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Statistical Anxiety as a Moderating Factor in the Relationship Between Academic Self-Efficacy and Motivational Orientations among Graduate Students

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Abstract

This study investigates the moderating effect of statistical anxiety on the relationship between academic self-efficacy and motivational orientations among graduate students at Jazan University. A cross-sectional survey was conducted with 202 graduate students (91 males; 111 females) enrolled in statistics-intensive courses. Participants completed validated self-report measures of academic self-efficacy, motivational orientations, and statistical anxiety. Moderated multiple regression analyses were performed using Hayes' PROCESS macro (Model 1), and simple slope analyses were conducted to evaluate conditional effects across low, medium, and high levels of statistical anxiety. Results indicate that academic self-efficacy is positively associated with motivational orientations. Statistical anxiety significantly moderates this relationship, attenuating the positive effect of self-efficacy on motivation at higher anxiety levels. Simple slopes analysis reveals that the association between self-efficacy and motivation is strongest at low statistical anxiety and progressively weaker at medium and high levels of anxiety. Statistical anxiety diminishes the extent to which graduate students' academic self-efficacy translates into goal-directed motivational engagement. These findings suggest that interventions targeting anxiety management may enhance the effectiveness of self-efficacy in promoting motivation and academic engagement.

Keywords: Affective barriers; Anxiety; Efficacy, Higher education; Motivation.

Introduction

Statistics has increasingly assumed a central position within the epistemological and methodological foundations of contemporary scientific inquiry. Beyond its traditional descriptive and summarizing functions, statistics now constitute a core inferential framework through which empirical phenomena are examined, hypotheses are tested, and evidence-based conclusions are derived. This expanded role has rendered statistical literacy an indispensable competence, particularly within postgraduate education, where rigorous research design and analytical precision are paramount across a wide spectrum of academic disciplines (Cook & Catanzaro, 2023).

Despite its methodological importance, statistics continue to be perceived by many learners as cognitively demanding and affectively threatening, especially within quantitatively oriented courses. Statistical anxiety has consequently emerged as a pervasive and multifaceted phenomenon, with heightened prevalence among students in the arts, humanities, and social sciences—fields in which prior exposure to quantitative reasoning is often limited. Empirical evidence suggests that students' emotional responses to statistics substantially shape their engagement with course content, their persistence in learning tasks, and ultimately their academic achievement. Accordingly, obtaining a nuanced and empirically grounded understanding of the nature and intensity of statistical anxiety is critical for optimizing instructional practices and fostering meaningful learning in statistics education (Abdullah, 2021).

Conceptualizing Statistical Anxiety

Conceptually, statistical anxiety is not a unitary construct but rather a complex constellation of affective, cognitive, and behavioral responses elicited in situations involving statistical learning and application. Prior scholarship has documented that statistical anxiety may be activated during the execution of statistical tasks, exposure to unfamiliar quantitative content, or demands for data interpretation and methodological reasoning. Such anxiety is frequently accompanied by heightened physiological arousal, cognitive disorganization, intrusive negative thoughts, and impaired performance in fundamental statistical operations, including data processing, interpretation, and transfer of statistical knowledge to novel contexts (Abu Aish, 2017). From a theoretical standpoint, statistical anxiety has been characterized as a persistent emotional state encompassing fear, tension, frustration, and psychological discomfort experienced when engaging with statistical material or performing statistical analyses. This state manifests across multiple dimensions, including anxiety related to data interpretation, classroom participation and assessment contexts, reluctance to seek assistance, fear of statistics instructors, perceived inadequacy in statistical competence, and diminished computational self-concept (Abu Hashim, 2009). Subsequent conceptualizations have reinforced this multidimensional view, emphasizing that statistical anxiety reflects not only situational stress responses but also stable beliefs about the value of statistics,

self-perceived competence, and social-evaluative concerns within instructional settings (Bobo, 2014; Williams, 2013).

Crucially, statistical anxiety does not emerge solely from exposure to statistics courses themselves. Rather, its origins can be traced to earlier educational experiences, particularly the study of mathematics during primary, secondary, and undergraduate schooling. Mathematics anxiety, a well-documented phenomenon, develops through repeated negative encounters with mathematical content, evaluative pressure, and perceived failure. Over time, this anxiety becomes generalized and persistent, accompanying the learner across successive academic stages. When students subsequently encounter statistics—a discipline perceived as mathematically dense—this pre-existing mathematics anxiety is reactivated and transformed into statistical anxiety. Thus, statistical anxiety is not an isolated, course-specific reaction but a chronic affective disposition rooted in the learner's developmental history with quantitative subjects. This perspective explains why many graduate students continue to experience heightened statistical anxiety even after completing multiple mathematics and statistics courses; the anxiety has become a stable, trait-like cognitive-affective schema that is triggered whenever statistical reasoning is required (Abdullah, 2021; Abu Aish, 2017).

Academic Self-Efficacy

Within this affective landscape, academic self-efficacy emerges as a theoretically robust and empirically validated construct for understanding individual differences in students' responses to statistical learning demands. Rooted in Bandura's (1977) social cognitive theory, academic self-efficacy refers to learners' beliefs in their capacity to organize and execute the actions required to achieve specific academic outcomes. A substantial body of research has consistently demonstrated that self-efficacy beliefs exert a powerful influence on motivation, cognitive strategy use, persistence in the face of difficulty, and academic performance across domains (Chang & Cheng, 2008; Pintrich & De Groot, 1990; Sungur, 2007). Students with high academic self-efficacy are more likely to set challenging goals, sustain effort under conditions of uncertainty or failure, and employ adaptive and flexible learning strategies. These regulatory processes, in turn, translate into more stable patterns of academic engagement and superior learning outcomes (Pajares, 1996; Pintrich & De Groot, 1990; Usher & Pajares, 2006). Importantly, academic self-efficacy reflects not merely perceived skill possession but students' judgments regarding their capacity to mobilize existing competencies to meet task-specific demands, regulate performance, and manage environmental constraints (Torales, 2020).

Cognitive Load as an Explanatory Mechanism Rationale for Moderation

However, the relationship between self-efficacy and academic outcomes is not unconditional. Under conditions of high anxiety, especially anxiety that is chronic and rooted in early mathematics experiences, the positive influence of self-efficacy may be substantially weakened. Cognitive load theory (Sweller, 1988) provides a useful

explanatory framework here. Statistical problem-solving imposes both intrinsic cognitive load (the inherent complexity of statistical concepts and their interrelations) and extraneous cognitive load (poorly designed instruction, time pressure, evaluative threat). When statistical anxiety is activated, it consumes additional cognitive resources, termed *anxiety-induced load*, through intrusive thoughts, worry, and self-monitoring. This added load competes with the working memory capacity needed for effective problem-solving, thereby reducing the learner's ability to access and apply their self-efficacy beliefs. As a result, even students with strong academic self-efficacy may fail to translate those beliefs into motivated action when anxiety is high. In this sense, statistical anxiety operates as a boundary condition, or moderator, that determines whether self-efficacy can fulfill its motivational function.

Motivational Orientations in Graduate Education

Motivation constitutes another foundational pillar in explaining academic functioning and achievement. Within educational psychology, motivation is widely recognized as a prerequisite for effective learning, goal attainment, and skill development across cognitive, affective, and behavioral domains. Academic motivation directs students' attention, sustains engagement, and regulates effort toward the attainment of educational goals, rendering it a decisive factor in learning success (Kuo et al., 2019). Intrinsic motivation, self-determined engagement driven by interest, enjoyment, and perceived relevance, has been identified as a critical determinant of deep learning and sustained academic involvement. Intrinsically motivated students tend to demonstrate higher levels of cognitive investment and achievement quality, as motivation functions as an internalized source of energy that enhances performance outcomes (Zaharin et al., 2019). Importantly, motivational orientations are not static; they are shaped by both cognitive appraisals (such as self-efficacy) and affective states (such as anxiety). Among graduate students, motivational orientations tend to lean toward mastery, the desire to achieve deep understanding and competence, rather than mere performance. However, when statistical anxiety intrudes during problem-solving, it disrupts the cognitive and emotional equilibrium required for mastery-oriented motivation to operate effectively. In such moments, anxiety acts as a cognitive symptom, causing disorganization and avoidance, thereby decoupling the learner's mastery goals from actual engagement.

The Research Gap and the Need for a Moderation Model

Given the above theoretical considerations, a more nuanced model is required. Rather than treating academic self-efficacy as an immutable predictor of motivation, it may be that under high cognitive load and high statistical anxiety, self-efficacy itself becomes vulnerable. However, the present study focuses on the more established directional path: self-efficacy as a resource that promotes motivational orientations, with statistical anxiety moderating that relationship. To the best of the researcher's knowledge, few, if any, studies, particularly within the Arab academic context, have

simultaneously investigated these constructs with a focus on the conditional influence of affective factors such as statistical anxiety. This gap is striking given the critical role that both self-efficacy and motivation play in shaping learners' engagement, persistence, and academic performance, particularly in graduate-level statistics courses where cognitive demands are high and affective barriers are often pronounced.

While substantial research has documented associations between self-efficacy and anxiety in academic contexts, the focus has been on direct or correlational relationships rather than conditional influences (e.g., the inverse relationship between self-efficacy and statistics anxiety described in psychology and social sciences student samples; Dodeen et al., 2025). Recent work further clarifies that personality dimensions, such as goal drive, persistence, and threat sensitivity, differentially relate to students' statistical anxiety and self-efficacy, underscoring the need to examine moderating emotional processes in statistics education (Mendes et al., 2024). Moreover, research on graduate populations highlights the role of self-regulated learning strategies in predicting statistics anxiety, suggesting that affective and metacognitive mechanisms should be considered when modeling students' engagement with statistical content (Youssef & Alibraheim, 2024). The theoretical gap is even more pronounced when considering the origins of statistical anxiety. Most existing studies treat statistical anxiety as a reaction specific to statistics courses, neglecting its developmental roots in earlier mathematics education. This omission limits the ability to design interventions that address the chronic, generalized nature of quantitative anxiety.

The Present Study and Hypotheses

The present study is guided by the hypothesis that variations in students' statistical anxiety influence the effect of academic self-efficacy on motivational orientations. By treating statistical anxiety as a moderating construct, the research aims to advance understanding of how emotional and cognitive processes interact to influence learning in higher education. This conditional approach matches recent educational research showing that self-efficacy predicts students' emotional responses and interacts with those emotional states to shape academic engagement and performance, especially in anxiety-laden environments such as online or STEM-oriented courses (Lizarte Simón et al., 2024; Lu et al., 2024; Nawawi, 2019).

Based on the theoretical framework elaborated above, the present study formulates the following hypotheses:

H1 (Main effect): Academic self-efficacy will be positively associated with motivational orientations among graduate students enrolled in statistics-intensive courses.

H2 (Moderation effect): Statistical anxiety will moderate the relationship between academic self-efficacy and motivational orientations such that the positive effect of

self-efficacy on motivation is strongest at low levels of statistical anxiety and weakens progressively as statistical anxiety increases.

The study's objectives are to empirically test this proposed moderating model and to examine how different levels of statistical anxiety influence the magnitude and variability of the self-efficacy–motivation relationship. The significance of the study extends across multiple dimensions. Conceptually, it contributes to the development of an empirically grounded framework that integrates self-efficacy, motivational orientation, and affective responses, offering a more sophisticated understanding of how these factors interact to shape learning outcomes. Empirically, it addresses the scarcity of research in the Arab educational context examining statistical anxiety as a moderating variable, providing data-driven insights that may inform both pedagogy and student support strategies. Practically, the findings have the potential to guide tailored interventions aimed at mitigating statistical anxiety, enhancing academic self-efficacy, and fostering adaptive motivational patterns, particularly among graduate students—a pivotal cohort for societal development and knowledge production.

Methodology

Participants

The study population consisted of all graduate students enrolled at Jazan University during the 2025 academic year. A stratified random sampling procedure was employed to ensure proportional representation across colleges and academic disciplines. The final sample, 202 participants (91 male & 111 female students), reflects the demographic composition of the population. Participants' ages ranged from 22 to 35 years, with a mean age of 27.3 years (SD = 3.1). All participants were actively enrolled in graduate-level courses incorporating statistics content, ensuring the relevance of the sample to the constructs under investigation.

Prior to participation, all students received an online invitation describing the study's purpose, procedures, and confidentiality assurances. Informed consent was obtained electronically via a secure online form. Participants were informed of their right to withdraw at any time without penalty. No identifiable personal information was collected, and all responses were anonymized to maintain confidentiality, in accordance with the ethical standards of Jazan University's Institutional Review Board.

Measures

The Statistical Anxiety Scale, Academic Self-Efficacy Scale, and Motivational Orientations Scale used in the present study were adapted from Zakari (2020). All three instruments were originally developed and validated in Arabic for use with graduate students. For the current study, the scales were translated into English following standard academic translation procedures. The English versions of the

three scales are provided as supplementary files, and the source has been appropriately cited in the manuscript.

Statistical Anxiety Scale (SAS)

The study was adapted and reworded to fit the university context and characteristics of graduate students. Statistical anxiety is a multidimensional psychological and affective construct, manifested in various educational situations related to learning and applying statistics, including attending lectures, completing assignments, taking exams, interpreting statistical results, and seeking academic assistance. The SAS was chosen for its capacity to provide a comprehensive measure of this form of anxiety, reflecting the real experiences of students while engaging with statistical content, with careful attention to linguistic clarity and appropriateness for the undergraduate level.

The final version of the scale comprises 29 items across three dimensions. The first dimension, classroom anxiety (items 1–11), assesses tension and discomfort in classroom settings related to statistics, such as encountering statistical content, preparing for exams, completing assignments, and responding to unexpected questions. The second dimension, fear of seeking help (items 12–16), measures anxiety experienced when requesting support or clarification from instructors, peers, or knowledgeable individuals, whether in understanding equations or interpreting analyses. The third dimension, interpretation anxiety (items 17–29), captures anxiety associated with interpreting tables, symbols, statistical values, organizing data, understanding graphs and frequency distributions, reading research results, making statistical decisions, and considering alternative approaches for hypothesis testing.

Responses are scored on a four-point Likert scale, ranging from (Does not cause anxiety=1 to Severe anxiety= 4). Total scores range from 29 to 116, with higher scores indicating elevated statistical anxiety and lower scores reflecting greater confidence and ease in handling statistical tasks. Previous studies, including Zakari (2020), demonstrated strong psychometric properties for the SAS, with confirmed construct validity and excellent internal consistency (Cronbach's alpha = 0.98), supporting its suitability for use among university students.

Motivational Orientations Scale (MOS)

To assess students' motivational drivers, the study employed the Motivational Orientations Scale (MOS), which measures internal and external factors that propel students to engage in goal-directed academic behaviors. The scale was selected for its ability to capture individual differences in academic motivation, essential for understanding students' engagement and commitment to academic tasks. It also allows differentiation between intrinsic motivation, associated with personal satisfaction and self-achievement, and extrinsic motivation, related to material rewards, social recognition, and validation from others, facilitating analysis of how these drivers influence academic performance.

The MOS consists of 29 items across two dimensions. Intrinsic motivation (items 1–16) measures internal drivers, including mastering orientation, enjoyment of challenges, persistence in problem-solving, satisfaction from completing difficult tasks, and self-improvement. Extrinsic motivation (items 17–29) assesses drivers related to external rewards, such as alignment of academic work with life goals, career benefits, instructor guidance, and the desire to demonstrate competence to others. Responses are recorded on a four-point Likert scale from always (4) to never (1), yielding total scores ranging from 29 to 116. Higher scores indicate stronger academic motivation. Prior research, including Zakari (2020), confirmed strong construct validity and internal consistency (Cronbach's alpha = 0.91) of this scale.

Academic Self-Efficacy Scale (ASES)

The Academic Self-Efficacy Scale (ASES) was used to measure students' beliefs in their capability to successfully perform academic tasks, solve problems, participate effectively in collaborative learning, and make informed academic decisions. The scale was adapted for the Saudi university context and chosen for its ability to assess confidence in academic competence, a critical factor in understanding student learning behaviors, engagement, and resilience in the face of academic challenges.

The ASES comprises 21 items across four dimensions. Academic ability and preparedness (items 1–6) reflect confidence in personal capabilities and readiness to meet course demands. Task performance (items 7–10) assesses the ability to complete assigned academic responsibilities effectively.

Academic achievement (items 11–16) evaluates students' sense of accomplishment, ability to overcome difficulties, and engagement in collaborative learning. Organization (items 17–21) captures planning, time management, problem-solving, and goal-setting skills. Responses are provided on a three-point Likert scale, ranging from (Applies completely (3) to Does not apply (1)), allowing measurement of self-efficacy levels from low to high. Previous validation studies, including Zakari (2020), demonstrated construct validity for all items and adequate internal consistency (Cronbach's alpha = 0.76), confirming the scale's suitability for assessing academic self-efficacy among university students.

Reliability of the Instruments

Cronbach's alpha coefficients were computed to examine the internal consistency reliability of the study scales and their dimensions. As shown in Table 1, the reliability coefficients ranged from 0.76 to 0.98, indicating acceptable to excellent internal consistency. Specifically, the motivation-related dimensions demonstrated high reliability, with Cronbach's alpha values of 0.84 for Intrinsic motivational orientations and 0.87 for Extrinsic motivational orientations, while the overall motivation scale yielded a coefficient of 0.91. Similarly, the anxiety-related dimensions showed very high internal consistency, with alpha coefficients of 0.94 for lecture hall anxiety, 0.95 for fear of asking for help, and 0.97 for interpretation anxiety. The overall anxiety

scale displayed an excellent level of reliability, with a Cronbach's alpha of 0.98. In addition, the academic self-efficacy scale demonstrated acceptable reliability, with a coefficient of 0.76.

Table 1. Cronbach's Alpha reliability coefficients for the study scales

Dimension	Cronbach's Alpha
Intrinsic motivational orientations	0.84
Extrinsic motivational orientations	0.87
Motivation scale (overall)	0.91
Lecture hall anxiety	0.94
Fear of asking for help	0.95
Interpretation anxiety	0.97
Anxiety scale (overall)	0.98
Academic self-efficacy	0.76

Data Collection

Data collection was conducted entirely online using Jazan University's secure survey platform. After providing electronic informed consent (see section 2.4), participants completed the three scales in a fixed order: SAS first, then MOS, then ASES. This order was chosen to avoid priming self-efficacy before reporting anxiety. The survey took approximately 20–25 minutes to complete. No identifying information (e.g., name, student ID) was collected. IP addresses were not recorded. All responses were anonymized and stored on password-protected university servers accessible only to the research team.

Data Analysis

All statistical analyses were performed using IBM SPSS Statistics version 28 and IBM SPSS Amos version 28 for confirmatory factor analyses. The moderation analysis was conducted using Hayes' (2013) PROCESS macro for SPSS (Version 4.0, Model 1), which is specifically designed for conditional process analysis and provides bias-corrected bootstrap confidence intervals for interaction effects.

Preliminary data screening: Missing data were minimal (<1% per variable) and handled via listwise deletion, as recommended by Peng et al. (2006) for such low rates. Univariate outliers were examined using standardized residuals; no cases exceeded ±3.29. Multivariate outliers were assessed using Mahalanobis distance with $p < 0.001$ as the critical threshold; no influential cases were identified (maximum Mahalanobis distance = 15.8, critical value = 20.5 for 3 predictors). Normality of residuals was confirmed via Q–Q plots and the Shapiro–Wilk test ($p > 0.05$ for all

variables). Linearity was inspected using scatterplots of residuals against predicted values. Homoscedasticity was evaluated using the Breusch–Pagan test ($\chi^2 = 2.14$, $p = 0.34$) and visual inspection of standardized residuals vs. predicted values. Independence of errors was confirmed with the Durbin-Watson statistic ($d = 1.97$, within the acceptable range of 1.5–2.5).

Moderation analysis (PROCESS Model 1): Academic self-efficacy (ASES total score) was specified as the independent variable (X), motivational orientations (MOS total score) as the dependent variable (Y), and statistical anxiety (SAS total score) as the moderator (W). All continuous variables were mean-centered prior to creating the interaction term (self-efficacy × anxiety) to reduce multicollinearity and improve interpretability. PROCESS was run with 5,000 bootstrap samples to generate 95% bias-corrected confidence intervals for the conditional effects. The Johnson-Neyman technique was employed to identify regions of significance across the entire range of the moderator.

Simple slopes analysis: Following a significant interaction, simple slopes were computed at three levels of statistical anxiety: low (mean – 1 SD), medium (mean), and high (mean + 1 SD). The conditional effect of academic self-efficacy on motivational orientations was calculated at each level, along with standard errors, t-values, p-values, and 95% confidence intervals.

Reporting standards: Effect sizes are reported as unstandardized regression coefficients (β) for the interaction and ΔR^2 for the contribution of the interaction term. All tests were two-tailed with $\alpha = 0.05$.

Ethical Approval: This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee of Jazan University (Approval No. REC41/2-071, 18 December 2019).

All participants provided electronic informed consent prior to completing the survey. The informed consent form clearly explained the study's purpose, procedures, voluntary nature, confidentiality measures, and the right to withdraw at any time without penalty. Only students who actively provided online consent were allowed to proceed to the survey.

Participation was entirely voluntary. No identifiable personal information was collected, and all responses were anonymized to maintain confidentiality. Data were securely stored in password-protected files accessible only to the research team.

Results

Moderating Effect of Statistical Anxiety on the Relationship Between Academic Self-Efficacy and Motivational Orientations

A moderated multiple regression analysis was conducted using Model 1 of Hayes' (2013) PROCESS macro to examine whether statistical anxiety moderates the relationship between academic self-efficacy and motivational orientations among

graduate students at Jazan University. Academic self-efficacy was entered as the independent variable, motivational orientations as the dependent variable, and statistical anxiety as the proposed moderator.

Descriptive analyses, missing data screening, and outlier diagnostics were performed to ensure data suitability for regression modeling prior to testing the moderation model. Descriptive statistics included means, standard deviations, skewness, and kurtosis to confirm appropriate central tendency and distributional properties for all variables.

Missing data were minimal (<1%) per variable and managed via listwise deletion.

As shown in Figure 1, outliers were examined using standardized residuals, Mahalanobis distance, and leverage values, with no cases exceeding critical thresholds ($p < 0.001$). This result indicates no undue influence on the regression estimates. Figure 2 shows that linearity between predictors and the dependent variable was verified through scatterplot inspection, whereas normality of residuals was confirmed using Q–Q plots and the Shapiro–Wilk test.

As shown in Figure 3, homoscedasticity was evaluated via plots of standardized residuals against predicted values, demonstrating constant variance across levels of motivational orientations. Independence of errors was assessed with the Durbin–Watson statistic ($d = 1.97$), within the acceptable range of 1.5–2.5. These analyses collectively established the psychometric robustness and appropriateness of the dataset for moderated regression procedures.

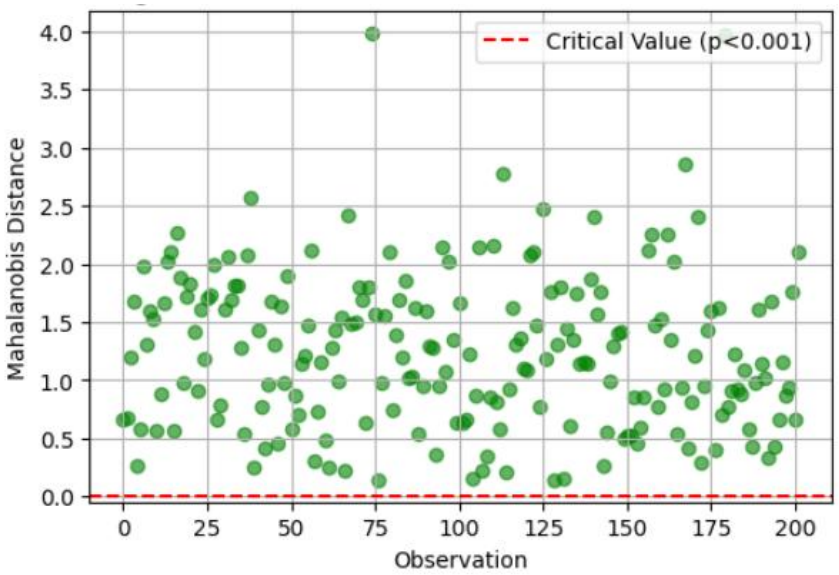

Figure 1. Mahalanobis distance for outlier detection

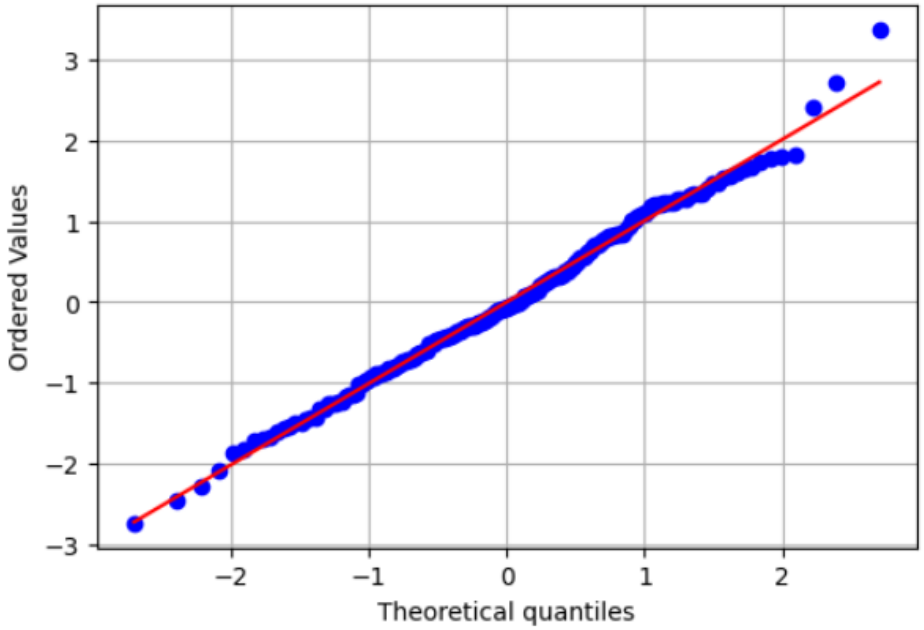

Figure 2. Q-Q plot of standardized residuals

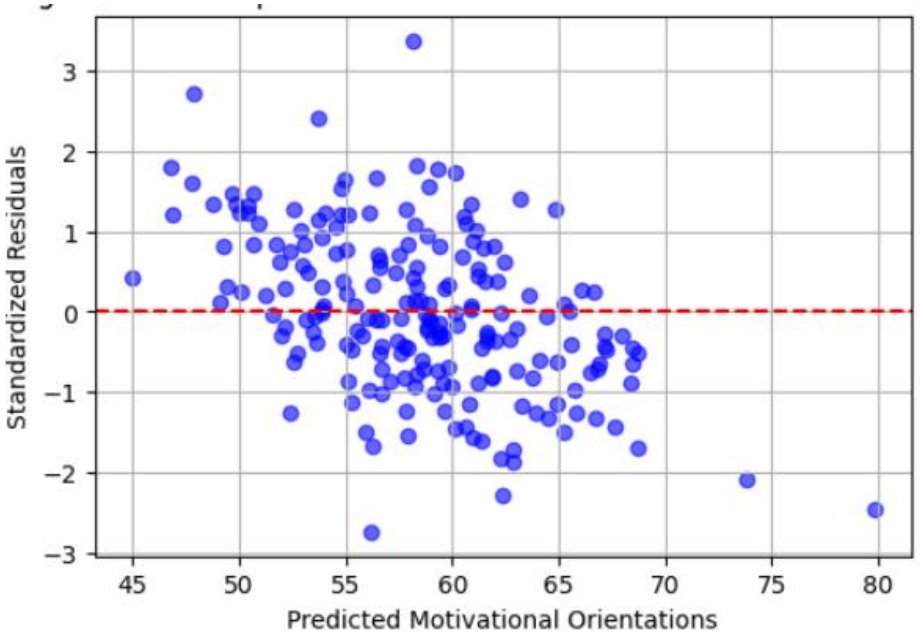

Figure 3. Scatterplot of standardized residuals vs predicted values

The moderated regression model was statistically significant, explaining 35% of the variance in motivational orientations ($R^2 = 0.350$, $F(3,198) = 35.527$, $p < 0.001$). The main effect of academic self-efficacy was strong and significant ($\beta = 1.216$, $SE = 0.122$, $t = 10.009$, $p < 0.001$), confirming that higher self-perceived competence is associated with stronger motivational orientations. The main effect of statistical anxiety was non-significant ($\beta = 0.004$, $SE = 0.004$, $t = -3.443$, $p = 0.873$), consistent with psychometric theory, indicating that a moderator need not exert a significant direct effect to meaningfully influence conditional relationships (Cohen et al., 2003).

Critically, the interaction term between academic self-efficacy and statistical anxiety was statistically significant ($\beta = -0.012$, $SE = 0.019$, $t = -5.234$, $p < 0.001$), with an associated $\Delta R^2 = 0.039$ ($F = 11.854$, $p < 0.001$), indicating that statistical anxiety moderates the relationship between self-efficacy and motivational orientations. The negative coefficient suggests that higher levels of statistical anxiety attenuate the positive association between academic self-efficacy and motivation, whereas lower levels of anxiety allow this relationship to remain strong. Psychometrically, this quantifies the conditional effect of statistical anxiety, demonstrating that it explains approximately 4% of the variance in motivational orientations beyond the main effects of self-efficacy and anxiety.

These results substantiate the conceptualization of statistical anxiety as a moderating variable, highlighting the nuanced interplay between affective and cognitive processes in shaping goal-directed behaviors. The findings indicate that statistical anxiety delineates when and to what extent academic self-efficacy translates into

enhanced motivational engagement. In applied terms, the results suggest that interventions aimed at reducing statistical anxiety may bolster the effectiveness of self-efficacy in promoting motivational orientations, while elevated anxiety may constrain this effect. This underscores the importance of accounting for conditional emotional factors in higher education research, particularly in cognitively demanding, affectively charged contexts such as graduate-level statistics courses.

Conditional Effects of Statistical Anxiety on the Relationship Between Academic Self-Efficacy and Motivational Orientations

To address the second research question, whether the strength and direction of the relationship between academic self-efficacy and motivational orientations vary across levels of statistical anxiety, a simple slopes analysis using the Johnson–Neyman technique was conducted. This procedure allows for the estimation of the conditional effect of the independent variable (academic self-efficacy) on the dependent variable (motivational orientations) at low, medium, and high levels of the moderator (statistical anxiety).

The results of the simple slopes analysis, presented in Table 2, reveal distinct patterns across the three designated levels of statistical anxiety. At low levels of statistical anxiety (mean minus one standard deviation, -23.906), academic self-efficacy exhibited a strong positive association with motivational orientations, with a standardized regression coefficient (β) of 1.506, standard error (SE) = 0.178, t = 8.469, $p < 0.001$, and a 95% confidence interval ranging from 1.156 to 1.857. At the mean level of statistical anxiety (zero), the effect of self-efficacy remained positive and significant, albeit slightly attenuated (β = 1.216, SE = 0.122, t = 10.009, $p < 0.001$; 95% CI [0.976, 1.456]). At high levels of statistical anxiety (mean plus one standard deviation, +23.906), the association persisted as positive but was further reduced (β = 0.926, SE = 0.110, t = 8.414, $p < 0.001$; 95% CI [0.709, 1.143]).

Table 2. Conditional effects of academic self-efficacy on motivational orientations across levels of statistical anxiety (simple slopes analysis, Johnson–Neyman)

Level of Statistical Anxiety	β (Regression Coefficient)	SE	t	p	95% CI Lower	95% CI Upper
Low (-1 SD, -23.906)	1.506	0.178	8.469	<0.001	1.156	1.857
Medium (Mean, 0)	1.216	0.122	10.009	<0.001	0.976	1.456
High (+1 SD, +23.906)	0.926	0.110	8.414	<0.001	0.709	1.143

These results indicate that statistical anxiety exerts a conditional weakening effect on the relationship between academic self-efficacy and motivational orientations, consistent with the negative interaction observed in the moderated regression analysis.

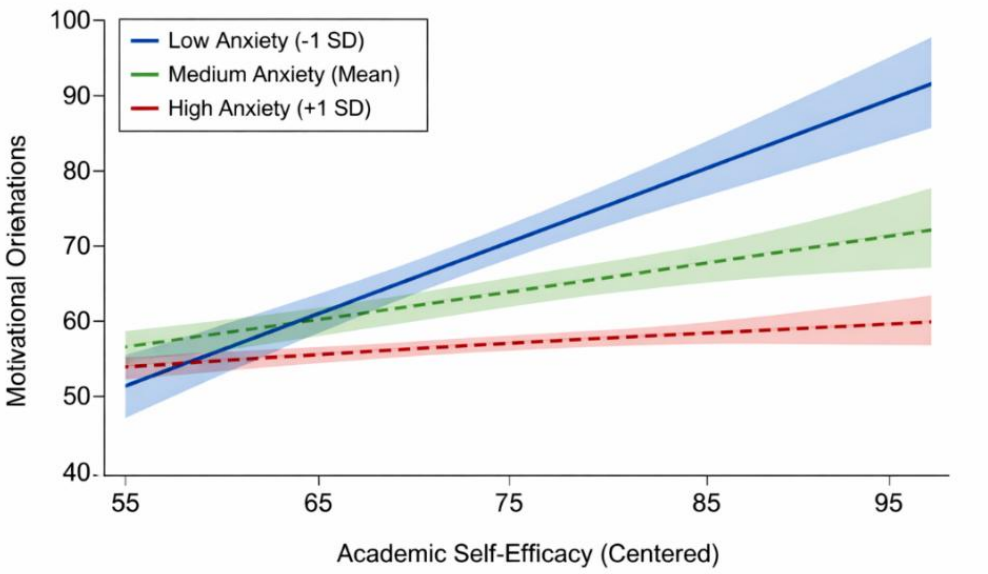

Figure 4. Simple slopes plot of academic self-efficacy on motivational orientations across levels of statistical anxiety

According to Figure 4, graphical inspection via the simple slopes plot corroborates these findings. The slope representing the low statistical anxiety condition is the steepest, indicating a strong positive effect of academic self-efficacy on motivational orientations. The slope at the medium anxiety level is less steep, reflecting a moderate attenuation of this effect. At high statistical anxiety, the slope is shallowest, confirming a marked reduction in the efficacy–motivation association under elevated anxiety conditions. These patterns demonstrate that statistical anxiety systematically modulates both the magnitude and conditional direction of the relationship: as anxiety increases, the predictive power of self-efficacy diminishes, whereas reduced anxiety improves its influence on motivational engagement.

Collectively, the simple slopes analysis provides psychometrically robust evidence that the interaction between academic self-efficacy and statistical anxiety is not uniform across the anxiety continuum. Rather, the conditional effects underscore the importance of considering affective moderators when examining cognitive-motivational processes in higher education. The results suggest that interventions aimed at lowering statistical anxiety could meaningfully enhance the translation of self-efficacy beliefs into motivational orientations, thereby optimizing goal-directed learning behaviors among graduate students. These findings extend theoretical

models of self-efficacy by demonstrating how affective barriers shape the effectiveness of motivational drivers in academically demanding, affectively charged contexts.

Discussion

The present study was designed to test whether statistical anxiety moderates the relationship between academic self-efficacy and motivational orientations among graduate students at Jazan University. The results fully support the hypothesized moderating model. Consistent with social cognitive theory, academic self-efficacy exhibited a strong positive main effect on motivational orientations, confirming that students who believe in their academic capabilities are more likely to engage in goal-directed behaviors. However, the critical finding is the significant negative interaction between academic self-efficacy and statistical anxiety, which indicates that the beneficial effect of self-efficacy on motivation is not unconditional but rather depends on the level of affective distress experienced by the learner. As statistical anxiety increases, the positive self-efficacy–motivation link weakens progressively. This pattern aligns with Bandura's assertion that self-efficacy beliefs operate within affective contexts that can either facilitate or impede their translation into action. From a theoretical standpoint, the results refine existing models by specifying statistical anxiety as a boundary condition that determines when and to what extent perceived competence mobilizes motivational engagement.

Comparing these findings with prior research conducted in different cultural and educational contexts reveals both convergence and unique contributions. Studies from Western higher education settings, such as those by Dodeen et al. (2025) and Mendes et al. (2024), have documented inverse correlations between statistical anxiety and self-efficacy, as well as between anxiety and motivation. However, those studies primarily examined direct or bivariate relationships rather than conditional effects. The present study advances this literature by demonstrating that statistical anxiety functions as a moderator, not merely a correlate. In the Arab educational context, where statistics instruction often emphasizes rote procedural knowledge and where help-seeking may be stigmatized, the attenuating role of anxiety may be particularly pronounced. For example, Abdullah (2021) reported high prevalence of statistical anxiety among Saudi social science students, and the current findings extend that work by showing how such anxiety undermines the motivational utility of self-efficacy. Conversely, in educational systems with more integrated quantitative literacy training from early stages, the moderating effect of statistical anxiety might be weaker. This cultural comparison suggests that the conditional dynamics observed here may be amplified in contexts where students enter graduate statistics courses with limited prior exposure and where affective responses to quantitative tasks are rarely addressed pedagogically.

Practical Implications

The practical implications of these findings for higher education stakeholders are substantial. For instructors and curriculum designers, the results suggest that simply enhancing students' academic self-efficacy, through mastery experiences, modeling, or persuasive feedback, may not be sufficient if statistical anxiety remains unaddressed. Interventions that target both cognitive beliefs and affective regulation are likely to be more effective. Structured anxiety management programs, such as cognitive restructuring exercises, relaxation techniques, and incremental exposure to statistical tasks, could lower anxiety levels and thereby preserve the motivational benefits of self-efficacy. For graduate program coordinators, integrating self-regulated learning strategies into statistics courses, as recommended by Youssef and Alibraheim (2024), may help students manage anxiety while building confidence. Additionally, creating supportive classroom environments that normalize difficulty and reduce evaluation apprehension could diminish the fear of seeking help, a dimension of statistical anxiety measured in this study. University counseling centers might offer workshops specifically tailored to statistics-related anxiety, distinguishing it from general academic stress. For faculty advisors, recognizing that high-anxiety students may exhibit reduced motivation despite adequate perceived competence can inform targeted mentoring and referral to support services.

Despite its contributions, this study has several limitations that warrant acknowledgment. First, the cross-sectional design precludes causal inferences. Although the proposed moderation model is theoretically grounded, it is possible that lower motivation contributes to higher statistical anxiety, or that unmeasured third variables influence all constructs. Longitudinal or experimental designs are needed to establish temporal precedence. Second, the sample was drawn from a single Saudi university, limiting generalizability to other Arab or international graduate populations. The stratified random sampling strengthens internal validity, but replication across diverse institutions and cultural contexts is essential. Third, all measures were self-report, raising concerns about common method variance and social desirability bias. Future research should incorporate behavioral indicators of motivation, such as task persistence or course engagement metrics, and physiological or implicit measures of anxiety. Fourth, the study did not differentiate among subtypes of statistical anxiety (e.g., interpretation anxiety vs. classroom anxiety), yet the moderating effect might vary across dimensions. Fifth, the relatively modest R^2 change ($\Delta R^2 = 0.039$) attributed to the interaction, while statistically significant, suggests that other moderators, such as perfectionism, prior mathematics achievement, or instructor support, may also play important roles.

Building on these limitations, several directions for future research are particularly insightful. Cross-cultural comparative studies could examine whether the moderating role of statistical anxiety differs between educational systems with early versus late introduction to statistics, or between collectivist and individualist learning environments. Intervention studies that randomly assign high-anxiety students to

anxiety reduction programs versus self-efficacy enhancement alone could test the practical recommendation that combined cognitive–affective approaches are superior. Qualitative research exploring graduate students' lived experiences of statistical anxiety, especially how they perceive its interference with their self-efficacy beliefs, would complement the quantitative findings. Furthermore, future studies should examine whether the moderating effect generalizes to other STEM disciplines or to undergraduate populations. Finally, investigating potential moderated mediation models, where statistical anxiety moderates the indirect effect of self-efficacy on achievement through motivation, would provide a more complete process model of academic success in statistics-intensive courses.

Conclusion

The results of this study provide compelling evidence that statistical anxiety exerts a negative moderating effect on the relationship between academic self-efficacy and motivational orientations among graduate students at Jazan University. Specifically, elevated levels of statistical anxiety weaken the extent to which students' confidence in their academic abilities translates into goal-directed motivational engagement, signaling a critical educational concern. Students experiencing high anxiety are more likely to demonstrate reduced participation, impaired acquisition of analytical and quantitative skills, and avoidance of challenging learning tasks, potentially resulting in widening performance gaps relative to peers with lower anxiety. The simple slopes analysis further clarifies that the predictive effect of academic self-efficacy on motivational orientations diminishes progressively across increasing levels of statistical anxiety, indicating that students with moderate to high anxiety are particularly susceptible to reductions in self-motivation despite possessing adequate self-efficacy. Collectively, these findings highlight the necessity of empirically informed interventions, including structured anxiety management programs, self-regulated learning strategies, and integrative cognitive–affective pedagogical support, to mitigate the deleterious effects of statistical anxiety, preserve the motivational utility of self-efficacy, and promote sustained engagement and achievement in statistics-intensive educational contexts.

Declarations

Conflict of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability statement

The datasets used during the current study are available from the corresponding author on reasonable request.

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