Marketing Students' Mathematics Performance: The Mediating Role of Math Anxiety on Math Self-Concept and Math Self-Efficacy

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Past empirical studies show that marketing undergraduates, in general, perform poorly in quantitative-based activities. However, numerical skills involving solving and analyzing numerical information is a skill set in high demand among business organizations. Unfortunately, students continue to struggle with high levels of math anxiety affecting their math self-concept and math self-efficacy. Structural equation model analysis is used to examine relationships among the constructs. Results confirm that math anxiety has a significant negative impact on both math self-concept and math self-efficacy, which in turn has positive impacts on math performance. Math self-concept and math self-efficacy also provide effective mediations to students' math performances. To impact the longitudinal implications of quantitative literacy for marketing majors, a more holistic view is needed that simultaneously addresses approaches that reduce math anxiety, increase math self-concept, increase math self-efficacy, and result in greater levels of math performance.

INTRODUCTION

The role of quantitative reasoning or mathematical understanding at times has not been a priority in the marketing discipline. A typical question arises, how comfortable are marketing students in solving quantitative problems? Given anecdotal evidence, teaching experiences, and a growing research base, the answer is not encouraging (Tasari, et al., 2012; Remington, et al., 2000). Empirical studies show that marketing undergraduates, in general, have always performed poorly in quantitative topics when compared to other business majors (Aggarwal, Valdyanathan, & Rochford, 2007). However, quantitative skills involving solving and analyzing numerical information has remained important criteria for new hires, demonstrating a concern from the industry (Brennan & Vos, 2013; Ganesh, Sun, & Barat, 2014). A consistent complaint from industries and business organizations revolves around under-preparedness of marketing graduates with handling data and quantitative information (Brennan & Vos, 2013). The situation creates a bleak outlook for marketing graduates wanting to rise up the corporate ladder (Tasari, et al., 2012; Malhotra, 2015). A common misconception that "marketing" is an easy avenue to avoid numbers is further exemplified given that a primary reason why a large number of students choose marketing as their major stems from math avoidance (Ganesh, Sun, & Barat, 2014; Pilling, Rigdon, & Brightman, 2012).

A broad domain of educational theories, mathematics education in particular, highlights the role of math self-efficacy, math self-concept, and math anxiety as important drivers of students' performance in mathematics (Pietsch, Chapman, & Walker, 2003). Sparse research exists to address specific modalities for marketing students. Even though quantitative knowledge ranks high on the list of necessary professional skills required for a new undergraduate marketing hire, math ranks much lower in marketing students' perceived importance of topics learned in marketing curriculum (Aggarwal, Valdyanathan, & Rochford, 2007). Strong mathematical knowledge has become even more critical in advancing career and job opportunities in an increasingly technology oriented society (Meece, Wigfield, & Eccles, 1990). As undergraduate marketing students tend to avoid quantitative business courses, it becomes pertinent to address issues that create such avoidance.

How does math anxiety, a dominant trait found in undergraduate marketing students, affect their performance on quantitative questions? Are there trait variables that moderate the impact of anxiety on students' quantitative performance? In particular, math anxiety has often been confounded with math self-concept and math self-efficacy. Are there clear distinctions between these three constructs? Research delineating conceptual and empirical distinctions between self-concept, self-efficacy, and anxiety is not just limited, but mixed and inconclusive across a wide range of disciplines (Lee, 2009).

The purpose of this paper is to differentiate the constructs of math self-concept, math self-efficacy, and math anxiety with reference to undergraduate marketing students. Discussion includes prior research from other disciplines to help understand measurable criteria and develop predictable factors that could help address the poor math performance of marketing students. Based on the review, four testable hypotheses were generated. Next, the study's research methodology was presented. The sampling and data gathering procedure, measurement scales, statistical methods used to assess reliability, validity, and empirical differences between the scales are discussed. Finally, structural equation modeling was used to test the strength of the relationships between the constructs and their effects on the math performance variable.

CONCEPTUAL DEVELOPMENT

Many important studies provide the conceptual basis of this research. Drawn from the works of Bong and Clark (1999), Marsh, Byme, and Yeung (1999), Pajares and Schunk (2002), and Pietsch, Chapman, and Walker (2003), a clear theoretical and empirical distinction between self-efficacy beliefs and self-concept beliefs emerges. Self-efficacy beliefs are topic-specific under a specific subject domain in contrast to self-concept which is expressed at a broad domain level. Self-efficacy beliefs reflect "can" questions such as "Can I do this mathematical problem." Self-concept reflects "being" questions such as "Am I good at mathematics?" Self-concept is viewed as multi-dimensional reflecting both affective and cognitive dimensions, whereas self-efficacy involves primarily cognitive dimension with a possibility of significant overlap in the context of mathematics. Finally, separation of the affective component from self-concept may lead self-concept and self-efficacy items to load on a single factor.

Math Self-concept

Rosenberg (1979, p. 7) defines self-concept as "the totality of the individual's thoughts and feelings having reference to oneself as an object." More broadly, Shavelson, Hubner and Stanton (1976, p. 411) suggest that self-concept is merely "a person's perception of himself." Primarily formed through interactions with the environment, there are five major antecedents to self-concept (Skaalvik, 1997): frames of reference, causal attributions, reflected appraisals from significant others, mastery experiences, psychological centrality. PISA (2013, p. 80) defines math self-concept as "students beliefs in their own mathematics abilities." Goldman and Penner (2016) suggest that students' base their mathematics self-concept largely on their experiences and history of achievement.

Math Self-efficacy

Primarily emerging from Bandura's (1977; 1982) research, self-efficacy reflects one's belief in one's ability to successfully execute a certain task. Self-efficacy is a cognitive appraisal of competence (Pietsch, Chapman, & Walker, 2003). Research shows self-efficacy influences the choice to engage in a task, effort spent in undertaking it, persistence shown to complete it (Bandura, 1977; Hackett & Betz, 1989), and overall performance (Locke & Latham, 1990). Math self-efficacy is defined as one's confidence in one's ability to perform or accomplish a mathematical task (Betz & Hackett, 1983). Often considered as a situational, problem-specific variable (Hodge, 2002), efficacy expectations are found to affect educational and career choices (Betz & Hackett, 1983). Due to the critical importance of mathematics in many careers, math self-efficacy plays an important role in preparing students for future careers.

Math self-efficacy is found to be positively correlated with math exam performances (Hodge, 1999). Though Betz and Hackett (1983) show moderate correlations between math self-efficacy, math anxiety, and math performance, Rounds and Hendel (1980) and Hodge (1999) found strong positive relationships among the variables.

Math Anxiety

Richardson and Suinn (1972, p. 551) define math anxiety as "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations." Although mathematics test anxiety is viewed differently from numerical anxiety (Rounds & Hendel, 1980), mathematics test anxiety may be a specific form of more general test anxiety (Benson, 1989). According to Cemen (1987), math anxiety depicts a nervous and worried response-state to a math related context, perceived as threatening, that leads to emotional expressions such as "panic, helplessness, paralysis, and mental disorganization." Tobias and Weissbrod (1980) argue that math anxiety is an important determinant of students' quantitative orientation in relation to math avoidance and other emotional side effects. Math anxiety can be classified across two broad definitional domains (Edelmuth, 2006): 1) an inability to cope with quantification and b) feelings of tension and anxiety that interferes with the manipulations of numbers. Thus math anxiety is viewed as a trait variable. With its underlying strong affective characteristics, math anxiety is assumed different from closely related constructs such as math self-concept and math self-efficacy. Although extant research is largely concentrated on a single factor of affective dimension of math anxiety (Richardson & Woolfolk, 1980), other studies have highlighted dual-factor conceptualizations of math anxiety reflecting a cognitive component and an affective component (Wigfield & Meece, 1988).

HYPOTHESES

Mitigating fear improves one's ability to handle a math problem and is expected to generate a positive attitude towards solving these tasks. Reducing inhibitions in approaching a mathematical task and ultimately solving it would lead to subsequent behavioral reinforcements that would generate confidence to solve math problems. Lower math anxiety would encourage adopting strategies or reorganize factors that improve self-concept. Hence math anxiety would impact self-concept negatively. Passolunghi et al. (2016) recent findings show that students with high mathematics anxiety were weak in several measures of mathematics achievement. Similarly, a study by Griggs et al., (2013) indicated that students' who reported higher levels of mathematics anxiety had lower levels of self-concept in mathematics. Thus, the following hypothesis is proposed:

Hypothesis 1: Among marketing majors, math self-concept is negatively impacted by math anxiety.

Reducing fear would develop a positive self-belief in one's ability to execute a mathematical task. Reducing emotions that degenerate one's math self-concept would lead to more engagement, larger effort, and greater persistence in solving math problems. Reducing anxiety and associated mental states may also lead to lower distractions and improving attention when solving a math task. Therefore, lower math anxiety is a functional pre-cursor to enhance one's task-specific confidence, math self-efficacy. Lavasani, Hejazi, and Varzaneh (2011) demonstrate the role of mathematics anxiety as a predictor of mathematics self-efficacy. In a study involving students enrolled in finance courses, Malhotra (2015) found a negative relationship between quantitative self-efficacy and quantitative anxiety. Thus, the following hypothesis is proposed:

Hypothesis 2: Among marketing majors, math self-efficacy is negatively impacted by math anxiety.

Low confidence in solving math problems results in poor performance in math (Goldman and Penner, 2016). For the purpose of this current research effort math performance is defined as the percent of correct mathematical or quantitative calculations. A low math self-concept can result in a weak coping strategy or reluctance to apply diligence in approaching math tasks and creates capacity constraints leading to avoidance, withdrawal, or disengagement in solving math problems. Improving confidence may eliminate processes that hinder how we handle mathematical problems (Tarasi et al, 2012). It follows that improved math self-concept should result in improved math performance. Task specific efficacy can also affect performance outcomes. A weak math self-efficacy belief may result in lower attention levels or smaller amounts of mental resources being spent on solving a math problem (Pilling, Rigdon, & Brightman, 2012). Focused attention often helps solve math problems, thus a positive relationship is expected between self-efficacy and math performances. Thus, two hypotheses are proposed:

Hypothesis 3: Among marketing majors, math performance is positively impacted by math self-concept.

Hypothesis 4: Among marketing majors, math performance is positively impacted by math self-efficacy.

RESEARCH METHODOLOGY

Sample & Data Collection & Measurement

Using Qualtrics, an online survey software, a computer-based questionnaire was administered to 139 undergraduate students (79 males and 60 females) from a mid-western university. The sample consisted of junior and senior marketing majors who had completed the two quantitative courses required for all College of Business students. Using convenience sampling, data was collected from non-overlapping students enrolled in four different marketing major courses. Students received course credit for participating in the study.

With researchers differing widely on the underlying conceptualization for a students' fear of solving mathematical problems, many consider the math anxiety scale as a subject-specific application of test anxiety (Lee, 2009; Hembree, 1988). Lee (2009) suggests using an abridged, unidimensional math anxiety scale. Based on Lee (2009), a five item Likert scale was utilized. Also borrowed from Lee (2009), were scale items for math self-concept and math self-efficacy. Math self-concept is measured with a four item Likert scale while math self-efficacy is measured with a five item Likert scale. The scales are shown in Table 1. To assess students' mathematics performance, five numerical problems were used, as shown in Table 2. Students were instructed to select an answer for each problem as they were sequentially displayed on the computer screen. Based on the percentage of correct answers scored, a percentage accuracy score was developed for each student. The accuracy scores could range between zero and one-hundred. Math performance served as the primary dependent (outcome) variable in the study. Due to the cross sectional data used in this study and to avoid time-related confounding factors, students' math performance, math anxiety, math self-efficacy and math self-concept questions were administered at the same time.

TABLE 1
EXPLORATORY FACTOR ANALYSIS RESULTS

Scale Items	Varimax rotated factor: Math Anxiety	Math Self-concept	Math Self-efficacy
I feel nervous solving quantitative problems.	.858		
I feel tensed while doing homework having quantitative topics.	.891		
I often worry that it will be difficult for me in courses having quantitative focus.	.869		
I feel helpless while doing quantitative problems.	.798		
I worry that I will get poor grades in courses having quantitative focus.	.852		
I always believed that mathematics is one of my favorite subjects.		.820	
I learn mathematics quickly.		.888	
I understand even the most difficult concepts in my mathematics class.		.827	
I have always received good grades in mathematics.		.841	
I feel confident about calculating how many sq ft of tile needed to cover a floor.			.770
I feel confident about calculating a 35% discount on a television set.			.822
I feel confident about understanding graphs presented in newspaper.			.806
I feel confident calculating gas mileage of a car.			.820
I feel confident in finding the distance between two places with a 1:100 scale.			.725
Overall Cronbach alpha	.930	.905	.858
Eigenvalue	6.29	2.28	1.85
Cumulative percentage of variance explained	44.91%	61.17%	74.36%
Factor correlation of math anxiety With Math self-concept -.43 With Math self-efficacy -.37			

TABLE 2
MATHEMATICAL PROBLEMS

The equation 4y – 3x + 2=0 denotes:	a)	a straight line with slope= 4 and intercept = 0
	b)	a straight line with slope= -3 and intercept = 2
	c)	a straight line with slope= 0.25 and intercept = 2
	d)	a straight line with slope= 0.75 and intercept = -2
	e)	none of the above
Differentiating the following problem	a)	2 tanx sec^2x
$Y= sin^2x/cos^2x$ gives the answer as	b)	2 tan^2x sec x
	c)	2 tanx secx
	d)	2 tanx/secx
	e)	None of the above
The mean, median, and mode of the following	a)	Mean =10 , median = 5 , mode = 5
observations are given by:	b)	Mean = 5 , median = 5 , mode = 5
5, 5, 10, 10, 10, 20	c)	Mean =10 , median =10 , mode = 5
	d)	Mean =10 , median =10 , mode = 10
	e)	None of the above
The formula for calculating total profit is given by	a)	$20
profit = q (p-c) where q: total quantity =	b)	$10
10units; p: price per unit = $2;	c)	$5
c: cost per unit=$1.5	d)	$15
The value of total profit is	e)	None of the above
The total interest accrued on $200 after 2 years on	a)	$20
a simple rate of interest of 2% per year is given	b)	$40
by:	c)	$10
	d)	$8
	e)	None of the above

RESEARCH FINDINGS

Descriptive

Table 3 shows the overall means for the constructs of interest. The results are consistent with prior studies (e.g., Hackett, 1985; Benson, 1989). Males exhibited lower levels of math anxiety and higher levels of math self-concept and math self-efficacy as compared to females. However, overall marketing students' math performance scores from the sample were low as on an average most students got only half of the answers correct. Comparing the trait (math self-concept) and context variables (math self-efficacy), most students had greater confidence in being able to solve certain problems than their overall confidence in their quantitative acumen. To test for normality of the variables, results show (see Table 4) all the reflective indicators, skewness and kurtosis values confirm that the sample data closely represents normal distributions. Most importantly, only one of the variables (MSE2) shows a very large value.

TABLE 3
MEAN SCORES FOR CONSTRUCTS

Constructs	Males	Females	Total
Math Performance (Percentage of Accuracy)	59%	49%	55%
Math Anxiety*	2.39	3.09	2.70
Math Self-concept*	3.58	3.00	3.33
Math Self-efficacy*	4.38	3.96	4.20

* Based on five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), a higher number indicates a higher level of the underlying construct.

TABLE 4
ASSESSMENT OF NORMALITY (MEASUREMENT MODEL)

Variable	min	max	skew	c.r.	kurtosis	c.r.
MSE1	1.000	5.000	-1.124	-5.409	1.024	2.464
MSE2	1.000	5.000	-2.163	-10.411	6.242	15.022
MSE3	2.000	5.000	-1.163	-5.598	1.567	3.770
MSE4	2.000	5.000	-1.233	-5.933	.992	2.387
MSE5	1.000	5.000	-.491	-2.364	-.910	-2.190
MSC1	1.000	5.000	-.085	-.408	-1.088	-2.619
MSC2	1.000	5.000	-.486	-2.337	-.857	-2.064
MSC3	1.000	5.000	.056	.272	-.846	-2.035
MSC4	1.000	5.000	-.577	-2.778	-.530	-1.276
MA5	1.000	5.000	.279	1.343	-.725	-1.746
MA4	1.000	5.000	.803	3.863	.093	.223
MA3	1.000	5.000	.254	1.224	-.833	-2.005
MA2	1.000	5.000	.488	2.349	-.523	-1.258
MA1	1.000	5.000	.622	2.994	-.392	-.943
Multi					43.960	12.243

The values for asymmetry and kurtosis between -2 and +2 are considered acceptable in order to confirm normal distribution (George & Mallery, 2010). Confirmation was also obtained by running the structural model analysis by omitting the variable MSE2 because of potential non-normality and found no significant differences in our main findings. Thereby, to remain consistent with previous studies MS[1]E2 was retained in the main analysis.

Exploratory Factor Analysis

Scale reliabilities for each variable as shown in Table 1 were well above acceptable level of 0.70, with Cronbach alpha value of 0.905 for math self-concept, 0.858 for math self-efficacy, and 0.930 for math anxiety. An exploratory factor analysis using all 14 items was conducted to determine underlying factor structures. Results (see Table 1) indicate that each of the constructs are unidimensional (i.e., individual factor loadings for respective scale items were high with low cross loadings). Scree plots and eigenvalues showed three distinct factors, and rotated factor loadings uniquely identified each relevant factor.

Confirmatory Factor Analysis

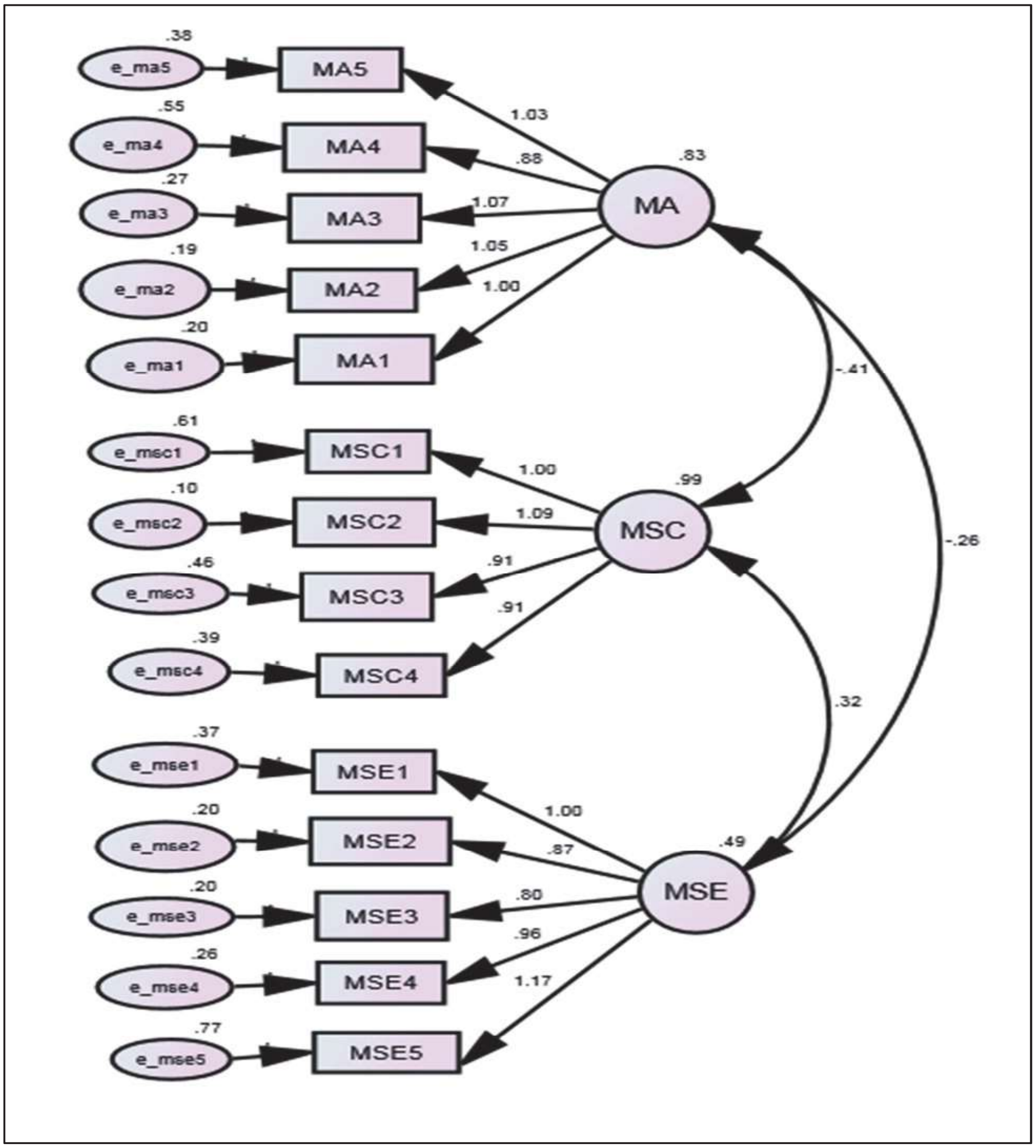
A confirmatory factor analysis (CFA) was run using AMOS, a statistical software for structural model analysis with a correlation matrix used as the input. In all CFA modeling, factor loadings and factor inter-correlations are specified as free parameters. All error terms were uncorrelated. First, several model fit indices including model chi-square, the comparative fit index (CFI) (Bentler, 1990), the Tucker–Lewis index (TLI) (Tucker & Lewis, 1973), goodness of fit index (GFI) (Jöreskog & Sörbom, 1989), adjusted goodness of fit index (AGFI), root mean square residual (RMR), and the root mean square error of approximation (RMSEA) (Steiger, 1988) were evaluated against their suggested benchmark values. As shown in Table 5 and Figure 1, the CFA model shows an acceptable model fit for each of the fit indices based on the following commonly accepted threshold values for a model fit: 0.90 for CFI, 0.95 for TLI, 0.80 for GFI and AGFI, and lower than 0.05 for RMSEA and RMR (Hu & Bentler, 1999).

TABLE 5
CONFIRMATORY FACTOR ANALYSIS FIT RESULTS

Item	χ^2	df	χ^2/df	GFI PGFI	CFI NFI TLI	P-ratio PNFI PCFI	RMR RMSEA Lo90-Hi90 P-close
3-factor model	119.48	74	1.615 (p<.001)	.886 .624	.967 .918 .959	.813 .746 .786	.045 .067 .044 - .088 .108
Independence model	1448.86	91	15.92	.282 .244	.000 .000 .000	1.000 .000 .000	.458 .329 .314-.344 .000

The Chi-square value was 119.48 with 74 degrees of freedom and the PCMIN/df ratio was 1.61, much less than suggested value of 5.0; CFI, TLI, GFI, and AGFI values were 0.97, 0.96, 0.89, and 0.84 respectively; RMR and RMSEA were .05 and 0.07 respectively. Although the RMSEA didn't have the desired value (<.05), the PCLOSE (p-value associated with a null of RMSEA<.05) was 0.11, suggesting failure to reject the null and conforming RMSEA to be in the desired range. The AIC and BCC criteria (181.49 and 189.05) were close to the saturated model (210.00 and 235.61), suggesting a good fit. None of the modification indices had high values (greater than 10) suggesting no significant cross loadings. Moreover, each of the indirect-effects having zero coefficients implied no significant cross-loadings with unrelated constructs. These results along with low correlations between math anxiety, math self-efficacy and math self-concept (each less than 0.5) (see Table 5) strongly suggest unidimensionality and discriminant validity of our model constructs.

FIGURE 1
MEASUREMENT MODEL



Structural Equation Model & Predictive Analysis

A structural equation model using math performance (percentage accuracy) as the main dependent variable was run. As shown in Table 6, two structural models were computed to compare the mediation processes emerging from the two self-perception (math self-efficacy and math self-concept) and one affective (math anxiety) factors. In Figure 2, Model 1 depicts math anxiety mediating the effect of math self-efficacy and math self-concept on math performance, which was then compared to Model 2 as shown in Figure 3, where math self-concept and self-efficacy mediates the effect of math anxiety on math performance. Using the model comparison, it was tested whether an overall affective variable, math anxiety, mediates or is mediated by more specific contextual and trait variables, math self-efficacy and math self-concept. Although model fits were comparable between both the models, Model 1 was adopted as a relatively better fitting model in which math anxiety mediates the effects of math self-efficacy and math self-concept. In addition, Model 1 has greater literature support. To check for mediation, the path coefficients were compared in the presence or absence of the mediator, math anxiety. A complete mediation was found for math self-efficacy and a partial effect for math self-concept when math anxiety worked as a mediator (see Table 6).

TABLE 6
STRUCTURAL MODEL ANALYSIS RESULTS

Paths	Coefficients (standard error)	t-values (significance)	Model fits (proposed model)	Model fits (indep. model)
Model-1			CMIN =136.150,	CMIN=1494.26
MSC→MA	-0.307 (0.087)	-3.518 (p<.001)	(85df), Cmin/df=1.6	(105df),
MSE→MA	-0.377 (0.145)	-2.606 (p<.05)	GFI=.876,	GFI=.282,
MSC→performance	0.009 (0.021)	0.417 (p<.05)	PGFI=.620	PGFI=.247,
MSE→performance	0.094 (0.035)	2.667 (p>.677)	RMR=.043,	RMR=.429,
MA→ performance	-0.057 (0.022)	-2.567(p<.05)	RMSEA=.066,	RMSEA=.310,
			90%CI=.044-.086	90%CI=.296-.324
			p-close=.103	p-close=.000
			CFI=.963, NFI=.910	CFI=.000,NFI=.000TL
			TLI=.955	I=.000
			P-ratio=.810,	P-ratio=1,
			PNFI=.736, PCFI=.780	PNFI=.000,
			AIC=206.145,	PCFI=.000
			BIC=308.852	AIC=1524.262,
				BIC=1568.279
Model -2			CMIN =149.359	CMIN=1494.26
MA→MSC	-0.458 (0.087)	-5.251 (p<.001)	(86df), Cmin/df=1.74	(105df),
MA→MSE	-0.278 (0.061)	-4.552 (p<.001)	GFI=.866,	GFI=.282,
MSC→performance	0.013 (0.021)	0.591 (p>.555)	PGFI=.621	PGFI=.247,
MSE→performance	0.092 (0.033)	2.790 (p>.005)	RMR=.088,	RMR=.429,
MA→performance	-0.056 (0.024)	-2.379 (p<.05)	RMSEA=.073,	RMSEA=.310,
			90%CI=.053-.092	90%CI=.296-.324
			p-close=.031	p-close=.000
			CFI=.954, NFI=.900	CFI=.000,NFI=.000TL
			TLI=.944	I=.000
			P-ratio=.819,	P-ratio=1,
			PNFI=.737, PCFI=.782	PNFI=.000,
			AIC=217.359,	PCFI=.000
			BIC=317.131	AIC=1524.262,
				BIC=1568.279

Two alternative model formulations were considered in order to draw evidence based conclusions on whether math anxiety or math self-concept and math self-efficacy provide effective mediation effects. Structural equation model analysis results clearly confirm the four proposed hypotheses. Math anxiety had a significant negative impact on both math self-concept (Hypothesis 1) and math self-efficacy (Hypothesis 2), which in turn had positive impacts on math performance (Hypotheses 3 and 4). Math self-concept and math self-efficacy also provide effective mediations on math performance.

IMPLICATIONS FOR MARKETING EDUCATION

The purpose of this study was to differentiate the constructs of math self-concept, math self-efficacy, and math anxiety using a marketing student sample. Using three primary streams of thoughts, math anxiety was differentiated from math self-efficacy and math self-construct. The empirical results converge with Pietsch, Chapman, and Walker (2003) with both indicating that competency constructs of math self-concept and math self-efficacy are clearly distinct from the affective construct of anxiety in the context of mathematics education. However results also showed clear differentiation between math self-efficacy and math self-construct which contradicts Pietsch, Chapman, and Walker (2003). Moreover the findings suggest the process of mediation works primarily through the affective component. Further confirmation for mediation process is needed as our results are limited to a single sample of undergraduate marketing majors.

FIGURE 2
STRUCTURAL MODEL #1:
MATH ANXIETY MEDIATES THE EFFECT OF MATH SELF-EFFICACY AND MATH SELF-CONCEPT ON MATH PERFORMANCE

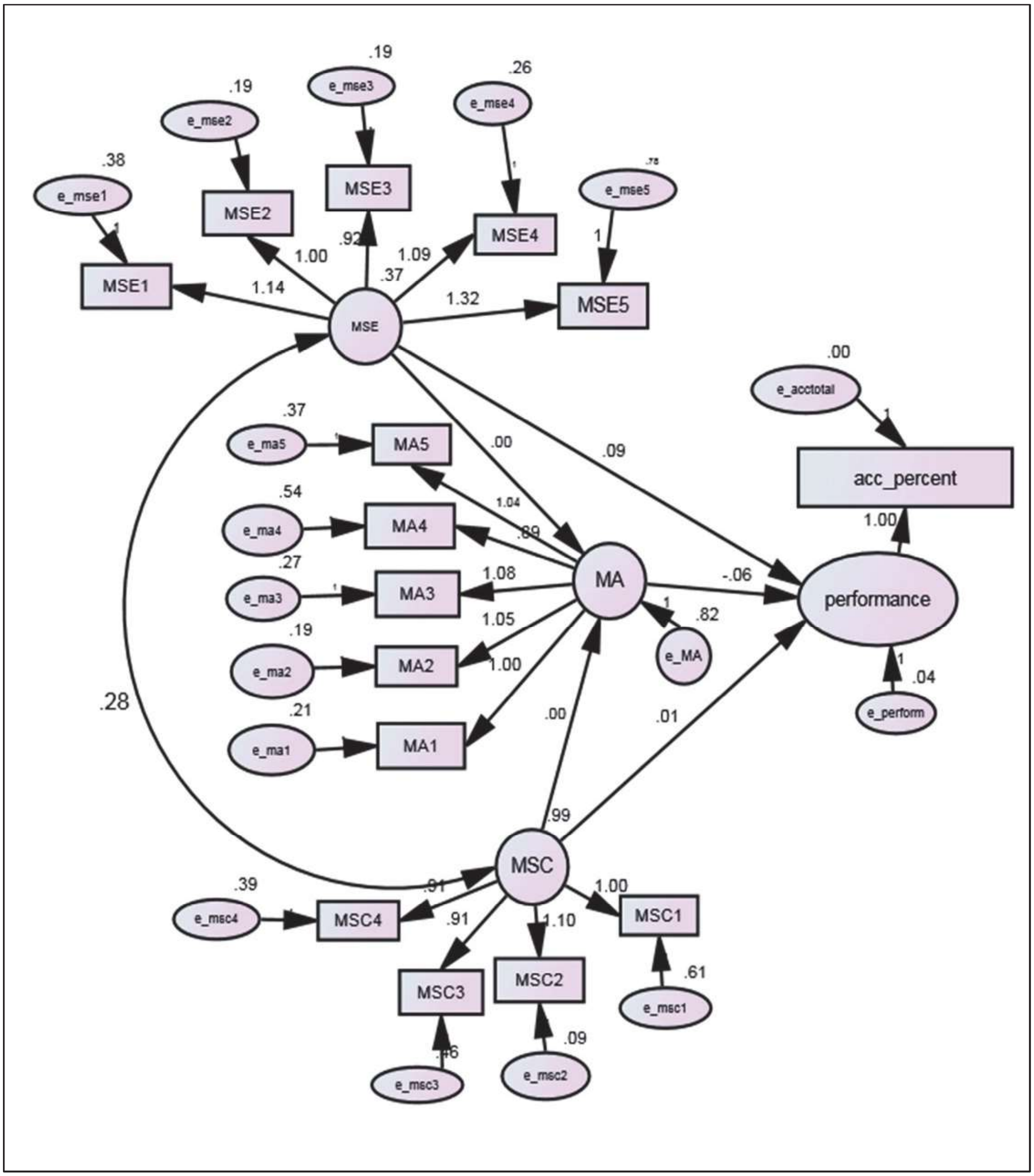
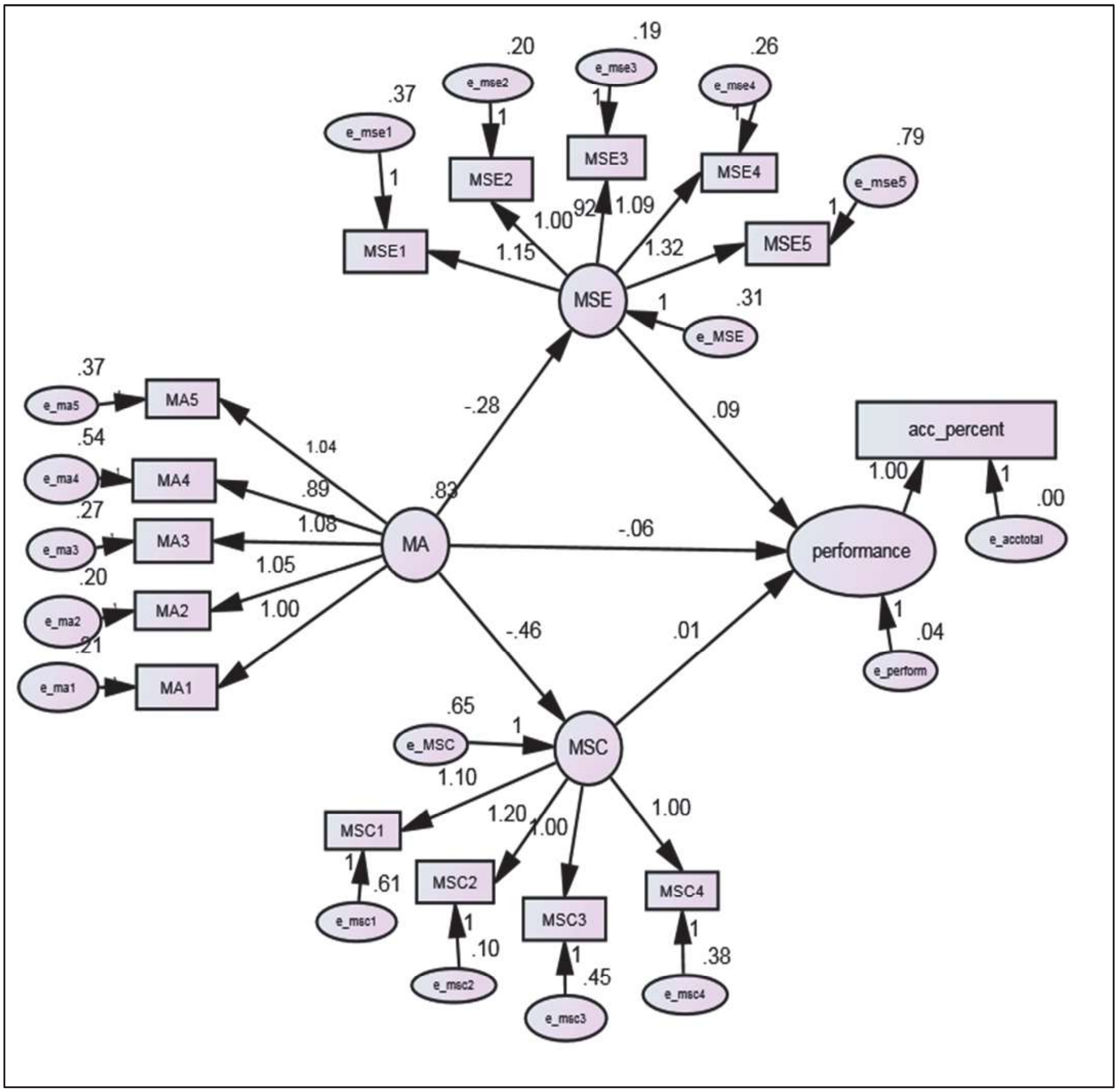


FIGURE 3
STRUCTURAL MODEL #2
MATH SELF-CONCEPT AND MATH-SELF EFFICACY MEDIATES
THE EFFECT OF MATH ANXIETY ON PERFORMANCE



Marketing educators, and business educators in general, are now focusing on quantitative literacy among their students (Brennan & Vos, 2013; Ganesh, Sun, & Barat, 2014; Malholtra, 2015; Pilling, Rigdon, & Brightman, 2012; and Tasari et al., 2012). Yet to a degree, such efforts lead to more questions than answers. Ganesh, Sun, and Barat (2014) and Pilling, Rigdon and Brightman (2012) each discuss recently designed core marketing courses that attempt to address the quantitative literacy challenge. However, the efforts did not contain any formal assessment of the relationships between math anxiety, math self-concept, math self-efficacy, and math performance. Brennan and Vos (2013) describe a simulation game designed to increase the quantitative skills of marketing students. Though scores increased as a result of game participation, students also reported lower levels of math self-efficacy upon completion. Tasari et al. (2012) also reported conflicting results in a survey of marketing majors that has completed a marketing research course. Although acknowledging that quantitative skills increased among students, they also reported lower levels of math self-concept as a result of the course. These overall results suggest the marketing discipline has yet to address the root causes and thus such efforts are impacting a moment in time rather than longitudinal career skills. In other words, are we treating symptoms rather than the disease? Thus, the current study's primary contribution as it relates to marketing students is the knowledge that the causal relationships between math anxiety, math self-concept, math self-efficacy are not definitive in terms of directional influence. Though all four hypotheses were supported, the two structural equation models documented competing directional influences among the three constructs.

CONCLUSION

Academicians are digging deeper. Stogsdill (2013) presents math therapy exercises that can reduce a student's level of math anxiety. Topics include a student's earliest memories of math, when and why math became difficult, worst memories of math, best memories of math, and real feelings about math. Bogue (1993) took a similar approach in asking students to document causes, reactions, and reduction of their anxiety. Maier and Curtin (2005) provide nine strategies that can build math self-efficacy in students that include such activities as guided mastery, peer modeling, verbal modeling, and repetition. Thus, to impact the longitudinal implications of quantitative literacy for marketing majors, a more holistic view is needed that simultaneously addresses approaches that reduce math anxiety, increase math self-concept, increase math self-efficacy, and result in greater levels of math performance.

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