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TRAIT EMOTIONAL INTELLIGENCE, SELF-CONFIDENCE AND VALUATION OF MATHEMATICS: MEDIATION AND MODERATED MEDIATION ANALYSES OF SUMMER VERSUS REGULAR SEMESTER STUDENTS

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Abstract:

Studies suggest trait emotional intelligence (EI) is related to improved attitudes about learning. Within the context of learning mathematics, researchers argue the inclusion of EI in the curriculum can improve student attitudes about mathematics, and consequently performance. However, the mechanism underlying the relationship between trait EI and attitudes about mathematics has not been empirically assessed. This study used structural equation modeling (SEM) to test the mediating effect of self-confidence in math ability on the relation between trait EI and math attitudes, using a diverse sample of undergraduate students at a large public university in the Northeastern US (N = 381). The results show self-confidence mediated such relation. Using moderated mediation SEM, the study also generalizes the results over summer versus regular semester students. The results suggest inclusion of trait EI within any mathematics curriculum will result in higher self-confidence among students, and therefore improved attitudes about mathematics.

Keywords:

Mediated Moderation, Trait Emotional Intelligence, Confidence, Attitudes, Mathematics

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1. Introduction

According to the Organisation for Economic Co-operation and Development (OECD) an individual's appreciation for and use of mathematics in decision making, is extremely important for success. Yet, in many societies including the US, assuming the identity of not being a "math person" is common (Boaler, 2015; Brown, Brown & Bibby, 2008; Moses & Cobb, 2001; Leder, Forgasz & Solar, 1996; Fennema & Sherman, 1977). Adopting such identity has been shown to negatively impact academic achievement (Job, Walton, Bernecker & Dweck, 2015; Paunesku, et al., 2015; Rattan, Good & Dweck, 2012; Farooq & Shah, 2008; Odell & Shumacher, 1999), and arguably results in an unskilled workforce (OECD Skills Outlook, 2015).

Research suggests such identification of oneself as not being a "math person", and consequently becoming disengaged in the learning of mathematics, is associated to the individual's lack of understanding of the role and value of mathematics in their lives and in society (Harris, 2012; Norris, 2012; Garii & Okumu, 2008; Skovsmose, 2005). Such negative attitudes or views about the usefulness of mathematics have been shown to mainly result from low self-confidence, and overpowering effects of mathematics anxiety (Lubienski, Robinson, Crane & Ganley, 2013; Chinn, 2012; Rattan, Good & Dweck, 2012; Gunderson, Ramirez, Levine & Bleilock, 2012; Tobias & Weissbrod, 1980; Fennema, 1979).

Evidently, emotions, and by extension an individual's perception of their emotional self-efficacy, are crucial to the development of numeracy skills, including an understanding of the role mathematics plays in society and in their lives (Buric, 2015; Brunye, et al., 2013; Hannula, 2002). Consequently, some researchers have suggested the inclusion of methods that improve students' behavioral tendencies, and perceptions regarding their emotional abilities in mathematics classes, for the sake of improving attitudes about mathematics (Colomeischi & Colomeischi, 2015; Parimala & Pazhanievelu, 2015; Tariq, et al., 2013; Salleh & Othman, 2014; Ibaishwa, 2014), and academic achievement (Tariq, et al., 2013; Erasmus, 2013; Maree, Fletcher & Erasmus, 2013; Galla & Wood, 2012; Petrides, Frederickson & Furnham, 2004). Said self-perceptions about emotional abilities are known in the literature as trait emotional intelligence (EI) (Petrides & Furnham, 2001).

Although some evidence points towards a positive link between trait EI and attitudes about mathematics, two key aspects are missing from the literature. First, the mechanism(s) underlying the relation between trait EI and attitudes about mathematics has not been established. Second, the assessment of the differential effects of those mechanisms between students who opt to take mathematics at an accelerated pace, such as over the summer term, relative to students who take mathematics during the regular term, are yet to be understood. Anecdotally, motives for taking mathematics classes vary between summer and regular semester students. Students generally take mathematics over the summer to either accelerate their studies (e.g. finish their degree early or complete a pre-requisite) or retake a failed class, whereas regular semester students typically do not. In either case, differences in motivational factors across groups – summer versus regular semester students – may affect the role of self-confidence in shaping attitudes about mathematics. Therefore both aspects, the mechanisms explaining the relation between trait EI and attitudes about mathematics, as well as the understanding of group differences in defining such mechanisms, are crucial in the development of intervention programs for student populations.

1.1. Trait Emotional Intelligence (EI) and Educational Outcomes

Trait EI pertains to an individual's self-perception of his or her emotional abilities (Petrides, 2009; Petrides & Furnham, 2001), and is regarded as a measure of emotion-related personality traits (Petrides, 2011). As described in Petrides (2011), some facets of trait EI include adaptability, assertiveness, emotion expression, emotion regulation, self-esteem, trait happiness, and trait optimism. These facets can be used to provide a global trait EI measure. Trait EI has been shown to predict job outcomes (e.g. Platsidiou, 2010; Singh & Woods, 2008; Van Rooy & Viswesvaran, 2004), health and clinical outcomes (e.g. Costa, Petrides & Tillmann, 2014; Uva et al., 2010; Watson, 2000) among others.

Within educational settings, trait EI has been shown to relate to adaptive behaviors, such as higher attendance, and positive peer relations (Gugliandolo, et al., 2015; Ruttledge & Petrides, 2012; Mavroveli, Petrides, Sangareau & Furnham, 2009; Mavroveli, Petrides, Shove & Whitehead, 2008; Mavroveli, Petrides, Rieffe, & Bakker, 2007; Petrides, Sangareau, Furnham & Frederickson, 2006; Santeso, Reker, Schmidt & Segalowitz, 2006). Empirical evidence has also shown that trait EI has a positive effect on happiness, life satisfaction, affect (Platsidou, 2013; Chamorro-Premuzic, Furnham & Lewis, 2007; Petrides & Furnham, 2003), and academic success, primarily among at risk students (Mavroveli, Sanchez-Ruiz, 2010; Parker, Summerfeldt, Hogan & Majeski, 2004; Parker et. al, 2004). Experimental findings have provided insight regarding the connection between trait EI and academic performance.

Mikolajczak and Luminet (2008) demonstrated that trait EI can have protective effects in stressful performance situations. More precisely, the authors found that low trait EI individuals are likely to approach stressful tasks with more defeatist outlooks than high trait EI individuals. Similar results were found by others, whereby in the presence of a stressful performance situation such as a public speech task, high trait EI subjects experienced less psychological and physiological reactivity, and therefore higher performance than their low trait EI counterparts (Mikolajczak, et al., 2007; Mikolajczak, Menil & Luminet, 2007; Ciarrochi, Deane & Anderson, 2002).

Given an established connection between trait EI, and positive attitudes toward stressful tasks, and consequently improved performance, it is no surprise that some researchers are advocating for the inclusion of teaching modes, or programs that help students improve their trait EI within mathematics instruction (Tariq, 2013; Brearley, 2001). In fact, and as mentioned above, some evidence suggests the inclusion of trait EI within the mathematics curriculum can lead to better attitudes about mathematics. Yet, two of the facets within trait EI are self-esteem and trait optimism, both which are characterized by a certain degree of self-confidence in life (Petrides, 2011). Hence, it is very likely that trait EI is related to self-confidence in mathematics ability, and this latter construct has also been linked to attitudes and performance in mathematics (e.g. Ker, 2016; Lim & Chapman, 2015; McDonald, 2013; Cho, 2013; Tariq & Durrani, 2012; Hyde, Fennema, Ryan & Frost, 1990; Kloosterman, 1988; Fennema & Sherman, 1976). Given such potential relation one can infer that the feature of trait EI guiding attitudes about mathematics is nothing other than trait EI's impact on a student's development of self-confidence in his or her mathematics ability.

However, differences between summer and regular semester students, may imply the role of self-cofidence in mathematics ability could vary across these groups. Arguably, summer students understand the material will be presented at an intensive and accelerated pace. As such, they are likely to be more emotionally prepared for the challenge. Also, students who take mathematics over the summer in order to accelerate in their program, are possibly more academically prepared than students who do not. These two issues combined highlight the possibility of motivational differences across summer and regular term students. A study by Howey (1999) between academically prepared and unprepared college students found that these groups exhibited clear motivational differences. Whereas academically prepared students were more likely to have higher self-efficacy and higher tolerance to test anxiety, unprepared students were more likely to be extrinsically motivated, had lower self-efficacy beliefs, and little tolerance to test anxiety. By this line of reasoning, it is reasonable to argue that self-confidence in ability plays a different role for summer students than it does for regular semester students. If so, efforts to increase self-confidence among students, and therefore improve attitudes about mathematics, should vary between summer and the traditional semester.

2. Current Study

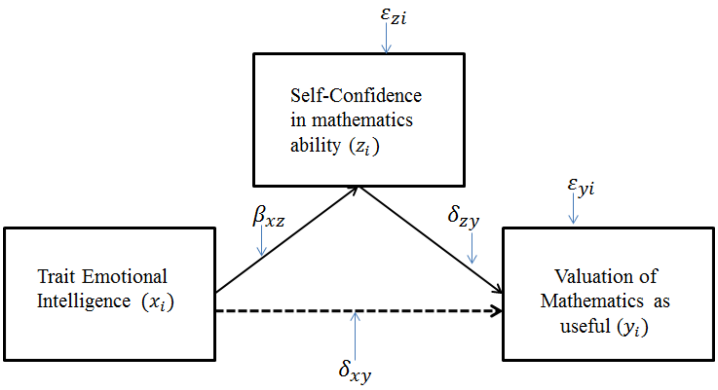
This study presents the results of two sets of analyses. First, it presents a mediation analysis of self-confidence in mathematics ability on the relationship between trait EI and student ratings regarding the usefulness of mathematics. Second, it presents a moderated mediation analysis verifying whether the mediating effect of self-confidence in mathematics ability varies between summer and regular semester students.

2.1. Conceptual Framework

The conceptual framework proposed herein suggests trait EI affects student attitudes about mathematics, so that students with high trait EI recognize the value and utility of mathematics, and rank it as highly useful for their lives and careers. However, trait EI is also associated to self-confidence in mathematics ability so that high trait EI students, holding constant their experiences taking mathematics classes and major, have higher self-confidence in their mathematics ability than low trait EI students. This higher self-confidence then leads to better attitudes about the role of mathematics in the student's life. In other words, the effect of trait EI on attitudes about the usefulness of mathematics is mediated by self-confidence in mathematics ability. This argument results in the following testable hypothesis:

H^1: The effect of trait EI on valuation of mathematics as useful is mediated by self-confidence in mathematics ability.

Figure 1: Mediation of trait EI's effect on Attitudes about Mathematics



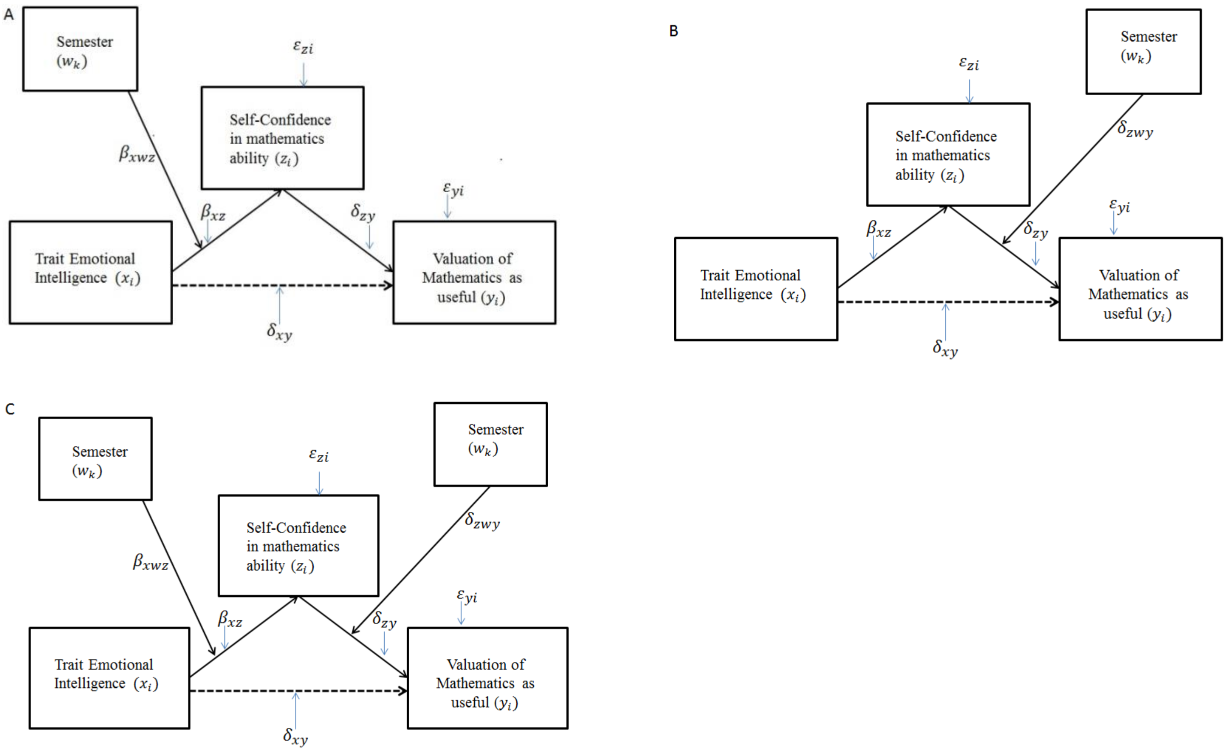
However, as aruged above the mediating effect of self-confidence may vary between summer and regular semester students. This relation is pictured in figure 2, and stated in the following hypotheses.

H^2: The path between trait EI and self-confidence is conditional on semester.

H^3: The indirect effect of trait EI on valuation of mathematics is conditional on semester.

H^4: The path between trait EI and self-confidence, as well as the indirect effect of trait EI and valuation of mathematics are conditional on semester.

Figure 2: Three possible paths of moderated mediation of trait EI by semester



Note: Figure 2 presents three moderated mediation models tested in this paper. Panel A states that the path between trait EI and self-confidence is conditional on semester. Panel B states the path from self-confidence to valuation of math as useful is conditional on semester. Panel C mixes both A and B, and suggests that both paths are conditional on semester. For the sake of simplicity the panels omit paths from the moderator, to the mediator and to the outcome directly. Coefficients describing these paths are explicitly stated in the corresponding SEM equations 1a through 1c, accordingly.

3. Materials and Methods

3.1. Participants and Procedure

Study participants (N = 381) were students enrolled in undergraduate mathematics courses at a public four-year college in the Northeastern U.S. Students came from a wide variety of majors and academic status. Classes ranged from basic mathematics, to statistics, and vector calculus. Data were gathered during two semesters, summer and fall 2015. Participants answered questionnaires in a research lab. Completion time ranged from 25 to 30 minutes. This study and all associated procedures were approved by the Institutional Review Board of the university, and prior to participation participants signed a written informed consent form. In the majority of cases, participants received course credit for their involvement in the study.

3.2. Measures

<u>Self-Confidence and Valuation of Mathematics as useful</u>: Participants responded to the Fennema-Sherman Mathematics Attitude Scale (Fennema & Sherman, 1976) modified by Doepken, Lawsky and Padwa (2003), adapted for a college sample. This instrument consists of 4 subscales measuring attitudes about mathematics from various perspectives. Two of these subscales, student self-confidence in their mathematics ability, and student perception about the usefulness of mathematics during and after college, were used in this study. Each subscale contains 12 items measured on a 5-point Likert-scale (5 = strongly agree … 1 = strongly disagree). Some sample items include "*I am sure of myself when I do math*" or "*I'll need mathematics for my future work*". Scoring was done as indicated by the authors - adding over all responses after reverse coding negative items. Accordingly, each subscale ranges between a minimum of 12 points and a maximum of 60 points.

<u>Trait Emotional Intelligence</u>: Participants responded to the Trait Emotional Intelligence Short Form (TEIQue-SF) (Petrides, 2009), which is a 30-item instrument that provides a global trait EI score. The construct corresponds to a series of emotion-related self-perceptions and dispositions (Petrides & Furnham, 2001). Items are presented on a 7-point Likert scale. Sample items include "*On the whole, I have a gloomy perspective on most things*" or "*I normally find it difficult to keep myself motivated*". Items were scored by adding over all responses after reverse-scoring negative items. Consequently, the scale ranges between 30 and 210 points.

<u>Demographics</u>: Participants provided information about their gender, ethnicity, age, education status (freshman, sophomore, junior, senior or graduate), major and experience taking mathematics classes, measured as an indicator for having taken more than 3 mathematics classes prior to the one(s) taken during the study.

Semester: Gauged via an indicator variable (0 if summer and 1 if fall).

3.3. Data Analysis and Method

This first hypothesis (H^1) was tested using mediation analysis with structural equation modeling (SEM), and maximum likelihood (ML) estimation using the sample covariance matrix as input (Gunzler, Chen, Wu & Zhang, 2013; Preacher & Hayes, 2004). All calculations were carried through with STATA v.14, and confirmed using the PROCESS macro for SPSS written by Andrew Hayes (2013). Each structural equation included age, gender, experience taking mathematics classes, education status and major as controls. Moderated mediation (H^2 - H^4), was conducted via conditional process modeling outlined by Preacher, Rucker and Hayes (2007), later updated in Hayes (2013). In these later models, residual variances were constrained to be equal for both levels of the grouping variable (Hayes, 2013; Preacher, Rucker & Hayes, 2007). In addition, as suggested in the literature, direct and indirect effects, standard errors, and confidence intervals were estimated via bootstrapping using 5,000 replications (Preacher & Hayes, 2004; Shrout & Bolger, 2002; Lockwood & MacKinnon, 1998; Bollen & Stine, 1990). In all cases, standardized estimates are reported, as they generalize to all structural equations.

Goodness of fit was assessed via commonly used measures of absolute fit as suggested by Hu and Bentler (1999). Specifically, the goodness of fit measures used include the root mean square error of approximation (RMSEA), the comparative fit index (CFI), the Tucker-Lewis index (TLI) and the standardized root mean square residual (SRMR). General guidelines representing a good fitting model were adhered to - CFI ≥0.95, TLI ≥0.95, SRMR ≤0.09 and RMSEA ≤0.06 (Hooper, Coughlan & Mullen, 2008; Hu & Bentler, 1999). All continuous variables were mean centered, and categorical variables were dichotomized as 0 or 1. Normality assumptions were gauged using the Shapiro-Francia test of normality, and multivariate normality was gauged using the Doornik-Hansen test for multivariate normality. In the presence of violations of model assumptions, the results were confirmed using non-parametric analogues or robust standard error approaches.

4. Results

4.1. Descriptive Statistics

All descriptive statistics appear in table 1. Participants had a mean age of 21.5 ($SD = 4.4$). The sample was characterized by 59.3% (n = 226) males and 40.7% (n = 155) female. Respondents represented a variety of majors within the areas of Science (13.4%, n = 51), Social Science (17.1%, n = 65), Engineering (55.9%, n = 213), Education (5.8%, n = 22) and a few undeclared majors (7.9%, n = 30). Participants were 23.6% freshmen (n = 90), 31.5% sophomores (n = 120), 26.8% juniors (n = 102), 12.6% seniors (n = 48) and 5.5% other (n = 21), mostly characterized by non-degree students.

The vast majority (71%) of participants had taken 3 or more mathematics courses prior to the one(s) taking during the semester in which they participated in the study. Some differences in the characteristics of the sample between summer and fall semesters are worth mentioning.

According to a Chi-Square test of independence, education status varies by semester, and the effect size is large $(\chi(4)^2 = 66.4, p = 0.00, V = 0.42)$. Specifically, a differences in proportions test highlights that summer students were highly less likely than fall students to be freshmen, (z = -9.06, p = 0.00) and more likely than fall students to be juniors (z = 3.96, p = 0.00) or seniors (z = 3.78, p = 0.00). According to an independent saples t-test, summer students were on average older than fall students with a moderate effect size (t = -5.13, p = 0.00, d = 0.53). This result was verified using a Kruskal-Wallis equality of populations test, as Age was, as expected of a college sample, not normally distributed according to the Shapiro Francia W' test $(W' = 0.78, p = 0.00)$. The Kruskal-Wallis test confirms the findings from the independent samples t-test $(\chi(1)^2 = 47.1, p = 0.00)$.

Summer students were also more likely to major in education than fall students, as indicated by a differences in proportions test (z = 2.96, p = 0.00). No other differences in major were captured between semesters. Also, a Chi-Square test of independence indicates that experience taking mathematics courses varied across semesters, and the effect size was moderate $(\chi(1)^2 = 39.2, p = 0.00, V = 0.32)$. Specifically, summer students were more likely than fall students to have taken more than 3 mathematics courses prior to the course(s) taken while participating in the study. Using a differences in proportions test, such difference is statitistically significant (z = 6.26, p = 0.00).

Table 1: Descriptive Statistics by Semester

	Total Sample (N = 381)	Summer [55.9%] (n = 213)	Fall [44.1%] (n = 168)	t or Chi-Square Statistic			
	% or Mean (SD)			χ^2 (t $_{\text{one tailed}}$)	df	P	Cramer's V (Cohen's d)
Gender							
Male	59.32%	55.40%	64.29%				
Female	40.68%	44.60%	35.71%				
Total	100.00%	100.00%	100.00%	3.07	1	0.08	---
Education Status							
Freshman	23.62%	9.39%	41.67%				
Sophomore	31.50%	30.99%	32.14%				
Junior	26.77%	34.74%	16.67%				
Senior	12.60%	18.31%	5.36%				
Other	5.50%	6.67%	4.17%				
Total	100%	100%	100%	**66.42**	4	0.00	0.42
Major							
Science	13.39%	13.62%	13.10%				
Social Science	17.06%	16.43%	17.86%				
Engineering	55.91%	55.40%	56.55%				
Education	5.77%	8.92%	1.79%				
Undeclared	7.87%	5.63%	10.71%				
Total	100%	100%	100%	**11.52**	4	0.02	0.174
Age	21.5(4.4)	22.5 (4.8)	20.3 (4.8)	**-5.13**	379	0.00	0.06
Prior Math Classes Taken							
3 or less	28.90%	15.96%	45.24%				
More than 3	71.13%	84.04%	54.76%				
Total	100%	100%	100%	**39.2**	1	0.00	0.32

Source: Own Data. Statistically significant comparisons in bold (p < 0.05).

4.2. Correlations between variables

As shown on table 2 the scales for trait EI, self-confidence in mathematics ability and valuation of mathematics as being useful significantly correlate and show high reliability suggesting all measures used are appropriate for the sample. Due to lack of bi-variate normality in each pair, Pearson correlations were confirmed using the Spearman Rank correlation. Both correlation coefficients are presented in table 2. In each case, the sign, magnitude and significance of the Pearson correlations was verified by the Spearman correlation.

Table 2: Correlations between continuous variables (N = 381)

All (N = 381)					
Measure	M	SD	Cronbach's α	1	2
1. Trait EI	147.99	25.35	0.90		
2. Self-Confidence Mathematics	47.22	9.22	0.92	0.31*** [0.34***]	
3. Valuation of Mathematics	50.38	80.04	0.89	0.15** [0.18***]	0.45*** [0.42***]
Summer (n = 213)					
Measure	M	SD	Cronbach's α	1	2
1. Trait EI	149.85	24.52	0.90		
2. Self-Confidence Mathematics	45.83	9.18	0.92	0.28*** [0.34***]	
3. Valuation of Mathematics	50.15	7.70	0.88	0.15* [0.20**]	0.40*** [0.37***]
Fall (n = 168)					
Measure	M	SD	Cronbach's α	1	2
1. Trait EI	145.64	26.24	0.91		
2. Self-Confidence Mathematics	48.99	8.99	0.93	0.40*** [0.38***]	
3. Valuation of Mathematics	50.67	8.47	0.90	0.16* [0.19*]	0.52*** [0.47***]

*Source: Own Data; EI = Emotional Intelligence, *p<0.05, **p<0.01, ***p<0.001. Pearson correlations presented outside of brackets. Spearmank Rank correlations presented inside brackets.*

4.3. Mediation Analysis

This section tests the model presented in figure 1, which corresponds to H[1]. In particular, for any given subject $1 \leq i \leq n,$ the mediating relation presented in figure 1 is described by the following equations (Gunzler, Chen, Wu & Zhang, 2013),

$$z_i = \beta_0 + \beta_{xz} x_i + \gamma\Delta + \varepsilon_{z_i} \quad (1)$$

$$y_i = \delta_0 + \delta_{zy} z_i + \delta_{xy} x_i + \epsilon\Delta + \varepsilon_{y_i} \quad (2)$$

where $x_i, z_i,$ and y_i correspond to Trait Emotional Intelligence, self-confidence in math ability and valuation of mathematics as useful for individual, $1 \leq i \leq n$, and Δ represents a matrix of covariates, as described in the measures section. Using these equations, one can also label the corresponding effects relevant to mediation analysis. Specifically, the direct effect of trait EI is given by δ_{xy} in equation (2). This represents the link between trait EI and valuation of mathematics once self-confidence is included in the model.

The indirect effect corresponds to the effect of trait EI on valuation of mathematics that goes through the mediator and is given by $\beta_{xz} * \delta_{zy}$. The total effect is then the direct effect and indirect effect added together and equals δ_{xy} + $\beta_{xz} * \delta_{zy}$. In this set up, one cannot reject the possibility of mediation (i.e. H[1]) if δ_{xy} is zero and statistically insignificant (Gunzler, Chen, Wu & Zhang, 2013; Baron & Kenny, 1986; James & Brett, 1984). The results for equations (1) and (2) are presented in table 3 below.

Due to observed violations of the normality assumption, in particular for the outcome variable, according to the Shapiro Francia W‘ test for normality (W‘ = 0.96, p = 0.00), standard errors of each structural model were obtained using the Huber-White sandwich estimator. This approach is an effective and conventional way of addressing concerns regarding violations of classical assupmtions of normality and variance homogeneity (Hayes, 2013; Freedman, 2006).

Table 3: Mediation Analysis with SEM (N = 381)

	Self-Confidence in math ability				
Predictor Variables	Beta	SE	t	pvalue	95% CI
Trait EI	**0.33**	0.04	7.64	0.00	(0.25, 0.42)
Age	-0.03	0.05	-0.66	0.51	(-0.13, 0.07)
Male	0.07	0.05	1.61	0.11	(-0.02, 0.17)
Fall Semester	**0.17**	0.05	3.58	0.00	(0.08, 0.26)
Senior	**-0.11**	0.06	-1.81	0.07	(-0.22, -0.01)
Math Classes (3+)	0.08	0.05	1.62	0.10	(-0.02, 0.18)
Education	**-0.10**	0.07	-1.58	0.12	(-0.23, 0.03)
Engineering	**0.15**	0.06	2.72	0.01	(0.04,0.26)
Science	0.03	0.06	0.47	0.64	(-0.09, 0.14)
Constant	-0.32	0.26	-1.23	0.22	(-0.83, 0.19)
	Equation 2				
	Outcome Variable				
	Valuation of Math as Useful				
Predictor Variables	Beta	SE	t	pvalue	95% CI
Self-Confidence in math	**0.41**	0.05	8.59	0.00	(0.31, 0.50)
Trait EI	0.02	0.05	0.49	0.62	(-0.07, 0.12)
Age	0.00	0.05	-0.04	0.97	(-0.10, 0.10)
Male	0.05	0.05	1.11	0.26	(-0.04, 0.15)
Fall Semester	-0.05	0.05	-1.06	0.31	(-0.15, 0.05)
Senior	-0.08	0.06	-1.64	0.18	(-0.19, 0.04)
Math Classes (3+)	-0.02	0.05	-0.33	0.74	(-0.11, 0.08)
Education	0.07	0.05	1.32	0.23	(-0.04, 0.17)
Engineering	**0.18**	0.06	3.25	0.00	(0.07, 0.29)
Science	0.03	0.06	0.51	0.65	(-0.09, 0.14)
Constant	-0.19	0.27	-0.68	0.50	(-0.72, 0.35)

RMSEA = 0.00 , 90% CI RMSEA (0.00, 0.00); CFI = 1.0; TLI =1.0 ; CD = 0.27

Direct Effect (δ_{xy})	0.007	0.015		0.538	(-0.02, 0.04)
Indirect Effect ($\beta_{xz} * \delta_{zy}$)	**0.043**	0.008			(0.03, 0.06)
Proportion of Total Effect mediated	0.86				
Kappa-Squared	0.140	0.027			(0.093, 0.197)

Source: Own Data; Standardized coefficients (Beta) reported. Statistically significant coefficients (p<0.05) in bold. Standard errors estimated using the Huber-White sandwich estimator. EI = Emotional Intelligence, CI = Confidence Interval, RMSEA = Root Mean Square error of approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, SRMR = Standardized Root mean Square Residual, CD = coefficient of Determination. Guidelines for good fit include CFI ≥ 0.95, TLI ≥ 0.95 SRMR ≤ 0.09, and RMSEA ≤ 0.06. Bootstrapped standard errors, and 95% confidence intervals with 5,000 replications reported for the indirect effect and the Kappa-Squared measure of effect size.

As shown, trait EI is positively related to self-confidence in mathematics ability ($\beta = 0.33, t = 7.64, p = 0.00$) as expected. In addition, variables that relate to self-confidence in ability include educational level and major. In particular, seniors have lower self-confidence than non-seniors ($\beta = -0.11, t = -1.81, p = 0.03$). Also, engineering students have higher self-confidence in their mathematics ability than social science students ($\beta = 0.15, t = 2.72, p = 0.01$) whereas education students have lower self-confidence ($\beta = -0.10, t = -1.58, p = 0.04$). There also appears to be a difference in self-confidence between summer and fall students. Specifically, fall students reported higher self-confidence in mathematics aptitude than summer students ($\beta = 0.17, t = 3.58, p = 0.00$), holding all else constant.

Self-confidence in ability is also positively related to valuations of mathematics as useful ($\beta = 0.41, t = 8.59, p = 0.00$). In fact, the effect is strong, and once included in the SEM model the numerical effect and statistical effect of trait EI go to zero. As shown, this SEM model provided a very good fit according to various indexes: $RMSEA = 0.00, CFI = 1.0, TLI = 1.0$ and $SRMR = 0.00$, with a moderate coefficient of determination (CD = 0.27). A more parsimonious model, including only major, semester, and an indicator for senior vs non-senior yielded a similar fit (RMSEA = 0.00 , CFI = 1.0; TLI =1.03 ; SRMR = 0.005; CD = 0.26) implying that the inclusion or exclusion of variables that were not statistically significant did not alter the results.

Inference regarding the indirect effect was obtained using resampling techniques with 5,000 replications. The results, presented at the bottom of table 3, show that the direct effect is zero, both mathematically and statistically, whereas the indirect effect is statistically significant at the 95% confidence level, as shown by the bootrapped 95% confidence interval. The proportion of the total effect that is mediated is high (0.82). Effect size was ascertained using kappa-squared (Preacher & Kelley, 2011), which represents the ratio of the indirect effect relative to the maximum possible indirect effect, and is interpreted in the same manner as the coefficient of determination, R^2, using the benchmarks proposed by Cohen (1988). Based on the Kappa-squared estimate of 0.14 (bootsrapped SE = 0.027), the effect size for the indirect effect is moderate.

4.4. Moderated Mediation Analysis

Self-confidence, which mediated the relation between trait EI and valuation of mathematics, was shown to vary between summer and fall students. This result implies that an interaction between semester and self-confidence may exist, and the extent to which such interaction alters the mediation effect found in section 4.3 is the subject addressed in this section. In particular, this section addresses the possibility of moderated mediation (James and Brett, 1984), and three possibilities are outlined in the second, third and fourth hypotheses (H^2 - H^4) displayed in Figures 2a through 2c.

First stage moderation (Figure 2a) states that the indirect effect of trait EI on self-confidence is conditional on semester. This effect is hypothesized in H^2, and using the symbol w_k to denote semester, equations (1) and (2) become the following:

$$z_i = \beta_0 + \beta_{xz} x_i + \beta_{wz} w_k + \beta_{xwz} x_i * w_k + \gamma\Delta + \varepsilon_{z_i} \quad (1a)$$

$$y_i = \delta_0 + \delta_{zy} z_i + \delta_{xy} x_i + \delta_{wy} w_k + \delta_{xwy} x_i * w_k + \epsilon\Delta + \varepsilon_{y_i} \quad (2a)$$

The indirect effect is now conditional on w_k and is given by, $\delta_{zy}(\beta_{xz} + \beta_{xwz} * w_k)$ where $k = 0$ for summer and 1 for the fall semester.

Second stage moderation (Figure 2b) is hypothesized in H^3, and suggests the path between self-confidence and valuation of mathematics as useful varies between summer and fall students. The corresponding structural equations are as follows:

$$z_i = \beta_0 + \beta_{xz} x_i + \gamma\Delta + \varepsilon_{z_i} \quad (1b)$$

$$y_i = \delta_0 + \delta_{zy} z_i + \delta_{xy} x_i + \delta_{wy} w_k + \delta_{zwy} z_i * w_k + \epsilon\Delta + \varepsilon_{y_i} \quad (2b)$$

The conditional indirect effect is, $\beta_{xz}(\delta_{zy} + \beta_{zwy} * w_k)$, where $k = 0$ or 1 as defined above.

First and second stage moderation is presented in Figure 2c, and stated in H^4. This model suggests the path between trait EI and self-confidence, as well as the path between self-confidence and valuation of mathematics as useful, vary across semesters. The relevant equations are as follows:

$$z_i = \beta_0 + \beta_{xz} x_i + \beta_{wz} w_k + \beta_{xwz} x_i * w_k + \gamma\Delta + \varepsilon_{z_i} \quad (1c)$$

$$y_i = \delta_0 + \delta_{zy} z_i + \delta_{xy} x_i + \delta_{wy} w_k + \delta_{xwy} x_i * w_k + \delta_{zwy} z_i * w_k + \epsilon\Delta + \varepsilon_{y_i} \quad (2c)$$

The conditional indirect effect is given by, $(\delta_{zy} + \delta_{zwy} * w_k)(\beta_{xz} + \beta_{xwz} * w_k)$, where w_k is defined as before. All corresponding goodness of fit measures are presented in table 4.

Table 4: Goodness of Fit statistics for Moderated Mediation Models (N = 381)

	Moderation Model – Semester as Moderator		
	First Stage (H^2)	Second Stage (H^3)	First and Second Stage (H^4)
RMSEA	0.03	0.00	0.00
90% CI for RMSEA	(0.00, 0.11)	(0.03, 0.07)	(0.00, 0.09)
CFI	0.99	1.00	1.00
TLI	0.96	1.06	1.06
SRMR	0.03	0.01	0.02
CD	0.28	0.28	0.28

Source: Own Data; CI = Confidence Interval, RMSEA = Root Mean Square error of approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, SRMR = Standardized Root mean Square Residual, CD = Coefficient of Determination. Guidelines for good fit include CFI ≥ 0.95, TLI ≥ 0.95 SRMR ≤ 0.09, and RMSEA ≤ 0.06.

All models provide a sound fit. However, as shown in table 5, in each case the difference between indirect effects over semester is small and not statistically significant at the 95% confidence level ($p > 0.05$), implying the mediating effect of self-confidence remains constant across summer and fall students. Therefore, moderated mediation claims (H^2 - H^4) are rejected at the 95% confidence level.

Table 5: Indirect Effects moderated by semester (N = 381)

	First Stage (H^2)		Second Stage (H^3)		First and Second Stage (H^4)	
	Summer	Fall	Summer	Fall	Summer	Fall
Conditional Indirect Effect	$\delta_{zy}(\beta_{xz} + \beta_{xwz} * w_k)$		$\beta_{xz}(\delta_{zy} + \beta_{zwy} * w_k)$		$(\delta_{zy} + \delta_{zwy} * w_k) * (\beta_{xz} + \beta_{xwz} * w_k)$	
Estimated value	**0.04**	**0.05**	**0.03**	**0.05**	**0.03**	**0.06**
Bootstrapped SE	0.009	0.011	0.009	0.011	0.010	0.013
95% CI *Bias Corrected*	(0.02, 0.06)	(0.03, 0.07)	(0.02, 0.06)	(0.03, 0.07)	(0.01, 0.07)	(0.03, 0.09)
Difference	-0.009		-0.02		-0.03	
pvalue	0.42		0.09		0.09	

Source: Own Data; CI = confidence interval; indirect effects computed using bootstrapping with 5,000 replications, and bias corrected confidence intervals presented. Statistically significant effects (p<0.05) in bold.

5. Discussion

This is the first study to show the connection between trait EI and perceptions about the usefulness and value of mathematics is through the development of self-confidence in mathematics ability. Research on the influence of student perceptions about their mathematics ability in shaping their intentions to study mathematics and attitudes about the subject is comprehensive (Tripney et al., 2010; Fredericks & Eccles, 2002). For example, Sax et al. (2015) demonstrate math self-concept is a powerful predictor of STEM aspirations, and conclude women's low confidence in mathematics can explain their underrepresentation in STEM fields. Consistent with Sax et al. (2015), other authors have found that self-confidence in mathematics ability relates to high school student intentions to participate in mathematics courses in college (Sheldrake, Mujtaba & Reiss, 2015). Among college samples, self-confidence in ability is argued to affect some types of students differently than others. Jameson and Fusco (2014) show adult learners have lower levels of mathematics self-efficacy than traditional students. Gender and racial/ethnic differences in self-confidence in mathematics ability, student attitudes, and intentions toward mathematics education have also been highlighted in academic research. The unifying conclusion is that women and racial minorities have lower self-confidence in their ability than males or racial majorities (e.g. Moakler, Kim & Minsun, 2014; Morony, Kleitman, Lee & Stankov, 2012; London et al., 2012; Nagy, et al., 2006).

With overwhelming evidence regarding the role of self-confidence in mathematics ability on the development of student attitudes about mathematics, and their intentions to engage in the learning of mathematics, it appears the recent inclusion of trait EI in the conversation, and arguments toward the renovation of curriculums to include trait EI overlook what we know about self-confidence in ability. However, that need not be the case. In fact, this study supports prior empirical work on both self-confidence and trait EI, and their relation to student attitudes about mathematics. More importantly, this study shows that the element of trait EI linked to positive attitudes about the role and value of mathematics is self-confidence in mathematics ability. In short, both research areas appear to have more in common than otherwise anticipated.

This is also the first study to assess differences between students who take mathematics courses over the summer versus students who do so over the regular term. As argued in prior sections motivational differences across summer and regular semester students may imply a varying role of self-confidence. In particular, students generally take mathematics over the summer for one of two reasons. Sudents either wish to accelerate in their program or they wish to make up for a failed grade. Section 1.1 discusses that in cases where acceleration is the main motive, summer students can be argued to be more academically and emotionally prepared than regular semester students. This difference in turn implies summer students may have higher self-efficacy and therefore higher self-confidence in their abilities. However, the findings show the opposite. While, summer students appear to be older and not freshmen, implying that maturity levels may vary, they were found to have lower self-confidence in mathematics ability than regular semester students. More importantly, the findings show the mediating effect of self-confidence did not vary across students, summer or regular semester.

5.1. Implications of findings

These results have implications for the development of interventions or teaching modules for mathematics instruction. The literature presenting empirical evidence demonstrating a relation between trait EI and attitudes about mathematics and/or performance in mathematics concludes in recommendations for the inclusion of trait EI in the curriculum. However, the studies do not clearly establish the facets of trait EI that should be incorporated in such interventions, which could lead to wide heterogeneity in the types of interventions created. This heterogeneity, in turn, will lead to difficulties in the evaluation of efficacies and the implementation of successful programs on a wider scale. The results presented in this analysis clarify that the aspects of trait EI students learning mathematics should develop the most are those leading to higher self-confidence in mathematics ability. The results also demonstrate any programs along this vein need not be differentiated between summer and regular semester students.

5.2. Limitations and Future Directions

Some limitations to be improved upon in future work are worth mentioning. First, this study assumed self-confidence leads to changes in attitudes, but given the cross-sectional nature of the data, the reverse is also possible. Future work should consider a time series or panel framework in the data collection. Also, grades were not assessed in the study and therefore this study cannot claim better attitudes about the value of mathematics lead to higher performance. Future work should include grades as an additional outcome variable to better gauge the relation between attitudes about mathematics and self-confidence. Finally, this study did not consider mathematics anxiety, which research has found to be negative for attitudes, self-confidence and performance. Further research must incorporate all these facets of learning mathematics, as they may show the relevance of additional facets of trait EI.

6. Conclusion

This study analyzed the extent to which self-confidence in mathematics ability mediates the relationship between trait EI and perceptions of mathematics as a useful subject. The findings show that the positive relationship between trait EI and valuation of mathematics as useful is fully through the development of self-confidence in mathematics ability. This result is invariant to academic semester, in particular between summer and regular semester students. These findings have implications for the development of intervention programs, particularly those who view self-confidence separate from trait EI.

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