Men of Color in STEM in the Community College from a Non-Cognitive Perspective: An Analysis of the Effect of Race and Generational Status

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This exploratory study sought to determine whether differences exist in students' non-cognitive make-up based on race/ethnicity and generational status, while controlling for the effects of GPA. Data utilized in this study were derived from the CCSM$^{©}$. This dataset was delimited to a sample of men in STEM majors from 17 select two-year, degree-granting institutions (N=558). Analyses were conducted using a one-way (1x3) ANOVA and a two-way (2x3) factorial ANCOVA. Findings from this study indicated significant differences based on race for three variables. The results of this study indicated that Latino students had significantly higher levels of locus of control than White students; Black students had significantly higher levels of action control than White and Latino students; and Black students had significantly higher levels of intrinsic interest than White students.

INTRODUCTION

Promoting success in *science*, *technology*, *engineering* and *mathematics* (STEM) is a national priority to ensure American competitiveness in the 21st Century global economy. The growth in STEM jobs from 2000-2010 was three times as fast as growth in non-STEM jobs over the same time period. STEM occupations are projected to continue to grow at an accelerated pace (Langdon, et al., 2011; Rodriguez-Kiino, 2014). However, this vital growth has given rise to a "new" American dilemma (NACME, 2008), noting that traditionally underrepresented

minorities (URMs)[1], which account for 31.7% of the U.S. population in the 2010 U.S Census, are underrepresented in the STEM workforce, only 13%, yet they are also the fastest growing group (NSF/NCSES, 2013). Adding to this dilemma, URMs are also underrepresented in the STEM education pipeline (Wang, 2013) as American colleges and universities struggle to produce diverse, qualified graduates to fill the labor shortage in high skilled, high-paying STEM occupations (Rodriguez-Kiino, 2014).

Community colleges serve as the central pathway for URMs into postsecondary education (Nevarez & Wood, 2010). With open access policies and low tuition costs, community colleges have a critical role in enhancing the STEM pipeline via student transfer to baccalaureate-granting institutions. However, access does not necessarily translate into academic achievement (Wood & Harris, 2013). As demonstrated in a report by the Higher Education Research Institute (Hurtado, et al., 2010), Latina/o and Black students were significantly less likely to attain a STEM bachelor's degree within five years, at 22.1% and 18.4%, compared to White and Asian students, at 33% and 42%, respectively. Moreover, Latinos and Black males complete community college degrees and certificates at disproportionately low rates relative to all other student groups, including women of color (CCCSE, 2014). Additionally, U.S. Department of Education Statistics (2009) noted that only 26.5% of transfer-track community college men of color successfully transfer within a six-year time frame.

The disengagement and underachievement of men of color have produced a national concern for understanding and meeting their needs for success in higher education, particularly in community colleges (Wood & Harris, 2013). Focused on STEM students in community colleges and comparing men of color to White males, this exploratory study sought to determine whether differences exist in students' non-cognitive make-up based on race/ethnicity and generational status, while controlling for the effects of GPA. Non-cognitive, intrapersonal factors include self-efficacy, locus of control, degree utility, action control and intrinsic interest. This study is significant as it represents one of the few studies in existence that focus on Black and Latino men in STEM in community colleges. Moreover, this study also advances prior research by examining factors influencing non-cognitive outcomes for these men. The next section addresses the theoretical framework used in this study.

RELEVANT LITERATURE

The theoretical framework employed in this study is Harris and Wood's (2014) Socio-Ecological Outcomes (SEO) model (See Appendix A). The SEO model attributes the success of men of color in community college to four primary, interrelated, socio-ecological domains. These domains include the non-cognitive domain (e.g. intrapersonal outcomes, identity); academic domain (e.g. faculty-student interaction, academic service usage); environmental domain (e.g. familial obligation, employment, stressful life events); and campus ethos domain (e.g. faculty/staff validation, climate of belonging). Leading to student success, Harris and Wood (2014) postulated that the non-cognitive domain interacts with the academic domain, with each domain also being simultaneously affected by the environmental and campus ethos domains. The four domains are influenced by two primary factors, student input characteristics (e.g., age, time status, generation status) and societal factors (e.g., racism, economic pressures).

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[1] Underrepresented minorities (URMs) include African Americans, Latinos and Native Americans.

Based on the SEO model, the study explored how input factors, particularly race and generation status, influenced non-cognitive factors that have been associated with greater student achievement. As demonstrated by extensive research, non-cognitive variables are significant predictors of student outcomes such as persistence, achievement, and educational attainment (e.g., Aguayo, Herman, Ojeda & Flores, 2011; Bong, 2001; Choi, 2005; Gore, 2006, Majer, 2009; Zimmerman, 2000). Moreover, for men of color, the distinct effects of these factors on student success outcomes have also be shown in prior research (e.g., Cole & Espinoza, 2009; Palmer & Wood, 2012; Saenz & Ponjuan, 2009; Strayhorn, 2012). Factors in the non-cognitive domain "capture students' perceptions of their educational experiences and the corresponding affective responses," e.g. emotions, feelings (Wood & Harris, 2013, p. 3). Specifically, this study focused on the five non-cognitive intrapersonal factors in the SEO model, including:

- Self-efficacy: The confidence and perceived ability of students for completing academic coursework successfully (Torres & Solberg, 2001; Solberg, et al., 1993)
- Locus of control: Students' personal sense of control of their behaviors and lives (Faison, 1993). In the context of this study, academic focused locus of control was examined.
- Degree utility: The perception by students of the anticipated usefulness of their collegiate endeavors (Bean & Metzner, 1985; Mason, 1998).
- Action control: The ability of students to regulate behavior, deliver a sustained level of effort, and persevere in the face of difficulties (Barber, 2011).
- Intrinsic interest: The genuine personal interests of students and authentic enjoyment in learning academic subject matter.

Guided by the SEO model, the next section explicates the methods employed in this study.

METHODS

Data utilized in this study were derived from the Community College Survey of Men (CCSM©). Designed by the Minority Male Community College Collaborative (M2C3), the CCSM is a comprehensive, institutional-level assessment tool for examining factors affecting the success of historically underrepresented and underserved men in community colleges. Overall, the CCSM has been employed with over 7,000 men at 40 community colleges throughout the country. This dataset was delimited to a sample of men in STEM majors from 17 select two-year, degree-granting institutions (N=558). STEM majors reflected in this study are consistent with the NSF STEM Classification of Instructional Programs Crosswalk (2014).

The non-cognitive outcome variables were self-efficacy (four items, α=.898), locus of control (four items, α=.862), degree utility (four items, α=.864), action control (four items, α=.904) and intrinsic interest (four items, α=.866). The effects of race and generational status were examined. The independent variable 'race' had three levels, White, Black, and Latino, while generational status had two levels, first generation college student and non-first generation. Additionally, college GPA was employed as a covariate.

First, validating the assumption that White males achieve at higher rates than men of color, a one-way (1x3) analysis of variance (ANOVA) was conducted with race as the independent variable and GPA as the outcome variable. Second, the data were analyzed using a two-way (2x3) factorial analysis of covariance (Factorial ANCOVA). After partialling out the

effects of GPA, separate models were generated for each outcome variable. GPA was controlled to isolate the effect of race on the non-cognitive outcomes. Custom models were developed to test the homogeneity of regression slopes assumption. Exploratory analyses also examined normality and homogeneity of variance assumptions. Effect sizes were interpreted using partial eta squared (partial n^2) and R^2 for the full model. Partial n^2 effect sizes of .01, .06 and .14 were interpreted as small, medium and large, respectively (Green & Salkind, 2009). Expectation maximization was used to replace missing values. All post-hoc tests were evaluated at .05, with Bonferroni corrections employed to adjust for potential Type I errors.

RESULTS

Two analyses yielded little interpretable information. The first Factorial ANCOVA for self-efficacy violated the assumption of homogeneity of variance, ($F=3.827$, p<.01). While the analysis for degree utility satisfied this assumption, the main effects for race ($F=.865$, p=n.s.) and generational status ($F=.125$, p=n.s.) were not significant, nor was the interaction effect, $F=.280$, p=n.s. However, the remaining analyses provided insight into the role that race and generation status have on non-cognitive outcomes.

The third Factorial ANCOVA examined whether there were significant differences in locus of control. The main effect for race was significant, $F=3.438$, p<.05. However, the main effect for generational status was not significant, $F=.150$, p=n.s. The partial n^2 indicated that race accounted for 1.2% of the variance in the outcome, this is a small effect. Additionally, the interaction effect for race and generational status on the outcome was also not significant, $F=.661$, p=n.s. Pairwise comparisons for race indicated that Latino students had greater mean scores (by .926) than White students. This difference was significant, p<.05 (see Figure 1).
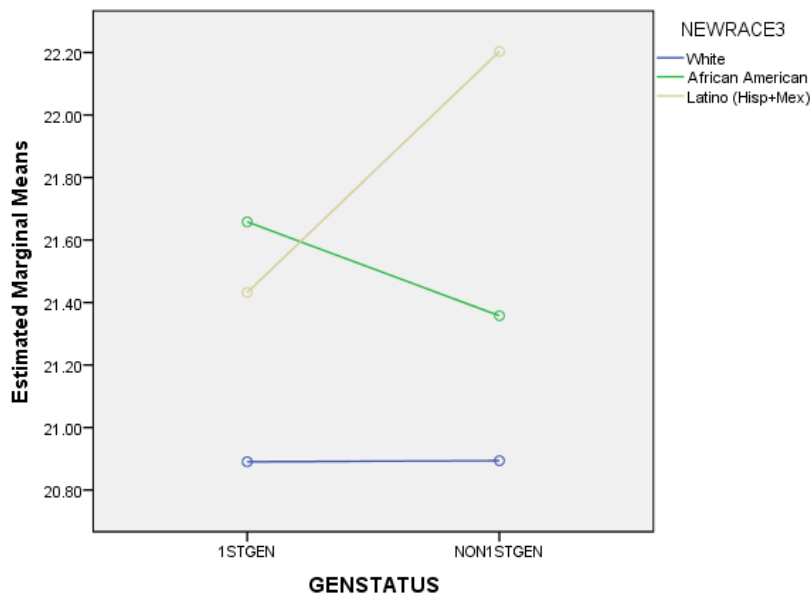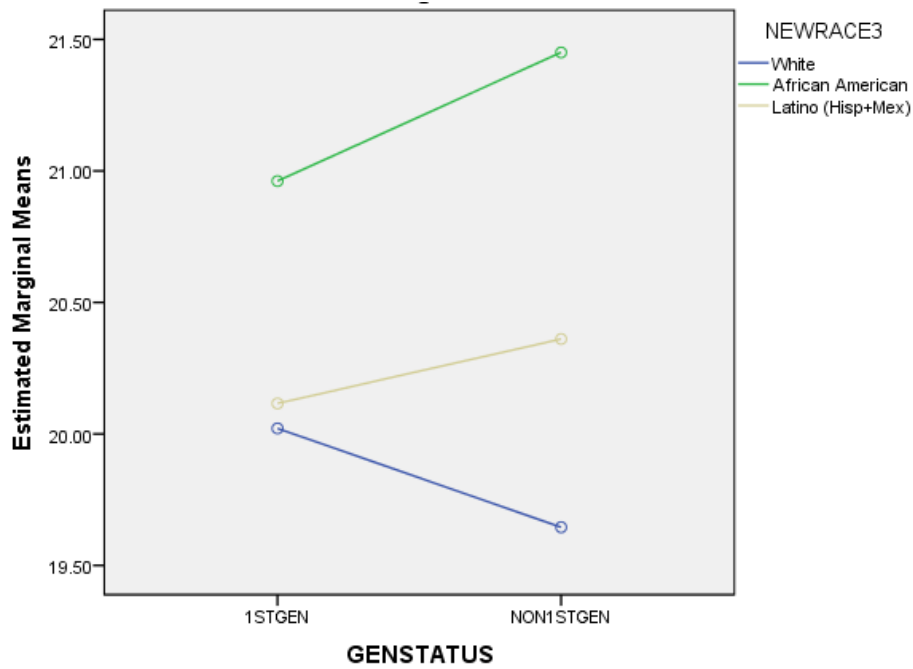

Figure 1. Estimated marginal means of locus of control
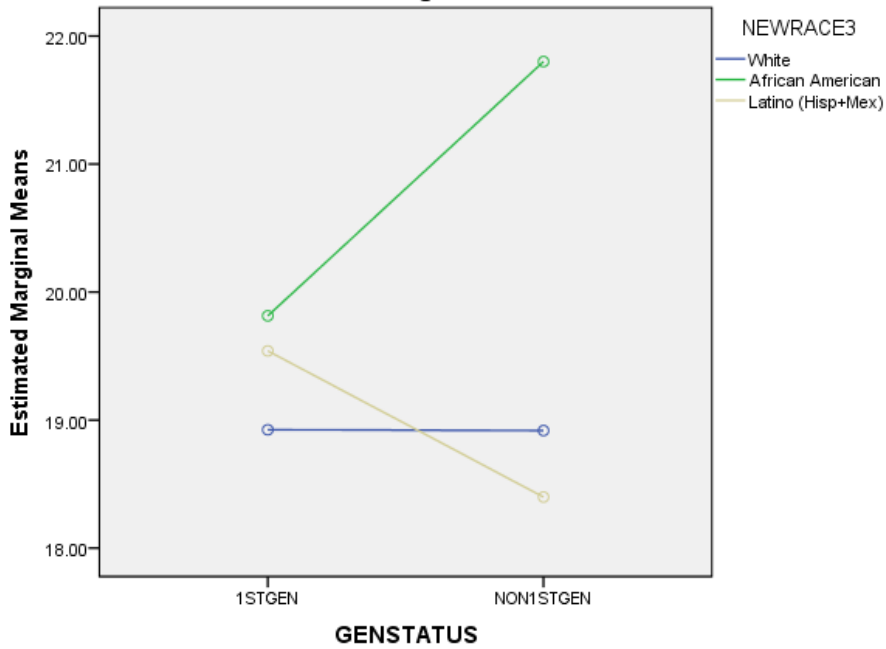
Figure 2. Estimated marginal means of action control

Figure 3. Estimated marginal means of intrinsic interest

The fourth Factorial ANCOVA analysis examined whether there were significant differences in action control. The main effect for race was significant, $F=5.165$, p<.01. However, the main effect for generational status was not significant, $F=.372$, p=n.s. The partial n^2 indicated that race accounted for 1.9% of the variance in the outcome, this is a small effect. Additionally, the interaction effect for race and generational status on the outcome was also not significant, $F=2.837$, p=n.s. Pairwise comparisons for race indicated two significant differences across the factor. African American students had greater mean scores (by 1.886) than White students. This difference was significant, p<.01. African American students also had greater mean scores (by 1.838) than Latino students, p<.05 (see Figure 2).

The fifth Factorial ANCOVA examined whether there were significant differences in intrinsic interest. The main effect for race was significant, $F=3.298$, p<.05. However, the main effect for generational status was not significant, $F=.079$, p=n.s. The partial n^2 indicated that race accounted for 1.2% of the variance in the outcome, this is a small effect. Additionally, the interaction effect for race and generational status on the outcome was also not significant, $F=.560$, p=n.s. Pairwise comparisons for race indicated one significant difference across the factor. African American students had greater mean scores (by 1.373) than White students. This difference was significant, p<.05 (see Figure 3).

DISCUSSION

As previously discussed, this study focused on men of color in STEM in community colleges and sought to determine whether differences exist in students' non-cognitive make-up based on race and generational status, while controlling for the effects of GPA. Specifically, this study focused on the five non-cognitive intrapersonal factors in Harris and Wood's (2014) SEO model. The series of 2x3 Factorial ANCOVA's, conducted for each of the non-cognitive outcome variables, indicated significant differences based on race alone for three variables (e.g., locus of control, action control and intrinsic interest).

Based on the results of the Factorial ANCOVA results for race, Latino students had significantly higher levels of locus of control than White students; Black students had significantly higher levels of action control than White and Latino students; and Black students had significantly higher levels of intrinsic interest than White students. These differences in levels were evidenced by "small" effect sizes, according to partial n^2, across the three analyses.

No significant differences were found for the effects of generational status or the interaction of race and generational status. While controlling for GPA, the results of this study indicate that the non-cognitive makeup of Black, Latino and White males is statistically similar across generational status and any combination of race and generational status. The next section discusses the implications and conclusions resulting from these outcomes.

IMPLICATIONS & CONCLUSIONS

The results identified in this study have direct implications for practice. While it is recommended that colleges build on the student's personal and cultural assets, this study highlights an opportunity to increase the success of men of color by enhancing their sense of locus of control, action control and intrinsic interest. As indicated by the results of this study, Latino and Black males had significantly higher levels for these non-cognitive, intrapersonal outcomes, as compared to their White male peers. These non-cognitive factors have been

demonstrated as significant predictors of student success outcomes, and they are especially critical assets for men of color, who are underrepresented in STEM majors and may face active stereotyping in the academic environment. Illustrating the significance of this outcome, prior research by Moore (2000) has shown that enhanced locus of control enables men of color to overcome racialized environments. In Moore's study, Black males in engineering majors developed coping mechanisms contributing to an increased locus of control to overcome stereotype threat and achieve personal academic goals.

In closing, the national focus on developing a skilled STEM workforce has precipitated an urgency for engaging, educating and graduating underrepresented minorities, especially men of color, via a STEM educational pipeline. This study has provided a non-cognitive lens for understanding the educational experiences of Black and Latino men in STEM in community colleges. The insight gained from this study is essential to the informed decision making that is necessary for providing effective and equitable educational opportunities for an increasingly diverse citizenry.

REFERENCES

Aguayo, D., Herman, K., Ojeda, L. & Flores, L. Y. (2011). Culture predicts Mexican American's college self-efficacy and college performance. *Journal of Diversity in Higher Education, 4*(2), 79-89.

Allen-Ramdial, S. A and Campbell, A. G. (2014). Reimagining the Pipeline: Advancing STEM Diversity, Persistence, and Success. *BioScience*, *64*(7), 612-618.

Aronson, J., Fried, C. B., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology*, *38*(2), 113-125.

Barber, B. (2011). Characteristics of students placed in college remedial mathematics: Using the ELS 2002/2006 data to understand remedial mathematics placement (unpublished doctoral dissertation). Arizona State University.

Bean, J. P. & Metzner, B. S. (1985). A conceptual model of nontraditional undergraduate student attrition. *Review of Educational Research, 55*(4), 485-540.

Bong, M. (2001). Role of self-efficacy and task-value in predicting college students' course performance and future enrollment intentions. *Contemporary Educational Psychology, 26*(4), 553-570.

CCSM (2014). Overview of the CCSM. *Minority Male Community College Collaborative*. Retrieved from http://interwork.sdsu.edu/sp/m2c3/the-ccsm-project/ccsm/

Center for Community College Student Engagement. (2014). Aspirations to achievement: Men of color and community colleges (A special report from the Center for Community College Student Engagement). Austin, TX: The University of Texas at Austin, Program in Higher Education Leadership.

Choi, N. (2005). Self-efficacy and self-concept as predictors of college students' academic performance. *Psychology in the Schools, 42*, 197-205.

Cole, D. G., & Espinoza, A. (2009). When gender is considered: Racial ethnic minority students in STEM majors. *Journal of Women and Minorities in Science and Engineering, 15*(3), 263–277

Faison, A. C. (1993). *The effect of autonomy and locus-of-control on the academic achievement of Black male community college students* (doctoral dissertation). Available from ProQuest Dissertations and Theses Database (UMI No. 9315460).

Gore, P. A. (2006). Academic self-efficacy as a predicator of college outcomes: Two incremental validity studies. *Journal of Career Assessment*, *14*, 92-115.

Green, S. B. & Salkind, N. J. (2009). Using SPSS for Windows and Macintosh: Analyzing and understanding data (5th ed.). Upper Saddle River, NJ: Pearson.

Harris III, F., & Wood, J. L. (2014, April 5). The socio-ecological outcomes model. Paper presented at the annual meeting of the Council for the Study of Community Colleges, Washington, DC.

Hurtado, S., Eagan, K., & Chang, M. (2010). Degrees of success: Bachelor's degree completion rates among initial stem majors. Higher Education Research Institute at UCLA, January.

Langdon, D., McKittrick, G., Beede, D., Khan, B., & Doms, M. (2011). STEM: Good Jobs Now and for the Future. ESA Issue Brief# 03-11. US Department of Commerce. Retrieved from http://eric.ed.gov/?id=ED522129.

Majer, J. M. (2009). Self-efficacy and academic success among ethnically diverse first-generation community college students. *Journal of Diversity in Higher Education, 2*(4), 243-250.

Mason, H. P. (1998). A persistence model for African American male urban community college students. *Community College Journal of Research and Practice, 22*(8), 751-760.

Moore, J.L. III. (2000). The persistence of African American males in the college of engineering at Virginia Tech. Unpublished doctoral dissertation, Virginia Polytechnic Institute and State University.

National Action Council for Minorities in Engineering (2008). *Confronting the "New" American Dilemma, Executive Summary*

National Science Foundation, National Center for Science and Engineering Statistics (2013). *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2013*. Special Report NSF 13-304. Arlington, VA. Available at http://www.nsf.gov/statistics/wmpd/2013/pdf/nsf13304_full.pdf

Nevarez, C., & Wood, J. L. (2010). *Community College Leadership and Administration: Theory, Practice, and Change* (Vol. 3). New York: Peter Lang.

NSF STEM Classification of Instructional Programs Crosswalk - Louis Stokes Alliances for Minority Participation - 2014. (n.d.). Retrieved July 25, 2014, from https://www.lsamp.org/help/help_stem_cip_2010.cfm.

Palmer, R., & Wood, J. L. (Eds.). (2012). *Black men in college: Implications for HBCUs and beyond*. New York, NY: Routledge.

Rodriguez-Kiino, D. (2014). The Role of the Community College in Leveling the Playing Field: Underrepresented Racial and Ethnic Minorities in Science, Technology, Engnering and Math. In J. L. Wood, & R. T. Palmer, *STEM Models of Success: Programs, Policies and Practices in the Community College* (pp. 1-26). Charlotte: Information Age Publishing.

Saenz, V. B., & Ponjuan, L. (2009). The vanishing Latino male in higher education. *Journal of Hispanics in Higher Education, 8*(1), 54–89.

Solberg, V. S., O'Brien, K., Villareal, P., Kennel, R. & Davis, B. (1993). Self-efficacy and Hispanic college students: Validation of the College Self-efficacy Inventory. *Hispanic Journal of the Behavioral Science, 15*, 80-95.
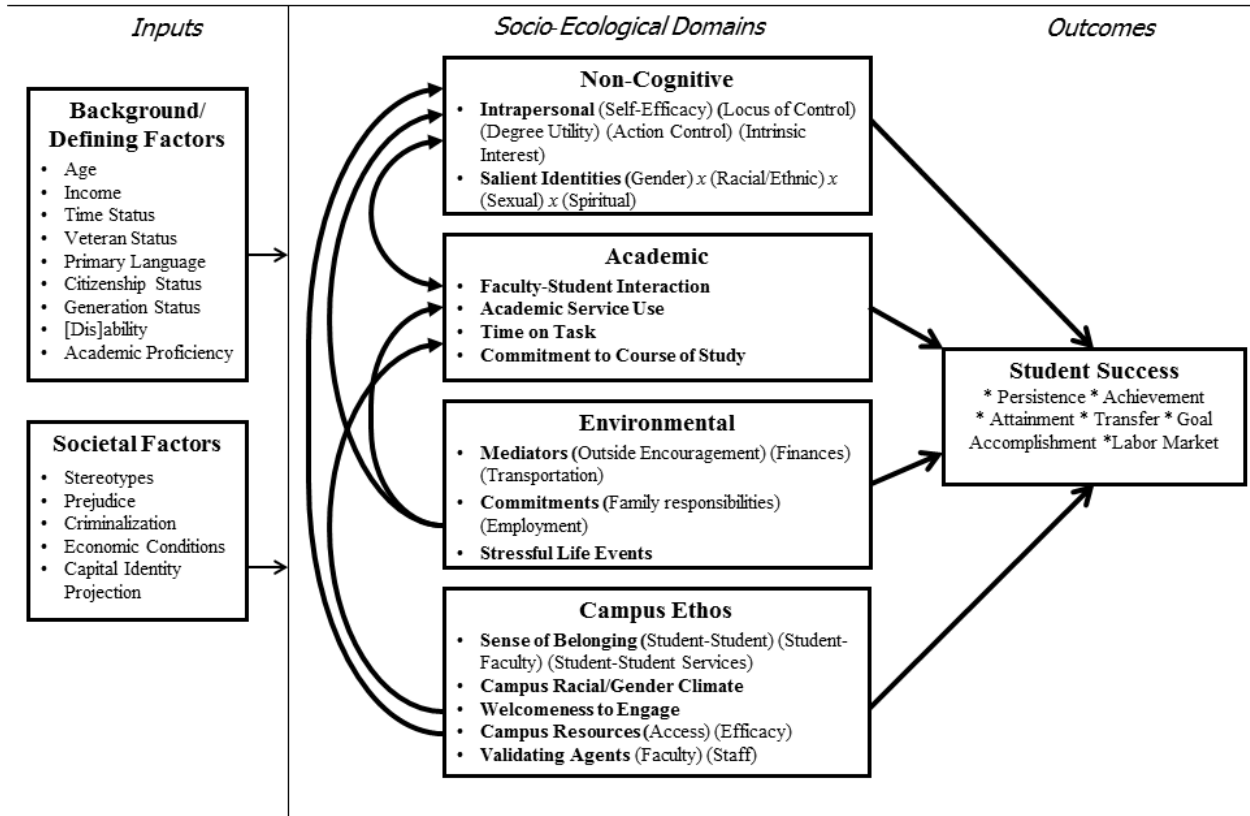
Strayhorn, T. L. (2012). *College students' sense of belonging: A key to educational success for all students*. New York, NY: Routledge.

Torres, J. B. & Solberg, V. S. (2001). Role of self-efficacy, stress, social integration, and family support in Latino college student persistence and health. *Journal of Vocational Behavior, 59*, 53-63.

U.S. Department of Education. (2009). Community college student 6-year retention and attainment 2009 by race= ethnicity (with multiple) and gender, for first institution sector (level and control) 2003–04 (public 2-year) and transfer plans 2003–04 (planned to transfer): 2003–04 Beginning Postsecondary Students Longitudinal Study, second follow-up (BPS:04=09). Washington, DC: National Center for Education Statistics.

Wang, X. (2013). Community College and Underrepresented Racial and Ethnic Minorities in STEM Education. In R. T. Palmer, & J. L. Wood, *Community Colleges and STEM* (pp. 3-16). New York: Taylor & Francis.

Wood, J. L., & Harris III, F. (2013). The Community College Survey of Men: An Initial Validation of the Instrument's Non-Cognitive Outcomes Construct. *Community College Journal of Research and Practice*, *37*(4), 333-338.

Wood, J. L., & Harris III, F. (2014). *Picturing inequity: An infographic report on persistence and completion for men in the California community college.* San Diego, CA: Minority Male Community College Collaborative.

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology, 25*(1), 82-91.

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Socio-Ecological Outcomes Model

Community College - Socio-Ecological Outcomes (CC-SEO) Model

Inputs

Background/ Defining Factors
- Age
- Income
- Time Status
- Veteran Status
- Primary Language
- Citizenship Status
- Generation Status
- [Dis]ability
- Academic Proficiency

Societal Factors
- Stereotypes
- Prejudice
- Criminalization
- Economic Conditions
- Capital Identity Projection

Socio-Ecological Domains

Non-Cognitive
- **Intrapersonal** (Self-Efficacy) (Locus of Control) (Degree Utility) (Action Control) (Intrinsic Interest)
- **Salient Identities** (Gender) x (Racial/Ethnic) x (Sexual) x (Spiritual)

Academic
- **Faculty-Student Interaction**
- **Academic Service Use**
- **Time on Task**
- **Commitment to Course of Study**

Environmental
- **Mediators** (Outside Encouragement) (Finances) (Transportation)
- **Commitments** (Family responsibilities) (Employment)
- **Stressful Life Events**

Campus Ethos
- **Sense of Belonging** (Student-Student) (Student-Faculty) (Student-Student Services)
- **Campus Racial/Gender Climate**
- **Welcomeness to Engage**
- **Campus Resources** (Access) (Efficacy)
- **Validating Agents** (Faculty) (Staff)

Outcomes

Student Success
* Persistence * Achievement * Attainment * Transfer * Goal Accomplishment *Labor Market

Figure A.1. Harris and Wood's (2014) Socio-Ecological Outcomes Model