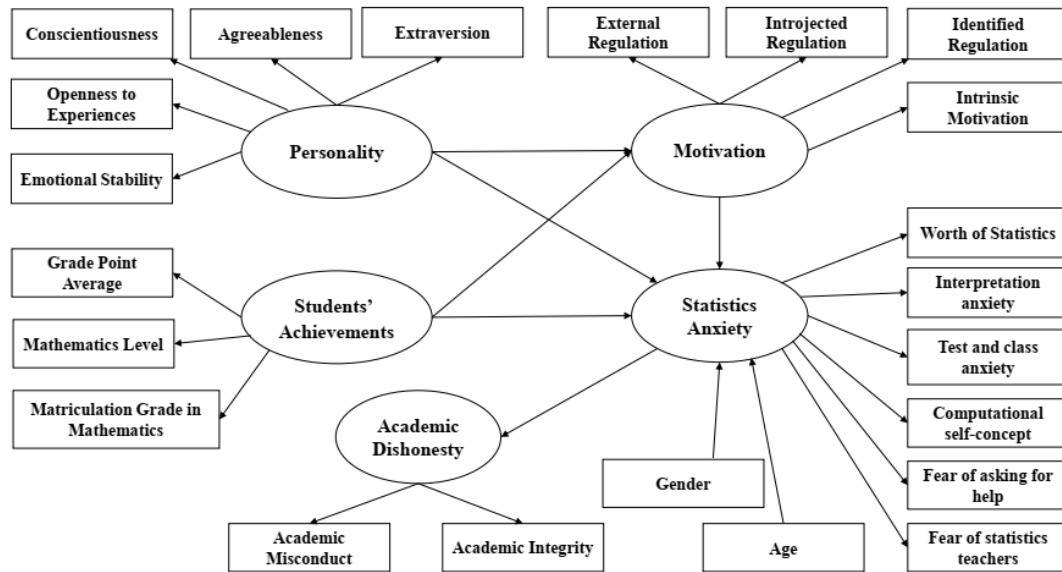


Figure 1. Structural Model for Determinants of Academic Dishonesty in Statistics Courses

The research model presents personality traits (measured by extraversion, agreeableness, conscientiousness, openness to experiences, and emotional stability), students' previous achievements (measured by mathematics level, grade point average, and matriculation grade in mathematics) with the mediation of the latent variable of motivation (measured by external regulation, introjected regulations, identifies regulation and intrinsic motivation), and statistics anxiety (measured by worth of statistics, interpretation anxiety, test and class anxiety, computational self-concept, fear of asking for help, and fear of statistics teachers) as the factors assumed to influence academic dishonesty.

2. METHODS

2.1 Participants and Procedure

Data were collected from students studying for bachelor's degrees in social sciences enrolled in introductory Statistics courses in five Israeli academic institutions. There was a total of 649 participants, 7% were male and 93% female students (Mean age=23.5 years, SD=7). Questionnaires were administered through an online platform following the approval of the Ethics Committee. More than half of the students (59%) enrolled in POE before COVID-19 outbreak, 18% in F2F before COVID-19, and 23% in ERT courses in 2020 (during the pandemic). Participants had no prior experience with ERT but were familiar with POE. The average time for filling out the questionnaires was 12 minutes. Fourteen percent of the participants were excluded from the analysis as their survey instruments were incomplete (less than 80%) or carelessly completed.

2.2 Instruments

2.2.1 Dependent Variables

Academic Dishonesty was measured directly through *the Academic Misconduct Scale* (Bolin, 2004) and indirectly through *the Academic Integrity Inventory* (Kisamore et al., 2007). and validated these instruments to the Israeli context. The *Academic Misconduct Scale* comprises 10 items on a five-point Likert scale, in which 1 means "Never" and 5 "Many times". Its reliability is excellent (0.91 Cronbach's alpha). The *Academic*

Integrity Inventory consists of 8 items on a five-point Likert scale, in which 1 means "Very unlikely" and 5 "Very likely". Its reliability is acceptable (0.75 Cronbach's alpha).

2.2.2 Mediating Variables

Statistics Anxiety – the Hebrew version of the Statistics Anxiety Rating Scale (H-STARS), which is an abridged version of the STARS scale developed by Cruise et al. (1985). The H-STARS has been adapted to the Israeli context and found reliable and valid (Steinberger, 2020). The H-STARS comprises 30 items and employs six different subscales: worth of statistics; interpretation anxiety; test and class anxiety; computational self-concept; fear of asking for help; fear of statistics instructors. Participants answer questions about possible anxiety-inducing situations and their attitudes to statistics on a 5-point scale, in which 1 means no anxiety and 5 a great deal thereof. Steinberger (2020) has reported good internal consistency reliability (0.80-0.94). These are consistent with those presented previously in Cruise et al. (1985). Following the authors' recommendation, calculating the overall score averages all questionnaire items, so the higher the score, the higher the anxiety level.

Motivational orientation – We employed the *Academic Self-Regulation Questionnaire (SRQ-A)* (Ryan & Connell, 1989), which evaluates four types of motivation: intrinsic motivation, identified, introjected, and external regulation. Participants answered 17 questions employing a five-point Likert scale, in which 1 means "Not true at all and 5 "Very true". As measured by Cronbach's alpha, the questionnaire's reliability is acceptable (0.75).

2.2.3 Independent Variables

Personality traits – the *Ten Item Personality Inventory (TIPI)* scale by Gosling et al. (2003), which is comprised of 10 items developed to evaluate the personality traits of the participants on a five-point Likert scale, in which 1 means "Not true at all and 5 "Very true". Two statements inform each trait. The reliability of this questionnaire, as measured by Cronbach's alpha is questionable (0.63).

Previous academic achievements are measured according to students' high school mathematics level, grade point average, matriculation grade in mathematics, and course enrolment type.

2.3 Plan of Analysis

We analysed the data through Structural Equation Modelling (SEM). Full information maximum likelihood estimates were computed using the Analysis of Moment Structures (AMOS) program (Arbuckle & Wothke, 1999). The model was examined for the goodness of fit using χ^2 , comparative fit index (CFI), and root mean square error of approximation (RMSEA) fit indices. CFI values above 0.90 and 0.95 indicate adequate and good model fit, respectively, and RMSEA values below 0.08 and 0.05 indicate adequate and good model fit, respectively (Browne & Cudeck, 1992; Hu & Bentler, 1999). In addition, we used descriptive statistics and Pearson Correlations to analyse the data. Reliability analysis was done as well. The structural model is diagrammed in Figure 1.

3. RESULTS

Among the participants, 6.5% reported high statistics anxiety (the mean higher than 4 on a scale from 1 to 5). A significant difference was found between all the three learning environments [$F_{(2,646)}=36.637$, $p<0.001$] in statistics anxiety (M=2.50, SD=0.60 for POE, M=3.02, SD=0.62 for F2F and M=2.80, SD=0.56 for ERT). Almost two-thirds of the participants (64.6%) reported having engaged in academic dishonesty at least once in the POE learning environment, compared to 55% in the F2F and 43.5% in the ERT modality. A significant difference was found between all the three learning environments [$F_{(2,646)}=17.893$, $p<0.001$] in academic dishonesty (M=4.12, SD=0.41 for POE, M=3.85, SD=0.44 for F2F and M=3.99, SD=0.41 for ERT). In the full sample, the results show significant negative correlations between all the five personality traits and academic dishonesty. Furthermore, there is a significant negative correlation between identified regulation and academic dishonesty and significant positive correlations between academic dishonesty, external and introjected regulation, and intrinsic motivation. There are positive correlations between each of the components of statistics anxiety and academic dishonesty.

The academic dishonesty variable was modelled by the variables of academic misconduct and academic integrity, by the latent variable of personality, and those of motivation, and of students' previous achievements with the mediation of the latent variable of statistics anxiety. The data fit the academic dishonesty model marginally well ($\chi^2=1,426.37$, $N=649$, $df=564$, $p<0.001$, $CFI=0.801$, $RMSEA=0.049$).

3.1 Academic Dishonesty Analysis - POE Sample

The results of the analysis indicate that the variance in academic dishonesty is explained by students' personality traits with the mediation of statistics anxiety. Accordingly, the POE sample supports H_1 . statistics anxiety is the variable having a greater impact on academic misconduct with a total effect of 67%. Test and class anxiety are among the most influential components of statistics anxiety. It has one of the highest effects ($b=0.79$, $p<0.001$), meaning that the higher a student's level of statistics anxiety as to test and class anxiety, the higher their propensity to cheat. Statistics anxiety component of computational self-concept has been found to have a strong significant effect as well ($b=0.77$, $p<0.001$), meaning the higher the student's computational self-concept, the higher the probability they engage in academic misconduct. Interpretation anxiety ($b=0.76$, $p<0.001$) is a further strong factor influencing academic misconduct. Accordingly, statistics anxiety regarding interpretation anxiety increases academic misconduct. In addition, personality traits were found to have a significant negative impact on statistics anxiety ($b= -0.34$, $p<0.05$). All five personality traits have a significant effect on the mediating variable of statistics anxiety: Extraversion ($b=0.16$, $p<0.05$), agreeableness ($b=0.48$, $p<0.05$), conscientiousness ($b=0.46$, $p<0.001$), openness to experience ($b=0.23$, $p<0.01$) and emotional stability ($b=0.73$, $p<0.001$). Accordingly, the higher levels of a student's personality traits, the less anxious they are. Motivation was also found to have a negative significant impact on statistics anxiety ($b= -0.36$, $p<0.01$), while all motivation types have a significant effect on the mediating variable: external regulation ($b=0.21$, $p<0.001$), introjected regulation ($b=0.70$, $p<0.001$), identified regulation ($b=0.76$ $p<0.001$) and intrinsic motivation ($b=0.77$, $p<0.001$). In other words, the higher the student's motivation, the lower the level of statistics anxiety.

3.2 Academic Dishonesty analysis – F2F Sample

The results indicate that the variance in academic dishonesty is explained by students' personality traits and motivation, with no significant effect of statistics anxiety as a mediator. Therefore no support for the four hypotheses was obtained in the F2F sample. Personality traits were found to have a negative significant impact on statistics anxiety ($b= -0.55$, $p<0.01$), while three personality traits have a significant effect on the mediating variable: conscientiousness ($b=0.35$, $p<0.05$), openness to experience ($b=0.72$, $p<0.001$) and emotional stability ($b=0.67$, $p<0.001$). This means that the higher a student's personality traits, the lower the level of statistics anxiety. Motivation was also found to have a negatively marginal significant impact on statistics anxiety ($b= -0.36$, $p=0.065$), while all motivation types have a significant effect on the mediating variable: external regulation ($b=0.58$, $p<0.001$), introjected regulation ($b=0.98$, $p<0.001$), identified regulation ($b=0.36$ $p<0.001$) and intrinsic motivation ($b=0.34$, $p<0.01$). In other words, the higher a student's motivation, the less anxious they are. Grade point average ($b=0.46$, $p<0.05$) is a further variable having a significant negative effect on statistics anxiety. The higher a student's grade point average, the lower the statistics anxiety. We also found that women experience greater statistics anxiety than their male counterparts, and the greater the age, the greater the statistics anxiety.

3.3 Academic Dishonesty Analysis - ERT Sample

The results indicate that the variance in academic dishonesty is explained by students' personality traits and students' previous achievement, with the mediation of Statistics anxiety. Therefore, H_1 and H_3 were confirmed in the ERT sample. statistics anxiety is the variable having the greatest impact on academic misconduct, with a total effect of 49%. Test and class anxiety are among the most influential components of statistics anxiety; it has one of the higher effects ($b=0.83$, $p<0.001$). The higher a student's level of statistics anxiety as to test and class anxiety, the higher their propensity to cheat. Similarly, the component of statistics anxiety regarding fear of asking for help was also found to have a strong significant effect ($b=0.82$, $p<0.001$). The higher a student's level of statistics anxiety as to fear of asking for help, the higher the probability they engage in academic misconduct. In addition, interpretation anxiety ($b=0.80$, $p<0.001$) is a further strong factor influencing

academic misconduct. Moreover, personality traits were found to have a negative significant impact on statistics anxiety ($b = -0.55$, $p < 0.001$), along with a positive significant effect on motivation ($b = 0.46$, $p < 0.01$), while all the personality traits have significant effect on the mediating variables: extraversion ($b = 0.36$, $p < 0.001$), agreeableness ($b = 0.38$, $p < 0.001$), conscientiousness ($b = 0.58$, $p < 0.001$), openness to experience ($b = 0.55$, $p < 0.001$) and emotional stability ($b = 0.54$, $p < 0.001$). This means that the higher a student's levels of one of the above personality traits, the more motivated and less anxious they are. Another set of variables having a negative significant effect on statistics anxiety are those related to previous student achievements. The higher the previous student achievements, the lower the level of Statistics anxiety.

As shown in Table 1, the results of the multi-group analysis indicate that there is a significant difference between all course types: POE, F2F, and ERT, thus confirming H₄.

Table 1. Comparison among the learning environments

Course Type	NFI Delta-1	DF	<i>p</i> -value	Difference
POE vs. F2F	.107	43	***	Yes
POE vs. ERT	.168	43	***	Yes
F2F vs. ERT	.023	43	.016	Yes
General Model	.171	86	***	Yes

4. CONCLUSIONS

This research presents for the first time a comparison between academic ethical behaviour, statistics anxiety, personality traits, and motivation in different learning environments (F2F, POE & ERT), while relying on Self-Determination Theory. In line with the scholarly literature, we believe that understanding the motivational and anxiety-related mechanisms involved in unethical academic behaviours is key to designing future teaching, learning, and assessment approaches (Etgar et al., 2019; Steinberger et al., 2021).

The results show that learning environments affect and play a significant role in interacting with statistics anxiety, motivation, personality traits, and academic dishonesty (H₄). Moreover, findings show that academic dishonesty is more prevalent in POE than in F2F and ERT environments. This study's findings improve the model employed in previous studies (Peled et al., 2019; Steinberger et al., 2021) by revealing that learning environments determine the mediating role of statistics anxiety. In digital learning environments (POE, ERT), mediation has been found between students' personality traits and academic dishonesty. No similar mediation could be established in the physical learning environment, F2F. In line with the scholarly literature (Whittle et al., 2020), this difference may be due to the lack of physical presence of academic instructors in both POE and ERT learning modalities, that might lead to uncertainty and anxiety and directly impact students' ethical disinhibition. Additionally, the differences from examining the two digital environments show that in ERT but not in POE, statistics anxiety mediates between students' previous achievements and academic dishonesty. The immediate necessity to move to digital learning without prior preparation during the global pandemic has led students to severe distress, potentially awakening statistics anxiety. In addition, the quality of distance teaching is lower in ERT due to being imposed at once without any prior pedagogical preparation (Hollweck & Doucet, 2020). Accordingly, students facing exceptional and extreme situations like this may rely exclusively on their previous academic experience or achievements in studies in general and, more concretely, in mathematics. A limitation that needs to be taken into consideration in this context is the relatively small size of the F2F sample, that might have influenced the SEM results.

Hence, we conclude that online courses should be designed according to student-centred approaches (Rapanta et al., 2020). The foregoing may include: Instructor's immediacy, improved communication, pre-planned real-life based on learning tasks (Neumann et al., 2013), monitoring of student progress and using continuous formative assessment (Torres Martín et al., 2021). This, in turn, promotes students' sense of self-competence and autonomy throughout their learning processes, thus reducing dishonesty (Kanat-Maymon et al., 2015). Additionally, positive attitudes towards learning statistics are crucial to motivate students and awaken their interest in the subject. Deepening student engagement and learning requires that faculty take part in discussing and communicating ideas and creating clear policies and shared tasks.

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