Exploring Undergraduate Teaching Assistants' Influence on Student Science Identity and Persistence in STEM Coursework

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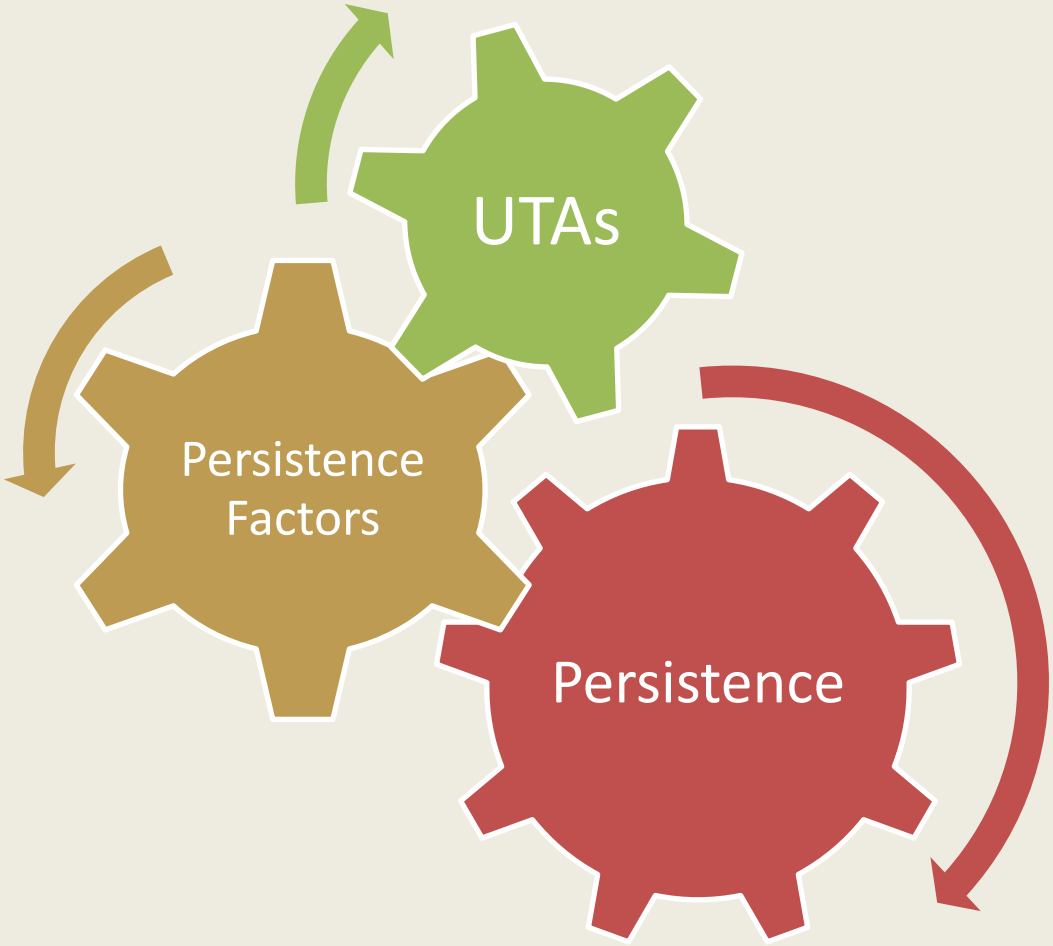
Our Challenge

- Many capable students leave STEM majors within the first two years of beginning undergraduate work
- Net loss of STEM majors may affect number of qualified K-12 science teachers

Addressing Challenge

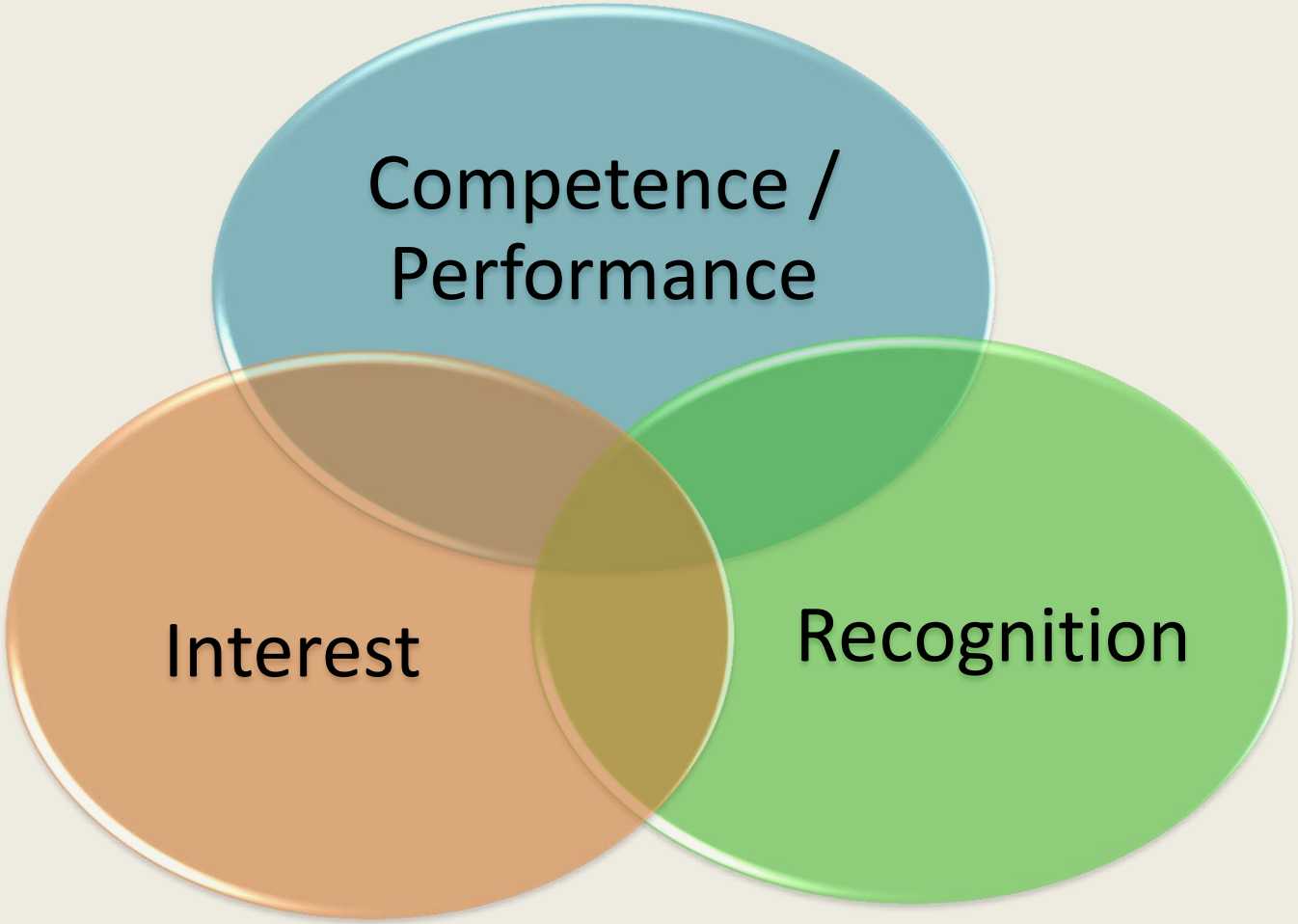
Trained and supported undergraduate teaching assistants (UTAs) to engage with students to strengthen factors that may increase persistence



STEM Persistence Factors

- Reasons students give for leaving STEM majors:
  - Academic achievement (Strenta, Elliot, Adair, Matier & Scott, 1994))
  - Poor quality instruction (Seymour & Hewitt, 1997; Strenta et al., 1994; Tobias, 1990)
- Predictors of Persistence:
  - Performance/Competence (Strenta et .al, 1994; Tai, Sadler, & Loehr, 2005)
  - Affect: interests, motivations, beliefs (Lent, Brown & Hackett, 1994, 1996; Tai, Liu, Maltese, & Fan, 2006)
  - Recognition by self and significant others: mothers (Bleeker & Jacobs, 2004); friends (Jacobs, Finken, Griffen, & Wright, 1998); and teachers (Woolnough et al., 1997)

Science Identity Framework



Adapted from Hazari, Sonnert, Sadler, & Shanahan, 2010

Measuring Science Identity

- Performance/Competence
  - Final Exam Grades, Course Grades, ACT Scores
- Interest (survey)
  - I am interested in experiments
  - I am interested in talking to others about science or math
  - I want to know more about science or math
- Recognition (survey)
  - I am a science or math person
  - Family/friends think I am science or math person
  - I want others to see me as science or math person

Research Questions

1. How did the science identity of UTA-led undergraduates compare with that of GTA-led students?

2. Did science identity relate to students persisting in STEM study, that is, enrolling in the second semester of general chemistry required for their major?

Study Context

Partnership for Retention Improvement in Mathematics, Engineering and Science (PRIMES)

- Trained and supported undergraduate teaching assistants (UTAs)
  - Selected by grades, application, and recommendations
  - Pre-semester workshop, bi-monthly seminar series, plan instructional activities
  - Pedagogical strategies introduced: questioning practice, metacognition, formative assessment
  - Practice and reflection
- "Business as usual" graduate teaching assistants
  - No formal pedagogical training taken during semester
  - Met as needed with instructors
  - Similar content knowledge test scores as UTAs
- Introductory level course (1st semester general chemistry)
- Recitation sections of a large course; cooperating instructors; common textbook and final exam

Research Design

- Quasi-experimental, untreated control group with post-test (survey) only
- Treatment group: 284 undergraduate students in 14 recitation sections led by a trained and supported UTA
- Control group: 310 undergraduate students in 15 recitation sections led by a traditional graduate teaching assistant
- Assignment of students and TAs
  - Students enrolled in recitation section; TA not yet assigned
  - Honors and night course sections not included in study
  - TAs assigned to recitation sections balanced over 4 course instructors, time of day, and day of week

End of Course Survey

- Given to all students in recitation sections at end of semester; anonymous responses to encourage candor
- Principal Components Analysis (varimax rotation)
- Component retained if eigenvalue > 1
- Four components explained over 69% of variance:
  1. Perceived TA Impact on Academic Success (10 items, $\alpha = .95$)
  2. TA Rapport-Building Skills (4 items, $\alpha = .77$)
  3. Student Science Recognition (3 items, $\alpha = .84$)
  4. Student Science Interest (3 items, $\alpha = .82$)

TA Impact on Academic Success

Component Items (α = .95)
(5-point Likert scale "strongly disagree to strongly agree)

- Course was enjoyable
- Course was valuable experience
- TA had strong content knowledge
- TA gave clear explanations
- TA led effective discussions
- Overall TA was excellent
- TA gave choices for learning
- My success in future courses is due in part to TA
- My grade is higher due in part to TA
- I understand more content due to TA

TA Rapport-Building Skills

Component Items (α = .77)

(5-point Likert scale “strongly disagree to strongly agree)

- I am able to be open with TA
- My TA encouraged questions
- My TA cares about me
- My TA tries to understand me

Results

Comparison of Mean TA Impact and TA Rapport Scores

	GTA	**UTA**				
Variable	**Mean (SD)**	**Mean (SD)**	**df**	**t**	***p***	**Cohen's d**
TA Impact	26.79 (6.64)	30.15 (6.02)	399	5.355	<.001	0.53
TA Rapport	9.92 (1.92)	10.64 (1.89)	410	3.856	<.001	0.38

Variables related to TA Impact

Linear Regression model—backwards entry

Variables tested	
ACT Math score (student reported)	TA Rapport score
number of STEM AP courses	Science Recognition score
parent education level	Science Interest score
gender	TA type (GTA = 0; UTA = 1)

Linear Regression: TA Impact on Academics

Predictor	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	**Std. Error**	**Beta**		
Constant	2.603	1.445		1.802	.073
TA Type (GTA = 0; UTA=1)	2.158	.535	.160	4.034	.000
TA Rapport	2.381	.139	.683	17.142	.000
Gender (0=male; 1=female)	-1.912	.542	-.137	-3.530	.001
Number of STEM AP courses	.469	.185	.099	2.538	.012
R^2	.561				
F	94.11				.000

Predictors of TA Rapport Building Skills

	Unstandardized Coefficients		Standardized Coefficients		
Predictor	**B**	**Std. Error**	**Beta**	**t**	**Sig.**
Constant	7.576	.652		11.61	.000
TA Type (0=GTA; 1=UTA)	.687	.218	.178	3.15	.002
Student Science Recognition	.230	.062	.209	3.70	.000
R^2	.520				
F	13.52				.000

Comparison of Mean Student Science Recognition and Student Science Interest Scores

	GTA	UTA				
Variable	Mean (SD)	Mean (SD)	df	t	p	Cohen's d
Student Science Recognition	9.94 (2.14)	10.44 (1.63)	374	2.643	.04	0.54
Student Science Interest	9.83 (2.14)	10.12 (1.82)	391	1.485	.353	-

While UTA-led students had stronger Science Recognition scores than GTA-led students, there was no significant difference in Science Interest scores between student groups.

Measurement of Persistence

- Course: 1st semester general chemistry
- Many STEM majors require 2nd semester general chemistry also
- How many students required to take 2nd semester enroll in course?
- How does this enrollment differ between UTA-led students and GTA-led students?

Persistence

- 384 students required to take 2nd semester general chemistry: 154 GTA-led students; 189 UTA-led students
- Proportionally more UTA–led students enrolled in 2nd semester (χ^2 (1, N = 343) = 12.07, *p* =.001).

Logistic Regression Analysis of Persistence

Predictor	B	S.E.	Wald	df	Sig.	Exp(B)
TA Type Code (GTA = 0; UTA =1)	1.160	.319	13.191	1	.000	3.188
Final Exam(%)	.025	.009	7.008	1	.008	1.025
College GPA	1.064	.251	17.943	1	.000	2.899
Math z-score	1.313	.252	27.188	1	.000	3.718
Parent Ed (no college=0; college = 1)	-.920	.387	5.652	1	.017	.398
Constant	-4.989	.813	37.695	1	.000	.007

Conclusions

- UTA-led students were not significantly different from GTA-led students on final exam grades, course grades, and Science Interest
- UTA-led students gave their TAs higher scores for TA Impact on Academic Success and TA Rapport-Building Skills
- TA Rapport-Building Skills score is positively related to Science Recognition score, controlling for all other variables
- TA Rapport-Building Skills score is positively related to being in a UTA-led recitation section, controlling for all other variables
- UTA-led students reported higher Science Recognition than GTA-led students
- UTA-led students three times more likely to enroll in a required 2nd semester general chemistry course than GTA-led students, controlling for all other variables

Discussion

- In comparing two groups of students similar in competence, performance and science interest, science recognition was the factor of the science identity model remaining for comparison
- Recognizing oneself and being recognized by significant others as a 'science person' is impacted by social relationships between the student and important others, such as instructors and TAs.
- UTAs may impact students more strongly due to recent experience in the same general chemistry program and use of research-based pedagogical strategies.
- **Connection warranting further study:** Students who had UTAs (in general, rating their TAs as more effective, reporting a greater student-TA rapport, and recognizing themselves more strongly as 'science people') were three times more likely to persist in a STEM program of study.

Time for questions…

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