Influence of Students' Perceived Value of Diversity in Engineering on Intentions to Persist

Introduction

Recruiting and retaining a diverse and skilled labor force in the science, technology, engineering, and mathematics (STEM) fields is a national concern [1]; the economic prosperity and global competitiveness of the U.S. hinges greatly on these enterprises—especially engineering [1] – [4]. Many engineering occupations require post-secondary education, and unfortunately, attrition from engineering degree programs continues to plague students [3], [5], [6]. Understanding why students engage and persist in engineering is increasingly studied under the social cognitive career theory (SCCT), e.g. [7], [8]. The current study tests an elaborated SCCT model to advance our knowledge of the psychosocial factors that influence engineering students' intentions to persist among a sample of undergraduates primarily in their first year.

Theoretical Framework

The SCCT (Figure 1) builds on Bandura's [9] social cognitive theory, stating that motivation is goal-directed behavior. Behaviors are produced and sustained by the anticipated consequences of one's actions (outcome expectations; OEE), a person's judgment of their ability to attain their goals (self-efficacy; SE), and their career-oriented interests [9], [10]. Pertinent to the career-oriented goals people set is the degree to which they feel their values are congruent with their work, which is an aspect of outcome expectations [11]. Further, the effect of outcome expectations on career-oriented goals is expected to be mediated by students' career-relevant interests.

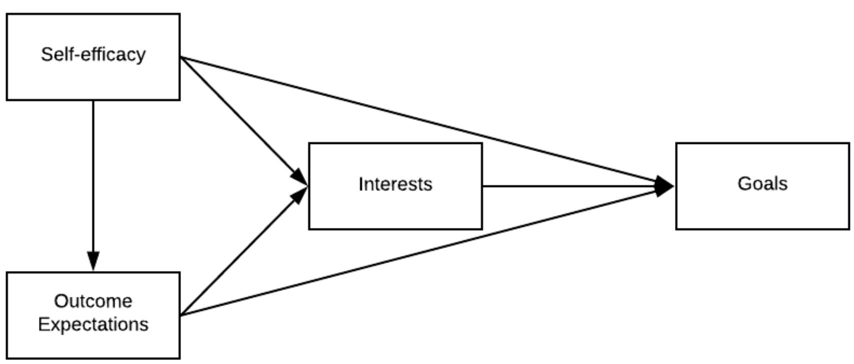


Figure 1. Path diagram of the Social Cognitive Career Theory.

In the seminal work establishing the SCCT, Lent et al. [11] theorize that interests in career-oriented activities are partially dependent on the extent to which people anticipate these behaviors will satisfy personal values. Although values are theoretically incorporated into OEE [11], popular measures of OEE often fail to fully conceptualize this construct [12], [13]. Physical (e.g., financial gain) and social-outcomes (e.g., status) receive the most attention, while self-outcomes (e.g., satisfying personal values) receive little to no attention [12], [13]. Interestingly, prior studies indicate many reasons for engineering students to value diversity in engineering are directly related to physical and self-outcomes.

There are many reasons why engineering students may value diversity within engineering. Prior studies have indicated engineering students tend to see two reasons for valuing diversity: to address the needs of consumers and improve the bottom line (physical outcomes) and to do the morally right thing (self-outcomes) [14]). For example, engineering students recognize the utility of considering diverse populations to better serve customers [14]. Engineering students also perceive that valuing diversity was "aligned with a strong inward desire for purpose and fairness in their work" [14]. Additionally, prior studies demonstrate that the extrinsic utilities (i.e., physical-outcomes) of engineering facilitated short- and long-term goals and were important predictors of persistence among students [15], [16]. Guided by the SCCT, this study seeks to explore the extent to which students' expected physical and self-outcomes for valuing diversity influence engineering students' academic goals.

The Current Study

The SCCT model has been applied to engineering student populations and demonstrates a strong ability to predict intended persistence [17], [18]. The current study explores factors associated with the intended persistence of students in an engineering degree program that have not previously been elaborated. We test an expanded SCCT model that included measures of personal values—specifically, students' perceived value of diversity in engineering—as predictors of interests of career-oriented goals. While we added both expected physical-outcomes and self-outcomes for valuing diversity in the model, we proposed expected physical outcomes of valuing diversity in engineering would (a) moderate the relationship between outcome expectations and career-relevant interest and (b) strengthen the indirect relationship between outcome expectations and career-oriented goals through interest (moderated mediation), over and above engineering identity, and self-efficacy—both important influences of behavior [11], [19], [20]. Self-efficacy is proposed to influence goal-directed behaviors, such as persistence, according to the SCCT [11]. The extant literature also suggests that contextual identities are important personal factors that affect behavior. Stevens et al. [19] found that students become engineers along three dimensions: disciplinary knowledge, identification, and navigation. Students' continuation in an engineering program was found to be contingent, at least in part, by the extent to which they identify themselves as engineers. Similar results were reported by Syed et al. [20], who explored commitment to STEM careers under the SCCT. Commitment to a STEM career was significantly influenced by self-efficacy and identification with one's field [20]. A conceptual model of our prediction is shown in Figure 2. From this point, we use the terms physical and self-outcomes to refer to the expected physical and self-outcomes students anticipate when valuing diversity in engineering, respectively.

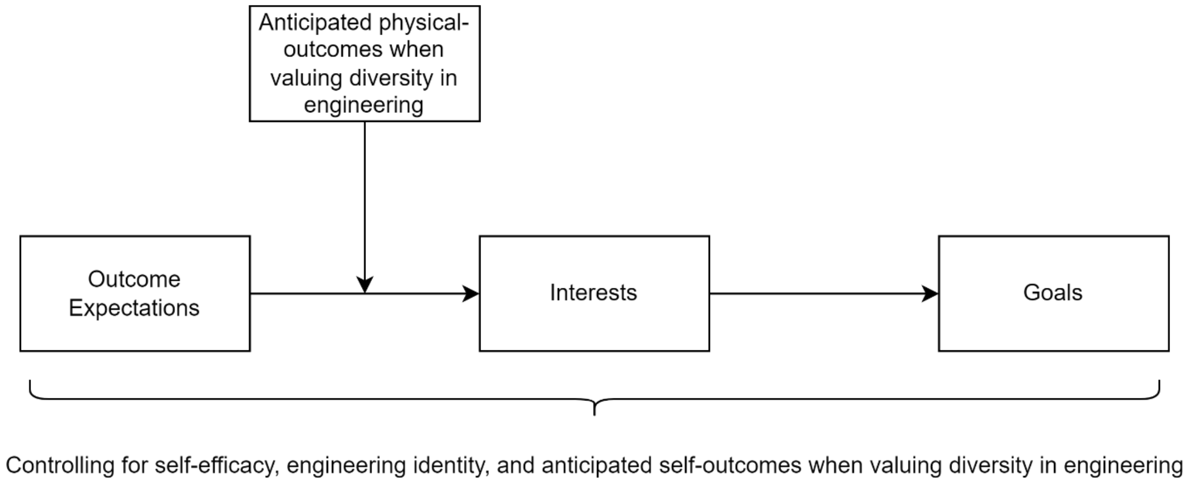


Figure 2. Conceptual model of the proposed conditional indirect effect of outcome expectations on goals through interests.

Table 1. Summary of the Social Cognitive Career Theory measures and variables.

Variable	Measurement Occasion	Construct Definition	Example Item	Items	Scale Range	α
Outcome Expectations	1	The anticipated consequences of earning a degree in engineering.	Students indicated the extent to which they agreed with statements such as, “Graduating with a BS degree in engineering will likely allow me to do work that I would find satisfying.”	3	1 (strongly disagree) to 7 (strongly agree)	.94
Self-efficacy	1	The degree of confidence a student holds in their ability to complete various task required to complete their engineering degree.	How much confidence do you have in your ability to excel in your engineering major over the next two semesters?	3	1 (no confidence) to 5 (complete confidence)	.86
Interests	2	The degree of interest in doing work related to engineering.	How much interest do you have in working on a project involving engineering principles?	3	1 (very low interests) to 5 (very high interest)	.85
Engineering Identity	1	The degree to which students identify themselves as an engineer.	Students indicated the extent to which they agreed with statements such as, "being an engineer is an important reflection of who I am."	4	1 (strongly disagree) to 7 (strongly agree)	.90
Goals	3	The extent to which students intend to persists in an engineering degree program.	Students indicated their level of agreement with statements such as, "I am fully committed to getting my college degree in engineering."	4	1 (strongly disagree) to 7 (strongly agree)	.89

Table 1 (Continued). Summary of the Value of Diversity in Engineering measures and variables.

Variable	Measurement Occasion	Construct Definition	Example Item	Items	Scale Range	α
Expected Physical-outcomes for valuing diversity in engineering	1	The extent to which students anticipate positive physical-outcomes when they value diversity in engineering such as improving business outcomes and serving customers.	Students indicated the extent to which extent they agreed with statements such as, "Engineers should value diversity in order to help them understand client and customer needs."	4	1 (strongly disagree) to 7 (strongly agree)	.87
Expected self-outcomes for valuing diversity in engineering	1	The extent to which students anticipate positive self-outcomes when they value diversity in engineering such as working for purpose and fairness in their work.	Students indicated their level of agreement with statements such as, "Engineers should value diversity in order to work for a greater cause."	4	1 (strongly disagree) to 7 (strongly agree)	.93

Table 2. Descriptive statistics and correlation matrix for the analytic sample (N = 125).

Variable	1	2	3	4	5	6	7
1. Goals	-						
2. [a]OEE	.63***	-					
3. [b]SE	.35***	.50***	-				
4. Interests	.60***	.66***	.38***	-			
5. Identity	.62***	.64***	.45***	.42***	-		
6. [c]Physical	.23*	.36***	.36***	.36***	.23**	-	
7. [d]Self	.16	.27***	.39***	.27***	.20***	.74***	-
M	5.53	5.73	3.68	4.01	4.99	6.10	5.93
SD	1.55	1.10	0.69	0.74	1.24	0.79	1.16
α	.89	.94	.86	.85	.90	.87	.93

[a]Outcome expectations for engineering; [b]Self-Efficacy; [b]Expected physical-outcomes for valuing diversity in engineering; [d]Expected self-outcomes for valuing diversity in engineering.
*Note: ***p < .001; **p < .01; *p < .05*

Methods

Participants and Procedures

All participants were from a large, land-grant institution in the Western United States enrolled in at least one of the following three introductory engineering courses: mechanical engineering, civil engineering, and a general engineering course that covered multiple engineering disciplines. All students were invited to participate via an online survey platform. Of approximately 350 students, 232 students responded to the survey (66% response rate). Among the students, 63% were male, 16.7% identified as a racial or ethnic minority, and 85% were in their first year. Most of the students in this study were mechanical engineering majors (33%), followed by civil (28%) and environmental (14%) engineering majors. Constructs were measured on three occasions—the eight (occasion one), twelfth (occasion two), and fifteenth week (occasion three) of the 15-week semester—establishing time precedence in the relationships among measures.

Measures

The SCCT measures were adapted from Lent et al. (2005, 2008) [7], [21]. The value of diversity measures was adapted from Rambo-Hernandez et al. (2021) [14]. Both scales have been previously used with populations of undergraduate engineering students and historically display psychometrically sound properties. All continuous measures were grand-mean-centered for analysis. Each measure is described in Table 1 (above). Table 1 provides the name of each measure, from which measurement occasion observations from each measure are used, an example item from each scale, the Likert scale range for each measure, and the empirical reliability. Summary statistics are provided in Table 2 (above). The top half of Table 2 displays the correlation matrix among observed measures, while the bottom of Table 2 displays the mean, standard deviation, and observed reliability for each measure.

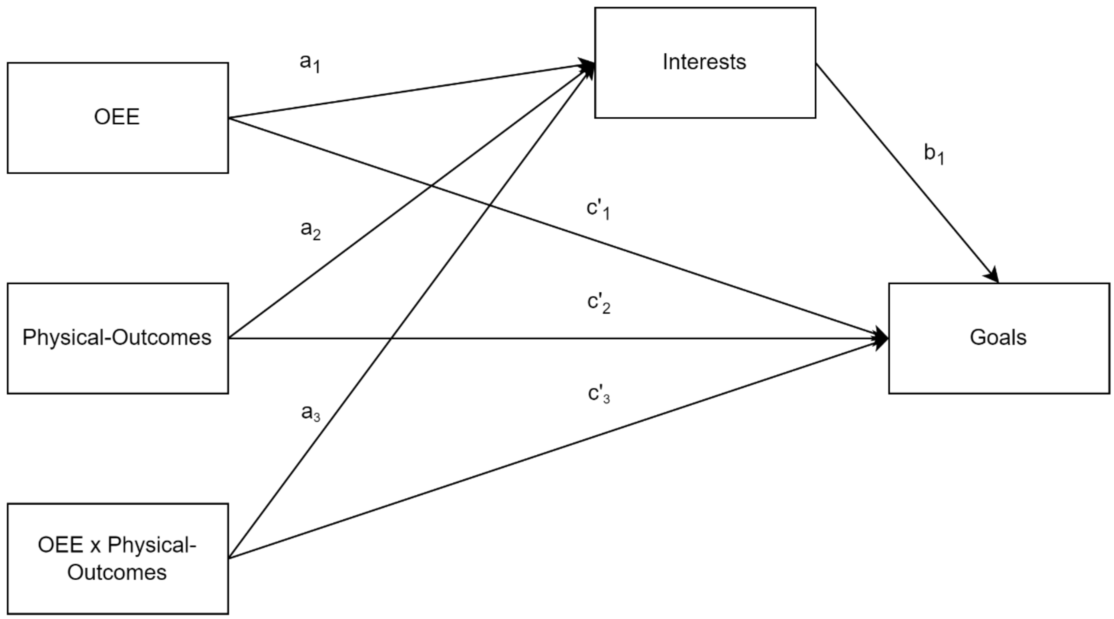
Missing Data

Missing data is common, especially in longitudinal studies. Missing rates in the current dataset ranged between 18-25% for a single measure, and 125 of the cases had complete data on all measurement occasions. Accordingly, the mechanism of missingness and the differences between observations with and without missing observations were investigated. Little's missing completely at random (MCAR) test was not statistically significant (χ^2 [26] = 27.59, p = .38). Conservatively, this is interpreted as indicating the data is likely missing at random (MAR) rather than MCAR. Further, independent samples *t*-tests found no differences between cases with and without missing observations. Therefore, listwise deletion was deemed appropriate.

Plan of Analysis

The purposes of this research were addressed by employing path modeling under a regression framework to test the conditional process model shown in Figure 3. Error terms and control variables were omitted from the figure for simplicity. In addition to the aforementioned control variables (self-efficacy, and self-outcome expectations), the squared value of engineering identity was included in each regression equation to appropriately model the underlying relationship between identity and the outcomes of interest.

Determination of the conditional indirect effect (θ) under examination followed established procedures for examining moderated mediation models [22], [23]. The indirect effect (θ) of OEE on goals though interests was determined using a product of coefficients strategy. As shown in Figure 3 equation 2, the effect of OEE on interest is moderated by physical-outcomes, and thus the magnitude of the a_1 path changes with physical-outcomes. Consequently, the indirect effect of OEE on goals becomes a function of physical-outcomes. Therefore, the magnitude and statistical significance of θ will be dependent on demonstrating the significance of the OEE x physical-outcomes path (a_3) and calculating the indirect effect at multiple values of the moderator, physical-outcomes. Here, the conditional indirect effect was analyzed at one standard deviation (SD) below the average (low), the mean, and one SD above the average (high) on physical-outcomes.



$$Interests_i = a_0 + a_1OEE_i + a_2Physical_i + a_3OEExPhysical_i \text{ [1]}$$

$$Interests_i = a_0 + a_2Physical_i + [a_1 + a_3Physical_i]OEE_i \text{ [2]}$$

$$Goals_i = b_0 + b_1Interests_i + \cdots \text{ [3]}$$

$$Conditional\ indirect\ effect\ (\theta) = f(\theta|Phsyical) = b_1(a_1 + a_3Physical) \text{ [4]}$$

Figure 3. Statistical model of the conditional indirect effect of OEE on goals through interests.

Analysis of the OEE by EXT Interaction

Determining the statistical significance for the moderation of the effect of OEE on interests by physical-outcomes was addressed using a model-building process. In Model 1, interest was regressed on OEE, physical-outcomes, and all control variables defined previously. Next, in Model 2, the interaction between OEE and physical-outcomes was added. The statistical significance of the interaction was determined by analyzing the change in variance explained, ΔR^2, between Model 1 and 2.

Analysis of the Conditional Indirect Effect

Products of coefficients are usually positively skewed and kurtotic. For this reason, bootstrapping procedures were used to determine the 95% CI of indirect effects [24]. The 95% confidence interval for θ at each level of physical-outcomes was determined using a bias-corrected bootstrapping technique with 10,000 replicates.

Results

Assumptions and Parameter Estimation

Models in the current study were estimated using ordinary least squares. All assumptions of multiple regression were determined to be tenable by analyzing residual-versus-predictor plots, density and Q-Q plots of residuals, and White's test for heteroskedasticity—which was nonsignificant (χ^2 [33] = 41.04, p = .16). Notably, although observations are nested within classrooms, the estimated intra-class correlation was practically zero for both the mediator (interests) and the outcome (goals). Therefore, clustering was not considered in the analysis.

Model Comparisons

Next, the model-building procedure described previously was performed (Table 3). Addition of the OEE by physical-outcomes interaction resulted in a statistically significant change in the variance explained (ΔF [1, 132] = 8.50, ΔR^2 = .037, p < .01). Given the statistical significance of the interaction term, Model 2 parameter estimates are examined further.

Table 3. Summary of Model Comparisons.

	R	R^2	ΔR^2	ΔF	*df1*	*df2*
Model 1	.675	.456	.456	16.63***	6	118
Model 2	.704	.495	.037	8.49**	1	117

*Note: *** p < .001; ** p < .01; * p < .05*

Table 4. Summary of Model 2 parameter estimates.

Source	*b*	*SE*	*95% CI*		*β*
			LL	*UL*	
[a]OEE, b_1	0.377	0.063	0.251	0.503	0.56
[b]Physical, b_2	0.223	0.099	0.027	0.419	0.24
OEExPhysical, b_3	0.174	0.059	0.056	0.292	0.21
[c]SE, b_4	0.034	0.088	-0.140	0.210	0.03
[d]ID, b_5	-0.020	0.057	-0.133	0.094	-0.03
ID^2, b_6	-0.020	0.022	-0.064	0.026	-0.07
[e]Self, b_7	0.003	0.064	-0.123	0.130	0.01
Intercept, b_0	-0.013	0.062	-0.136	0.109	-

[a]Outcome expectations for engineering; [b]Expected physical-outcomes for valuing diversity in engineering; [c]Self-Efficacy; [d]Identity; [e]Expected self-outcomes for valuing diversity in engineering.
Note: Outcome = Interests

Analysis of Model 2 Parameter Estimates

Overall, the predictors entered into Model 2 explained 49% of the variance in student interests (F [7, 117] = 16.37, R^2 = .495, p < .001). Inspection of the Model 2 parameter estimates revealed that both OEE and physical-outcomes were statistically significant predictors of student interests (b_1 and b_2 in Table 4, respectively). Further, the unstandardized parameter estimate for the OEE by physical-outcomes interaction (b_3, Table 4) was 0.17, meaning physical-outcomes enhance the relationship between OEE and interests. A simple slopes analysis (Figure 4) revealed that OEE was a moderately stronger predictor of student interests for students who anticipate greater physical-outcomes when valuing diversity in engineering than those with lower endorsement (partial η^2 = .068; 95% CI [.007, .168]).

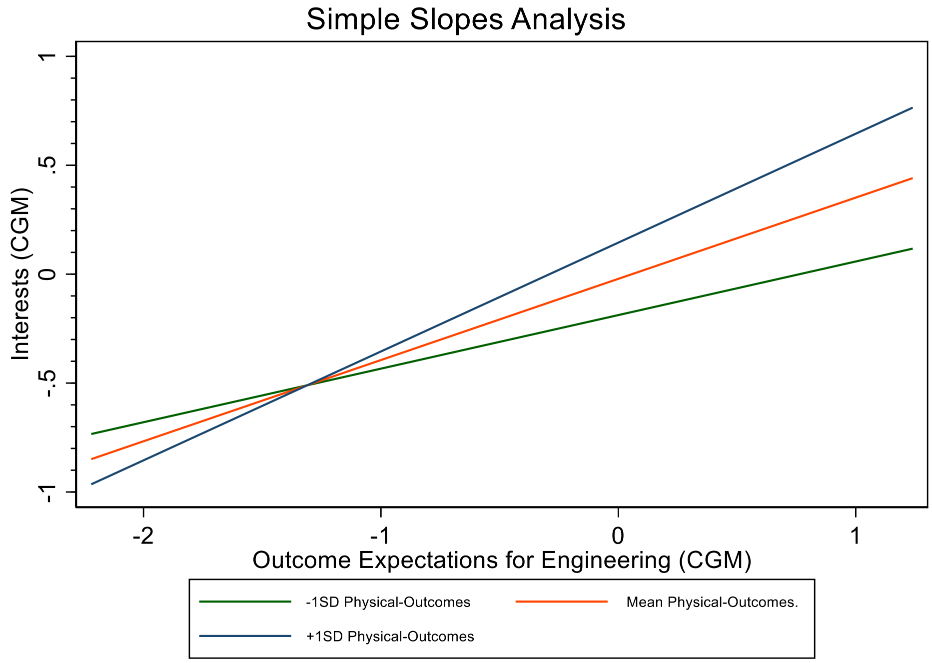


Figure 4. Simple slopes depicting the effect of OEE on Interests for students with low (-1SD), mean, and high (+1SD) anticipated physical-outcomes

Moderated Mediation Analysis

Mediation models were estimated to determine the conditional indirect effect of OEE on goals through interests. Table 5 displays the bootstrapped estimates and bias-corrected confidence intervals for the conditional indirect effect (θ). The mediation model (standardized solution) is shown in Figure 5. For clarity, control variables were removed from the figure. In this model, c designates standardized regression coefficients in the absence of the mediator (interests), and c' designates the standardized regression coefficients when the mediator is included. Note that given the path model is estimated under a regression framework, the model is just-identified. That is, fit measures that compare the model implied (co)variance and the observed (co)variance structure will not be informative—the observed (co)variance structure among the observed measures is perfectly recovered. Instead, the corresponding R^2 value and F test are reported for the mediator (interests) and the outcome (goals). As stated previously, 49% of the variance in student interests (F [7, 117] = 16.37, $R^2 = .495$, p < .001) was explained by OEE, physical-outcomes, the interaction between OEE and physical-outcomes, and all of the aforementioned control variables (not shown in diagrams for parsimony). Under the full mediation model (Figure 5), 57% of the variance in students' career-oriented goals was explained by interests, OEE, physical-outcomes, the interaction between OEE and physical-outcomes, and all of the aforementioned control variables (not shown in diagrams for parsimony), with F (8, 116) = 19.72, $R^2 = .576$, and $p < .001$.

In the absence of the mediator, interests, OEE was a significant predictor of goals while physical-outcomes were not. After including the mediator in the model, the path from OEE to goals becomes insignificant, indicating that interest fully mediates the effect of OEE on goals.

Bootstrapped estimates of the indirect effect of OEE on goals conditioned on physical-outcomes indicate that this indirect effect becomes stronger as anticipated physical-outcomes increases. The completely standardized indirect effect ranges from 0.11 (at -1SD on physical-outcomes) to 0.24 (at +1SD on physical-outcomes), a small to medium effect size.

Table 5. Summary of the Conditional Indirect Effects of OEE on Goals through Interests within levels of expected physical-outcomes for valuing diversity in engineering.

EXT Level	*Bootstrap point estimate (unstandardized)*	*SE*	*[a]95% CI*	
			LL	*UL*
Low (-1SD)	.153	.072	.038	.329
Mean	.235	.071	.117	.410
High (+1SD)	.318	.094	.159	.542

[a] Bias-corrected

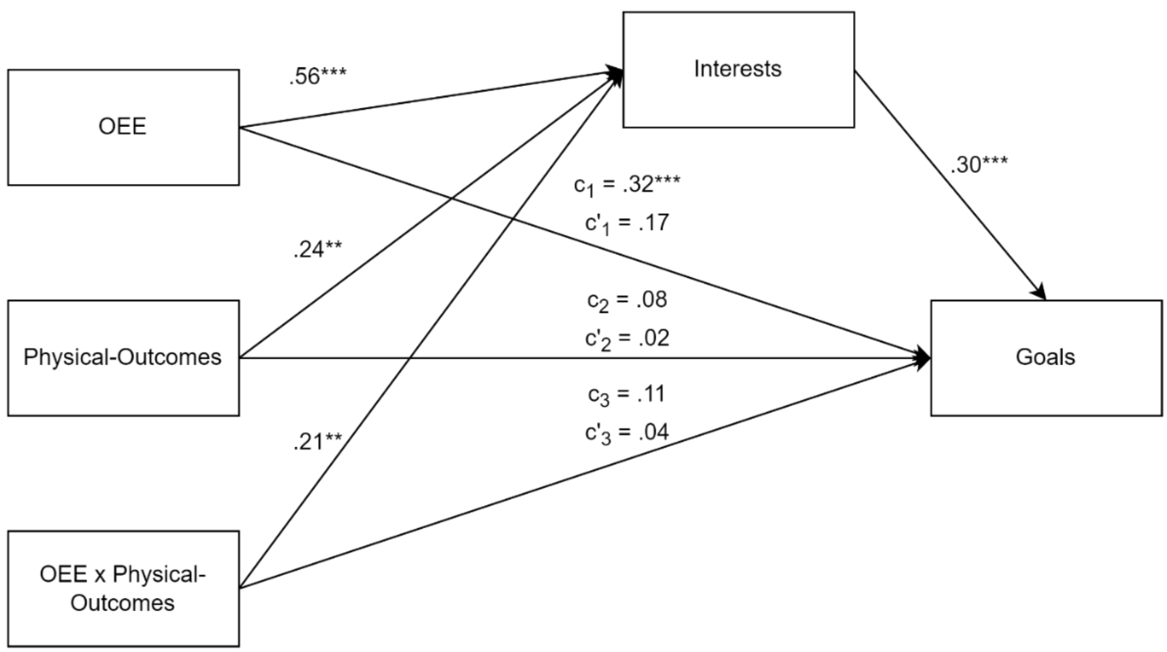


Figure 5. Mediation model displaying the standardized solution. *** p < .001; ** p < .01; * p < .05.

Discussion

The current study extends the SCCT literature by examining the extent to which anticipated physical-outcomes associated with valuing diversity in engineering moderated the indirect effect of outcome expectations on students' intentions to persist theorized in the SCCT [11]. The emergence of this conditional indirect effect has practical implications for engineering education and the application of the SCCT model more broadly.

Students' interest in their work and degree programs influence career-oriented decisions such as persisting through a degree program [11]. The current study suggests anticipated physical-outcomes associated with valuing diversity in engineering moderately enhance the relationship between outcome expectations and interests and, in turn, may increase persistence. Therefore, incorporating diversity-focused curricula may be a practical way to increase students' interest in their engineering degree program and promote students' intentions to persist.

This study also diverges from Lent et al.'s (2008) [7] longitudinal study that finds no temporal effect of outcome expectations on interests. Interestingly, the temporal effect of outcome expectations on interest is posited under the original conception of the SCCT [11]. One possibility for this divergence is the failure of current measures to fully conceptualize outcome expectations, leading to inconsistent results regarding the role of outcome expectations [12]. Alternatively, positive physical outcome expectations—like those assessed in Lent et al.'s (2008) [7] study and here—alone may not fully explain the relationship between outcome expectations and interests. Regardless, this study highlights the potential importance of a more complete conceptualization of outcome expectations. Failure to do so may obscure true effects and the role of outcome expectations.

Conclusion

The current study elaborates on the role of values, an aspect of outcome expectations often ignored, in influencing engineering students' intentions to persist in their degree programs. Specifically, the role of anticipated physical-outcomes associated with valuing diversity in engineering was examined. The endorsement of these values was associated with higher levels of interest and increased intentions to persist. Therefore, engineering curricula highlighting the personal importance of diversity may serve many practical purposes related to promoting students' short terms goals to persist in engineering.

Acknowledgements

This work was supported by the NSF IUSE (Improving Undergraduate STEM Education) funded, Partnership for Equity (P4E) project (NSF award numbers: 1725880 & 2033129).

References

[1] H.A. Valantine and F. S. Collins, “National Institutes of Health addresses the science of diversity,” *PNAS*, vol. 112, no. 40, pp 12240-12242, Oct. 2015.

[2] S. Fayer, A. Lacey, and A. Watson, “STEM occupations: Past, present, and future,” *Spotlight on Statistics*, vol. 1, pp. 1-35, Jan. 2017.

[3] B. Khan, C. Robbins, and A. Okrent, “Science and engineering indicators 2020: The state of U.S. science and engineering,” *Science & Engineering Indicators, NSB-2020-1*, Jan. 2020.

[4] Committee on Prospering in the Global Economy of the 21st Century, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. Washington, DC: National Academies Press, 2007.

[5] X. Chen, “STEM Attrition: College Students' Paths into and out of STEM Fields,” *Statistical Analysis Report, NCES 2014-001*, Nov. 2013.

[6] E. Litzler and J. Young, “Understanding the risk of attrition in undergraduate engineering: Results from the project to assess climate in engineering,” *Journal of Engineering Education*, vol. 101, no. 2, pp. 319-345, Apr. 2012.

[7] R. W. Lent, H. B. Sheu, D. Singley, J. A. Schmidt, L. C. Schmidt, and C. S. Gloster, “Longitudinal relations of self-efficacy to outcome expectations, interests, and major choice goals in engineering students,” *Journal of Vocational Behavior*, vol. 73, no. 2, pp. 328-335, Oct. 2008.

[8] R. L. Navarro, L. Y. Flores, H. S. Lee, and R. Gonzalez, “Testing a longitudinal social cognitive model of intended persistence with engineering students across gender and race/ethnicity,” *Journal of Vocational Behavior*, vol. 85, no. 1, pp. 146-155, Aug. 2014.

[9] A. Bandura, "Human agency in social cognitive theory," *American Psychologist*, vol. 44, no. 9, pp. 1175-1184, Sep. 1989.

[10] A. Bandura and D. Cervone, "Differential engagement of self-reactive influences in cognitive motivation," *Organizational Behavior and Human Decision Processes*, vol. 38, pp. 92-113, Aug. 1986.

[11] R. W. Lent, S. D. Brown and G. Hackett, "Toward a unifying social cognitive theory of career and academic interest, choice, and performance," *Journal of Vocational Behavior*, vol. 45, no. 1, pp. 79-122, Aug. 1994.

[12] N. A. Fouad and A. Guillen, "Outcome expectations: Looking to the past and potential future," *Journal of Career Assessment*, vol. 14, no. 1, pp. 130-142, Feb. 2006.

[13] R. W. Lent and S. Brown, "On conceptualizing and assessing social cognitive constructs in career research: A measurement guide," *Journal of Career Assessment*, vol. 14, no. 1, pp. 12-35, Feb. 2006

[14] K. E. Rambo-Hernandez et al., “Valuing diversity and enacting inclusion in engineering (VDEIE): Validity evidence for a new scale,” *IJEE*, vol. 37, no. 5, pp. 13, May 2021.

[15] B. D. Jones, M. C. Paretti, S. F. Hein and T. W. Knott, "An analysis of motivation constructs with first-year engineering students: Relationships among expectancies, values, achievement, and career plans," *Journal of Engineering Education*, vol. 99, no. 4, pp. 319-336, Oct. 2010.

[16] J. F. Domene, K. D. Socholotiuk and L. A. Woitowicz, "Academic motivation in post-secondary students: Effects of career outcome expectations and type of aspiration," *Canadian Journal of Education*, vol. 31, no. 1, pp. 99-127, 2011.

[17] R. W. Lent, S. D. Brown, J. Schmidt, B. Brenner, H. Lyons and D. Treistman, "Relation of contextual supports and barriers to choice behavior in engineering majors: Test of alternative social cognitive models," *Journal of Counseling Psychology*, vol. 50, no. 4, pp. 458-465, Oct. 2003.

[18] R. W. Lent, M. J. Miller, P. E. Smith, B. A. Watford, R. H. Lim and K. Hui, "Social cognitive predictors of academic persistence and performance in engineering: Applicability across gender and race/ethnicity," *Journal of Vocational Behavior*, vol. 94, June 2016.

[19] R. Stevens, K. O'Conner, L. Garrison, A. Jocuns, D. M. Amos, "Becoming an engineer: Toward a three dimensional view of engineering learning," *Journal of Engineering Education*, vol. 97, no. 3, pp. 355-368, July 2008.

[20] M. Syed, E. L. Zubriggen, M. M. Chemers, B. K. Goza, S. Bearman, F. J. Crosby … and E. M. Morgan, "The Role of Self-Efficacy and Identity in Mediating the Effects of STEM Support Experiences," *Analyses of Social Issues and Public Policy*, vol. 19, no. 1, pp. 7-49, Dec. 2019.

[21] R. W. Lent, S. D. Brown, H.-B. Sheu, J. Schmidt, B. R. Brenner, C. S. Gloster … and D. Treistman, "Social cognitive predictors of academic interested and goals in engineering: Utility for women and students and historically black universities," *Journal of Counseling Psychology*, vol. 52, no. 1, pp. 84-92, Jan. 2005.

[22] K. J. Preacher, D. D. Rucker, and A. F. Hayes, “Addressing moderated mediation hypotheses: Theory, methods, and prescriptions,” *Multivariate Behavioral Research*, vol. 42, no. 1, pp. 185-227, June 2007.

[23] A. F. Hayes, “An index and test of linear moderated mediation,” *Multivariate Behavioral Research*, vol. 50, no. 1, pp. 1-22, Jan. 2015.

[24] K. A. Bollen, and R. Stine, “Direct and indirect effects: Classical and bootstrap estimates of Variability,” *Sociological Methodology*, vol. 20, pp. 115-140, Jan. 1990.

Author Response to Reviewers

First, I would like to thank all of the reviewers who provided thoughtful feedback on the study above. Below, I briefly detail how reviewer concerns were addressed and respond to a few of the reviewers' questions.

One of the concerns among reviewers was that the connection between physical and self-outcomes and students' perceived value of diversity in engineering was unclear. This has been briefly addressed in the introduction with the addition of a few examples of both physical and self-outcomes associated with students' perceived value of diversity within the engineering profession. Second, there were also concerns regarding the link between self-efficacy and identity to the expanded SCCT model. Additional details have been added to the current study to further support the importance of these psychosocial factors in the estimated models. Third, reviewers pointed out that the data collection procedures, measures, and accompanying tables were not fully explained. Additional details regarding the sample and survey procedures have been added. The explanation of Tables 1 and 2 have also been expanded. Fourth, one reviewer pointed out that measures are never validated and asked that we update our wording to more accurately reflect the dynamic process of the fair and valid use of psychological measures. We completely agree and have updated our language. Fifth, one reviewer pointed out that certain claims in the discussion/conclusion may not be warranted. We updated the language in these sections to temper our interpretations of the findings and made them more consistent with the estimated model.

Additionally, reviewers had comments and questions regarding the statistical analysis. One reviewer asked for effect size information regarding the statistically significant interaction effect. To address this, the partial eta squared associated with the interaction coefficient has been added (in addition to the standardized coefficient found in Table 4). Reviewers also had concerns regarding the use of list-wise deletion, power, and the exclusion of model fit statistics. While list-wise deletion may reduce power in a study, the current study was not underpowered to find the conditional indirect effect in question. Monte Carlo power analyses reveal that our achieved power when estimating the indirect effect of outcome expectations on goals was generally greater than .8 in the estimated model (see Schoemann, A. M., Boulton, A. J., & Short, S. D. (2017). Determining power and sample size for simple and complex mediation models. *Social Psychological and Personality Science, 8*(4), 379-386. https://doi.org/10.1177/19485506177150680). List-wise deletion is also warranted given that missing data were consistent with a random process, and parameter estimates should be unbiased under this condition (see Little, R. J. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association, 83*(404), 1198-1202; Enders, C. K. (2010). *Applied missing data analysis*. Guilford press). However, we would agree that there are more appropriate ways to model the data (e.g., a cross-lagged panel model). Unfortunately, we would not have a sufficient sample size to estimate such a model. Last, model fit statistics, including the chi-square test of exact fit, RMSEA, CFI, and SRMR, are not reported because all of the models are just-identified. We clarify in the text that the path models presented are estimated under a regression framework. Therefore, we provide additional details regarding model fit using the total variance in the outcome explained as well as the accompanying F test. Last, reviewers asked that the modeling procure be clarified. Additional details regarding the modeling procedure were added in the plan of analysis and results to further clarify the path modeling process and the specification of each regression equation.