Supplemental Material

CBE—Life Sciences Education

Aikens *et al.*

Supplemental online materials for

Race and gender differences in undergraduate research mentoring structures and research outcomes

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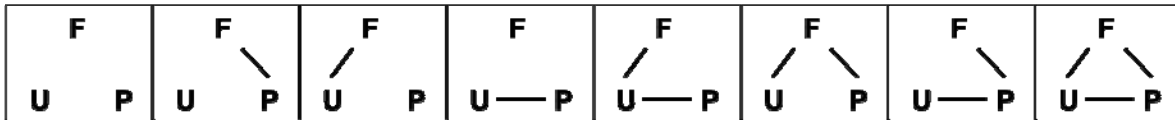
This supplement contains the following:

Survey Items

Mentoring triad type. The following are diagrams of the possible relationships among an undergraduate (U), postgraduate (P), and faculty member (F). Please select the diagram that you think best depicts your relationship with the postgraduate and faculty member you work/have worked with.

Frequency of interaction, rapport, and outcomes.

Table S1. The item stem, items, and response options for measures used in the analyses.[a]Items were reverse-scored for analyses.

Variable	Instructions	Item	Response options
Frequency of interaction		On average, how often did/do you interact with [faculty mentor's name]?[a]	1 = Several times a day; 2 = Daily, 3 = Weekly, 4 = Monthly, 5 = Less than once a month; 6 = Other; 7 = Prefer not to respond
Rapport (Schlosser and Gelso, 2001)	The following statements are about your relationship with [faculty member's name].	This individual offered me encouragement.	1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree; 6 = Not applicable / No response
		I got the feeling that this individual did not like me very much.[a]	
		I do not think that this individual believed in my ability to succeed in science.[a]	
		This individual took my ideas seriously.	
		This individual did not encourage my input into our discussions.[a]	
		This individual was not kind when commenting about my work.[a]	
		I did not feel respected by this individual in our work together.[a]	
		This individual welcomed my input into our discussions.	
		I do not think that this individual had my best interests in mind.[a]	
		I felt uncomfortable working with this individual.[a]	
		I was often intellectually "lost" during meetings with this individual.[a]	
Scientific identity (Estrada *et al.*, 2011)	Please indicate your level of agreement with the following statements.	I have a strong sense of belonging to the community of scientists.	1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree; 6 = I don't know; 7 = Not applicable / No response
		I have come to think of myself as a "scientist."	
		I feel like I belong in the field of science.	
		I derive great personal satisfaction from working on a team that is doing important research.	
		The daily work of a scientist is appealing to me.	

Table S1(continued)

Variable	Instructions	Item	Response options
Scholarly productivity (self-authored)	Please indicate how many times you completed each of the following professional activities as a result of your research experience.	Presented a poster or talk as part of a local program or event	0; 1; 2; 3; 4; 5+
		Presented a poster at a regional, national, or international conference	
		Presented a talk at a regional, national, or international conference	
		Participated in writing a manuscript for publication in a peer-reviewed journal	
		Published an article in a peer-reviewed journal.	
Intentions to enroll in a Ph.D. program (Hunter *et al.*, 2009; Weston and Laursen, 2015)	Compared to your intentions before doing research, please indicate how likely are you now to…	Enroll in a Ph.D. program in science, mathematics, or engineering	1 = Not more likely; 2 = A little more likely; 3 = Somewhat more likely, 4 = Much more likely, 5 = Extremely more likely; 6 = I don't know; 7 = Not applicable / No response

Rapport scale. Better measures of the quality or closeness of the undergraduate-faculty relationship are needed before examining the development and influence of rapport further. The Cronbach's alpha value indicated that the AWAI subscale we used to measure rapport was behaving as anticipated (α=0.887). However, we were concerned about the many items that were negatively worded, a feature that has been demonstrated to introduce measurement error in responses (Van Sonderen *et al.*, 2013), and other items reflected a lack of distinction between feelings about the relationship and particular mentoring functions, such as providing encouragement (Eby *et al.*, 2013). Thus, we conducted a confirmatory factor analysis (CFA) and an exploratory factor analysis (EFA) with the data collected using this scale to learn more about the relationship between the items on the AWAI rapport subscale (see Supplemental Materials for full details of the CFA and EFA). While the fit statistics from the 1-factor CFA suggested that the scale might be unidimensional, a second CFA modeling the negative wording effect fit significantly better. The EFA results indicate that the scale is measuring a single underlying factor dominated by three items: *I do not think that this individual believed in my ability to succeed in science*, *I do not think that this individual had my best interests in mind*, and *I felt uncomfortable working with this individual*. When we consider these items at their face and reverse score them as we did for this study, these items seem to represent lack of a negative mentoring experience (Eby and McManus, 2004; Eby *et al.*, 2004), rather than indicating high levels of relationship quality. In addition, only 3 factor loadings from the 1-factor CFA were higher than .7, indicating that the remaining 8 items were capturingless than half of the variance in these responses. Moving forward, we recommend that this scale be further revised to remove all negative wording and to focus the content on relationship quality or closeness. Other measures of relationship quality should also be tested for their usefulness in measuring quality of the undergraduate researcher-faculty mentor relationship (e.g., relationship quality scale in Allen and Eby, 2003).

References

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Table S2. Correlations among the variables used in this study. Correlations were estimated using maximum likelihood. Correlations involving a continuous or ordinal variable are based on Pearson's *r*. Correlations between two binary variables are based on phi. Correlations of 0.09 or greater are significant at *p*< 0.05 (two-tailed).Gender: 0 = Male, 1 = Female; URM: White = 0, URM = 1; Asian: White = 0, Asian = 1; Triad: 0 = Open Triad, 1 = Closed Triad. [†]continuous variable; [‡]ordinal variable; [§]dichotomous variable

	(1) [§]	(2) [§]	(3) [§]	(4) [§]	(5) [†]	(6) [†]	(7) [†]	(8) [‡]
(1) Gender[§]	1							
(2) URM[§]	0.05	1						
(3) Asian[§]	0.04	-0.35	1					
(4) Triad[§]	-0.11	0.12	-0.11	1				
(5) Frequency of interaction[†]	-0.12	0.14	-0.08	0.52	1			
(6) Rapport[†]	-0.06	0.07	-0.11	0.47	0.32	1		
(7) Scientific identity[†]	-0.07	0.12	-0.15	0.20	0.22	0.37	1	
(8) Scholarly productivity[‡]	-0.10	0.07	0.02	0.14	0.13	0.14	0.26	1
(9) Intentions to pursue a Ph.D. in STEM[‡]	0.00	0.18	-0.17	0.17	0.19	0.23	0.46	0.22

Table S3. Regression results for Path Model 1. The rows contain the independent variables in the regressions, and the columns contain the dependent variables in the regressions. The odds of being in the closed triad relative to the open triad were calculated as e^b. Odds-ratios < 1 indicate less likelihood of being in the closed triad than the open triad, and odds-ratios > 1 indicate greater likelihood of being in the closed triad than the open triad. Covariation ($\pm$ SE)between rapport and frequency of interaction was 0.178 (0.025), $p = 0.000$.

	Frequency of interaction		Rapport		Triad membership (closed)		
Intercept (±SE)	3.068 (0.073)		4.386 (0.044)		-10.388 (1.012)		
	b (±SE)	*p*-value	*b* (±SE)	*p*-value	*b* (±SE)	*p*-value	e^b
Gender							
Female	-0.254 (0.079)	0.001	-0.078 (0.048)	0.108	-0.357 (0.227)	0.115	0.700
Race/Ethnicity							
Asian	-0.074 (0.087)	0.398	-0.116 (0.053)	0.028	-0.133 (0.233)	0.569	0.876
URM	0.324 (0.101)	0.001	0.066 (0.061)	0.285	0.525 (0.308)	0.088	1.691
Frequency of interaction					1.409 (0.144)	0.000	4.090
Rapport					1.706 (0.203)		5.507
R^2	0.035		0.017		0.564		

Table S4. Regression results for Path Model 2. The rows contain the independent variables in the regressions, and the columns contain the dependent variables in the regressions. Multiple intercepts were included for the ordinal variables. Odds-ratios for binomial and ordinal variables were calculated as e^b. Odds-ratios < 1 indicate less likelihood of being in the closed triad than the open triad, less likelihood of achieving a higher level of scholarly productivity, or less likelihood of increasing intentions to pursue a Ph.D. in STEM as a result of the research experience. Odds-ratios > 1 indicate greater likelihood of being in the closed triad than the open triad, greater likelihood of achieving a higher level of scholarly productivity, or greater likelihood of increasing intentions to pursue a Ph.D. in STEM as a result of the research experience. Because a binary mediator variable was used in the analyses, no R^2 values were computed.

	Triad membership (closed)			Scientific identity		Scholarly productivity			Intentions to pursue a STEM Ph.D.		
Intercept 1 (±SE)	-0.958 (0.163)			3.984 (0.068)		-1.067 (0.181)			-0.639 (0.174)		
Intercept 2 (±SE)	NA			NA		0.298 (0.176)			-0.017 (0.172)		
Intercept 3 (±SE)	NA			NA		0.986 (0.179)			0.601 (0.173)		
Intercept 4 (±SE)	NA			NA		NA			1.499 (0.181)		
	b (±SE)	p-value	e^b	b (±SE)	p-value	b (±SE)	p-value	e^b	b (±SE)	p-value	e^b
Gender											
Female	-0.525 (0.176)	0.003	0.592	-0.070 (0.058)	0.232	-0.331 (0.146)	0.023	0.718	0.033 (0.145)	0.822	1.033
Race/Ethnicity											
Asian	-0.294 (0.181)	0.104	0.745	-0.175 (0.063)	0.005	0.264 (0.161)	0.100	1.302	-0.462 (0.158)	0.003	0.630
URM	0.617 (0.235)	0.009	1.853	0.103 (0.074)	0.166	0.329 (0.182)	0.071	1.389	0.536 (0.189)	0.005	1.710
Triad membership											
Closed				0.269 (0.059)	0.000	0.507 (0.150)	0.001	1.661	0.536 (0.148)	0.000	1.709