Supplemental Material

CBE—Life Sciences Education

Pedersen *et al*.

Supplemental Materials **for Similarity and Contact Frequency Promote Mentorship Quality Among Hispanic Undergraduates in STEM**

The purpose of these supplemental materials is to provide additional background, methodological, and statistical details that support the results and logic in the main narrative. Here we provide details such as:

- The full correlation matrix and descriptive statistics for variables used in the analyses (Table S1);

- Confirmatory factory analysis (CFA) models testing alternative measurement models of faculty mentorship support (Table S2);

- Summary of factor loadings (pattern coefficients) from the best fitting CFA model of faculty mentorship support (Table S3)

- Figure depicting the conceptual "Process-Oriented Model of Mentorship" and hypotheses tested in the current paper (Figure S1).

Results

Bivariate correlations

Correlation analysis revealed a pattern of bivariate associations partially consistent with expectations. Concerning inputs to mentorship support, Hispanic student perceptions of receiving psychosocial support were strongly and positively correlated with their perceptions of psychological similarity with their mentor, as well as being weakly and positively associated with having a female mentor (Table S1). Similarly, perceptions of receiving career support were strongly and positively correlated with perceptions of psychological similarity. Interestingly, co-

authoring support had a different pattern of associations with inputs. That is, receiving co-authoring support was moderately and positively correlated with contact frequency, having a Hispanic faculty mentor, and initial intentions to pursue a research career. Concerning inputs to relationship satisfaction, the analysis revealed strong and positive correlations with perceptions of psychosocial support, career support, and psychological similarity. Finally, concerning mentoring processes linked to scientific research career persistence intentions, the analysis revealed moderate positive associations with co-authoring support and initial persistence intentions.

Confirmatory factor analyses

Approach. A preliminary goal of this research was to provide additional measurement validation evidence for our measures of mentorship quality, particularly in Hispanic college students samples. First, we examined the measurement properties of psychosocial support, career support, and co-authoring mentorship support. Therefore, a series of nested CFA models were conducted in order to compare (a) a single-factor model that subsumed all types of mentorship support processes into a global factor, (b) a two-factor model that separated psychosocial support from career support – where career support included both general career support and co-authoring support, and (c) a three-factor model that separated psychosocial support, career support, and co-authoring support. The three-factor model treats co-authoring as a unique kind of career-related support within the academy, consistent with the approach of Paglis et al., (2006). Finally, a fourth and final non-nested model was also tested, which included mentoring relationship satisfaction.

Since indicators of these scales were ordinal or binary in nature, CFA models were estimated using weighted least squares (WLSMV) in Mplus v8.6 (Muthén & Muthén, 2021). In

addition, cluster robust standard errors were estimated given the nested nature of the date (i.e., students within universities) using the TYPE=Complex command in Mplus.

Concerning model fit, nested model comparisons were performed using the modified chi-square difference testing approach for ordinal/binary data in Mplus (i.e., DIFFTEST command) and statistically significant results indicate that model fit improves with the more complex nested model. Furthermore, the assessment global model fit of CFA models was evaluated across multiple fit statistics, including the comparative fit index (CFI), root-mean-square error of approximation (RMSEA), and the standardized root-mean-square residual (SRMR) (Kline, 2016). Adequacy of global model fit was judged against typical criteria (e.g., CFI values ≥ 0.95, RMSEA values ≤ 0.05, & SRMR values ≤ 0.08) and newly recommended T-size equivalence testing methods for assessing adequacy of model fit (Hu & Bentler, 1999; Yuan et al., 2016). If global model fit was inadequate, we assessed local model fit to identify potential model revisions (Kline, 2016).

Findings. As shown in Table S2, the one-factor model (i.e., global mentorship support factor) did not exhibit adequate data-model fit across any of the fit indices. The two-factor model (i.e., psychosocial and career support factors) significantly improved model fit compared to the one-factor model; however, the two-factor also exhibited poor data-model fit across all fit indices. The three-factor model (i.e., psychosocial, career, and co-authoring support factors) significantly improved model fit compared to the two-factor model. Further, the three-factor model exhibited good data-model fit on CFI and RMSEA indices, and approached good fit on the SRMR index. Therefore, we proceeded with the three-factor model of mentorship support.

Next, a non-nested four-factor model was fit to the data, which included the three latent mentoring support processes and also included indicators of relationship satisfaction loading on a

latent mentor relationship satisfaction construct. The four-factor model provided good fit to the data using conventional criteria and the T-size equivalence testing approach indicated that the observed CFI value of Model 4 exceeded "excellent" fit and the observed RMSEA value was between "close" and "excellent." As shown in Table S3, the factor loadings (i.e., pattern coefficients) were acceptably high for the indicators of psychosocial support (loadings .70-to-.88), career support (loadings .64-to-.83), co-authoring support (loadings .60-to-.94), and relationship satisfaction (loadings .80-to-.98). Thus, we conclude that the four-factor model provides adequate evidence of measurement validity for use of these scales in this sample of Hispanic students in STEM majors.

Supplemental Material References

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*(1), 1-55. https://doi.org/10.1080/10705519909540118

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4 ed.). Guilford Press.

Muthén, B. O., & Muthén, L. K. (1998-2021). *Mplus user's guide*. In (Version 8.6) Muthén & Muthén.

Yuan, K.-H., Chan, W., Marcoulides, G. A., & Bentler, P. M. (2016). Assessing structural equation models by equivalence testing with adjusted fit indexes. *Structural Equation Modeling: A Multidisciplinary Journal*, *23*(3), 319-330. https://doi.org/10.1080/10705511.2015.1065414

Table S1. *Descriptive statistics and correlation between mentoring antecedents, quality mentorship, and career commitment (N=186).*

Variable	1	2	3	4	5	6	7
1. Initial Career Commitment	--						
2. Female Status Protégé	-.05	--					
3. Female Status Mentor	-.18*	-.08	--				
4. Matched Gender	-.11	-.23**	.34*	--			
5. Matched Race/Ethnicity	.08	-.10	-.03	.02	--		
6. Psychological Similarity	.05	-.09	.03	.01	.10	.87	
7. Contact	.03	-.09	-.01	-.06	.04	.00	--
8. Psycho-Social Support	.02	.09	.14*	.08	-.06	.59**	.08
9. Career Support	.08	-.03	-.10	.07	.05	.58**	.11
10. Co-authoring Support	.21**	-.03	-.14	-.00	.17*	.09	.28**
11. Relationship Satisfaction	.04	-.08	.03	.09	.06	.66**	-.01
12. Career Commitment	.35**	-.01	-.09	-.05	.14	.08	.12
M or %	8.91	67%	39.2%	50%	29%	3.57	7.16
SD	1.55	--	--	--	--	0.86	7.87
Skew	-1.82	--	--	--	--	-0.25	1.68
Kurtosis	6.87	--	--	--	--	2.85	5.93

Table Continues...

Table S1. Continued...

Variable	8	9	10	11	12
8. Psycho-Social Support	.91				
9. Career Support	.68**	.83			
10. Co-authoring Support	.08	.23**	--		
11. Relationship Satisfaction	.73**	.70**	.11	.86	
12. Career Commitment	-.05	.07	.24**	.01	--
M or %	4.03	3.78	1.11	4.20	8.42
SD	0.77	0.83	1.29	0.80	2.53
Skew	-.79	-.50	0.92	-.97	-1.86
Kurtosis	2.90	2.49	3.00	3.65	5.74

Notes: Italicized values on the diagonal are internal consistency reliability coefficients and

values off diagonal are correlation coefficients. Shown here are uncentered variables.

*p<.05. **p<.01.

Table S2. *Summary of confirmatory factor analyses (N = 186)*

Model	χ^2 (df)	CFI	RMSEA (90% CI)	SRMR	Model Comparison	Pass
1. One-Factor Model of Mentorship Support	413.06 (152)***	.899	.096 (.085, .107)	.127	n/a	n/a
2. Two-Factor Model (Psychosocial and Career Support)	374.11 (151)***	.914	.089 (.078, .101)	.121	1. vs. 2. 29.38 (1)***	Y
3. Three-Factor Model (Psychosocial, Career, & Coauthoring Support)	245.75 (149)**	.963	.059 (.046, .072)	.092	2. vs. 3. 72.10 (2)***	Y
4. Four-Factor Model (Psychosocial Support, Career Support, Coauthoring Support, & Relationship Satisfaction)	327.30 (203)***	.983	.057 (.046, .069)	.088	n/a	n/a

Notes: The T-size equivalence testing approach indicated that RMSEA values ≤ 0.034 are "excellent" and values ≤ 0.62 are "close."
The RMSE values of Model 4 (final model) fall between "excellent" and "close." The T-size equivalence testing approach indicated
that CFI values ≥ 0.965 are "excellent." The CFI values of Model 4 (final model) exceed "excellent."

Table S3. *Summary of pattern coefficients from the final 3-factor confirmatory factor analysis (Model 4)*

Indicator	Psychosocial Support	Career Support	Co-authoring Support	Relationship Satisfaction
1. Discussed concerns about competence, advancement, relationships with peers[a]	.70	--	--	--
2. Shared career history[a]	.82	--	--	--
3. Encouraged to prepare for next steps in career[a]	.88	--	--	--
4. Promoted your academic interests[a]	.81	--	--	--
4. Conveyed respect[a]	.79	--	--	--
5. Conveyed empathy for your concerns/feelings[a]	.81	--	--	--
6. Encouraged to talk about anxieties[a]	.80	--	--	--
7. Shared personal history[a]	.78	--	--	--
8. Served as role model[a]	.83	--	--	--
9. Helped finish tasks/meet deadlines[b]	--	.64	--	--
10. Explored career options[b]	--	.83	--	--
11. Helped you meet people[b]	--	.68	--	--

Indicator	Psychosocial Support	Career Support	Co-authoring Support	Relationship Satisfaction
12. Given challenging assignments[b]	--	.74	--	--
13. Helped you meet people in your field[b]	--	.73	--	--
14. Gave poster presentation[c]	--	--	.85	--
15. Gave spoken presentation[c]	--	--	.60	--
16. Submitted paper for publication as (co)author[c]	--	--	.94	--
17. Been (co)author on paper accepted for publication[c]	--	--	.81	--
18. Presented at research fair/competition[c]	--	--	.77	--
19. Effectively used mentor to develop[d]	--	--	--	.80
20. Mentor met expectations[d]	--	--	--	.95
21. Satisfied with mentor[d]	--	--	--	.98

Notes: [a]Indicators of psychosocial support; [b]Indicators of career support; [c]Indicators of co-authoring support; [c]Indicators of mentor relationship satisfaction.