THE BUTLER DIDN'T DO IT

LOOKING BEYOND THE USUAL SUSPECTS IN UNDERSTANDING DOCTORAL SUCCESS

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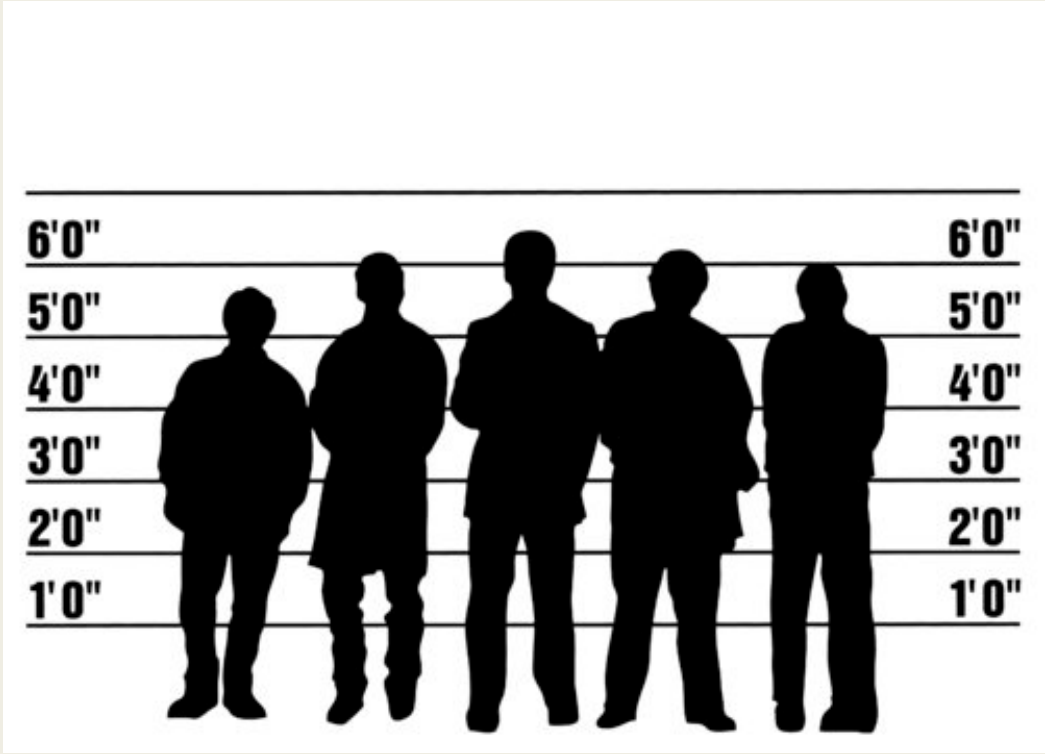
The Usual Suspects

- Socialization
- Faculty Mentors
- Cumulative Advantage
- Supplemental Interventions



Socialization

Socialization

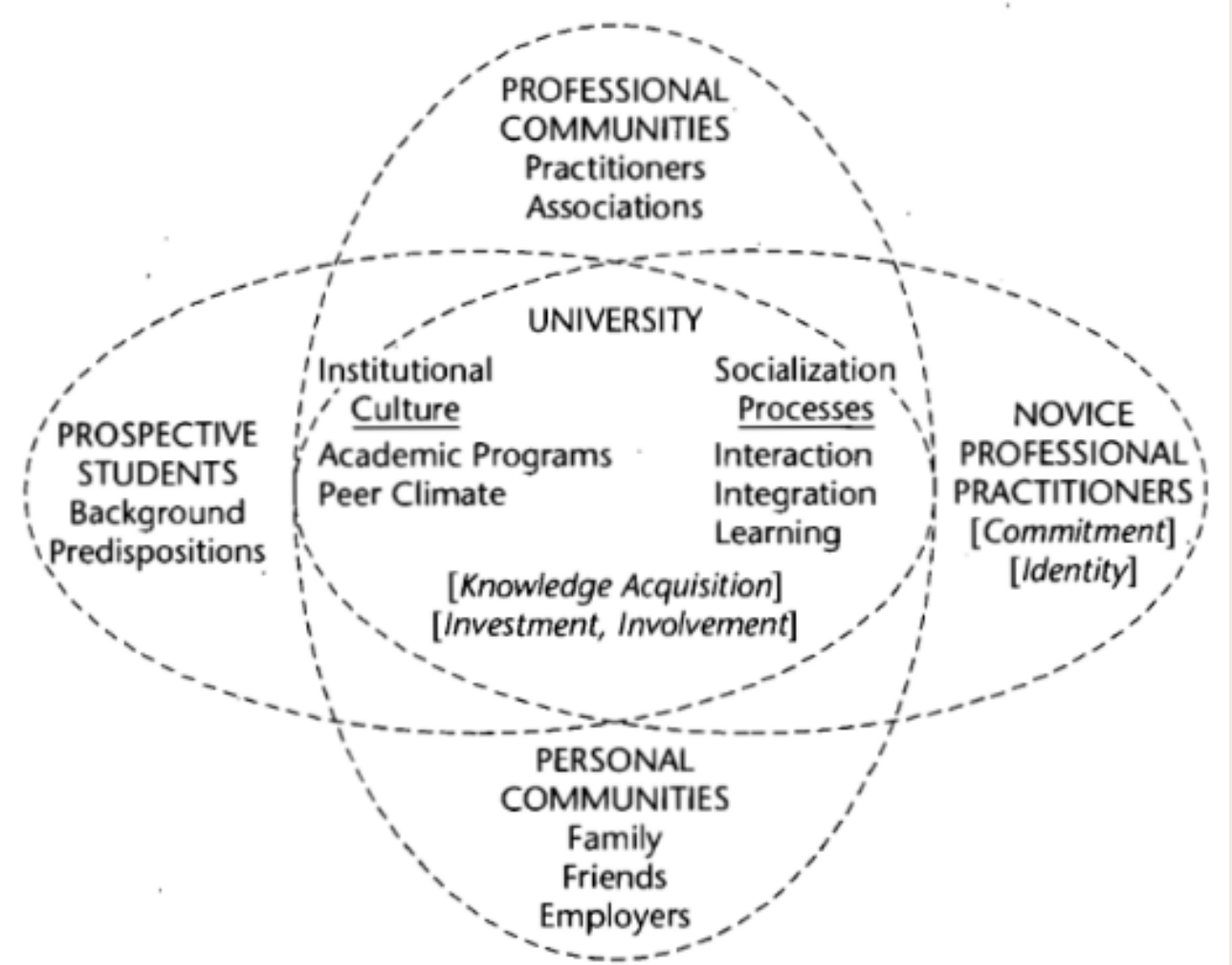
The process by which people selectively acquire the values and attitudes, the interests, skills and knowledge – in short, the culture – current in the groups to which they are, or seek to become a member. It refers to the learning of the social roles.

--Merton, Reader, & Kendall (1957, pp. 40-41)

A process of internalizing the expectations, standards, and norms of a given society, which includes learning the relevant skills, knowledge, habits, attitudes, and values of the group that one is joining.

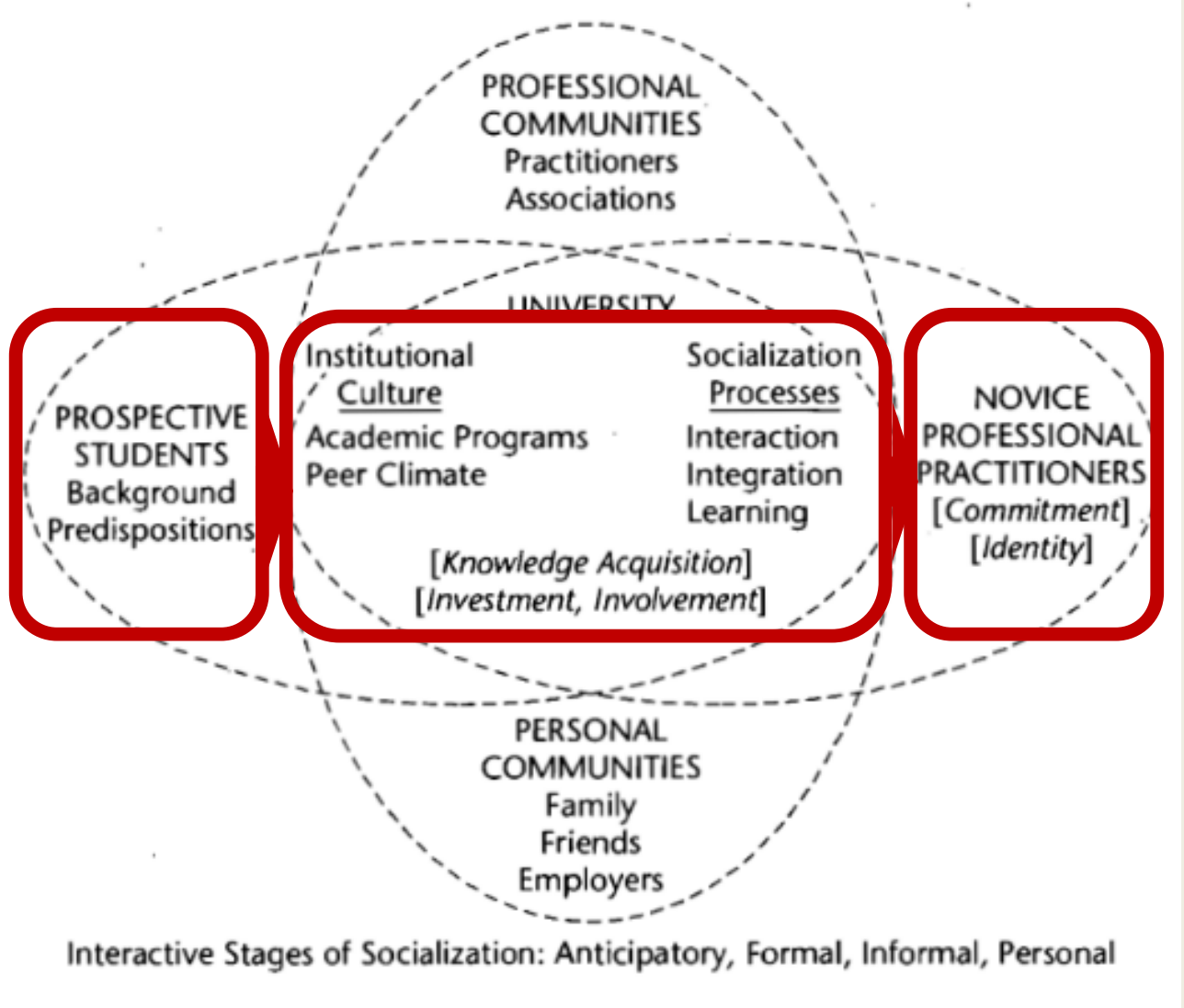
--Austin & McDaniels (2006, p. 400)

Socialization



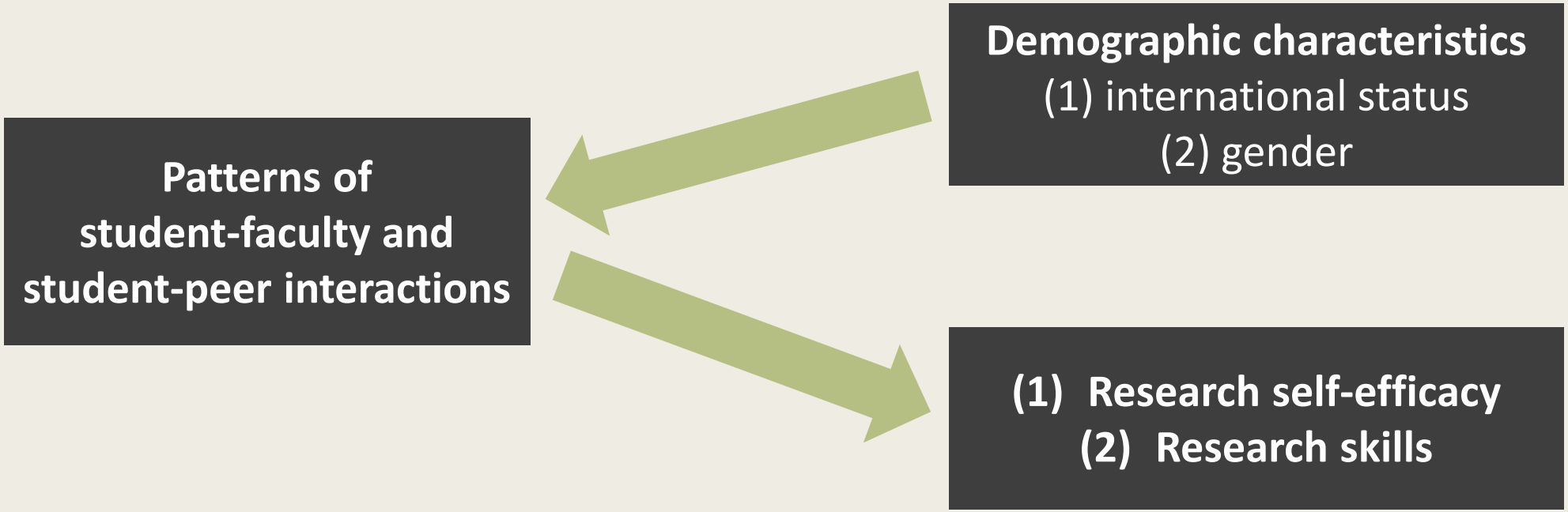
Interactive Stages of Socialization: Anticipatory, Formal, Informal, Personal

Socialization



Interactive Stages of Socialization: Anticipatory, Formal, Informal, Personal

Proposition 1:



Measures (Jeong et al., 2018a; *AERA*)

Interaction with faculty and peers (8 items)

Weidman & Stein (2003)

"Is there a professor or any student in your department with whom you…"
Item1,5. Sometimes engage in **social conversation**
Item2,6. Often discuss **topics in his/her field**
Item3,7. Often discuss **other topics of intellectual interest**
Item4,8. Ever talk about **personal matters**

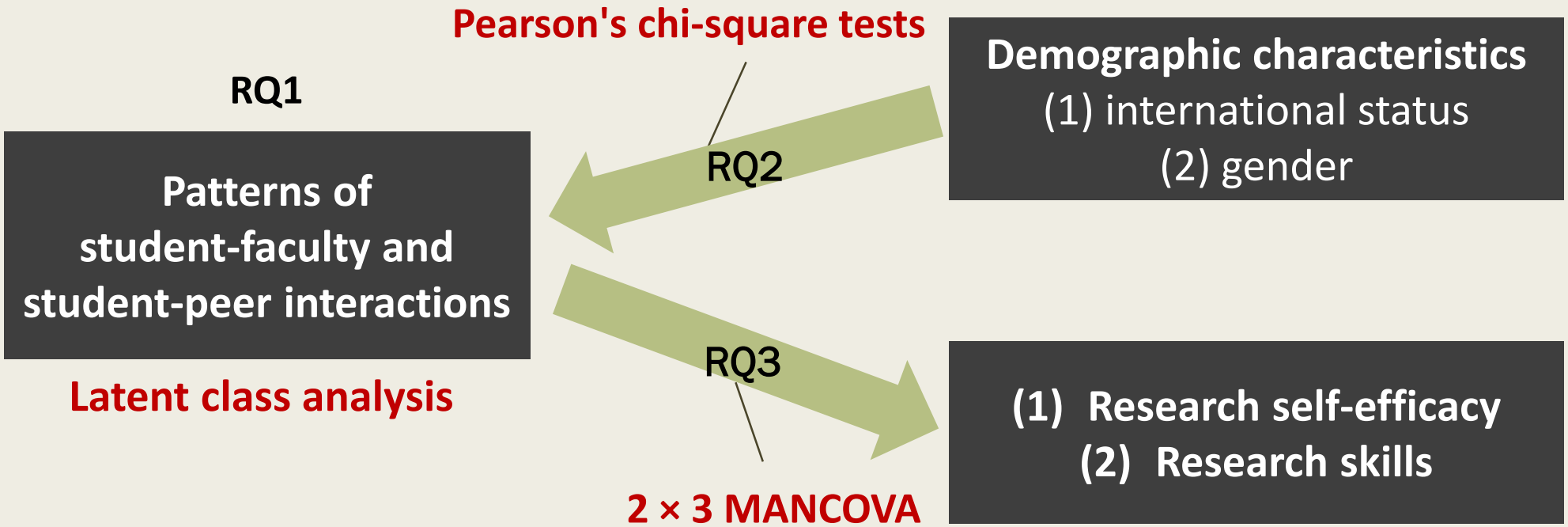
Research self-efficacy (10 items)

"**To what extent do you feel you can** observe and collect data?"
Kardash (2000)

Performance in research skills (13 skills)

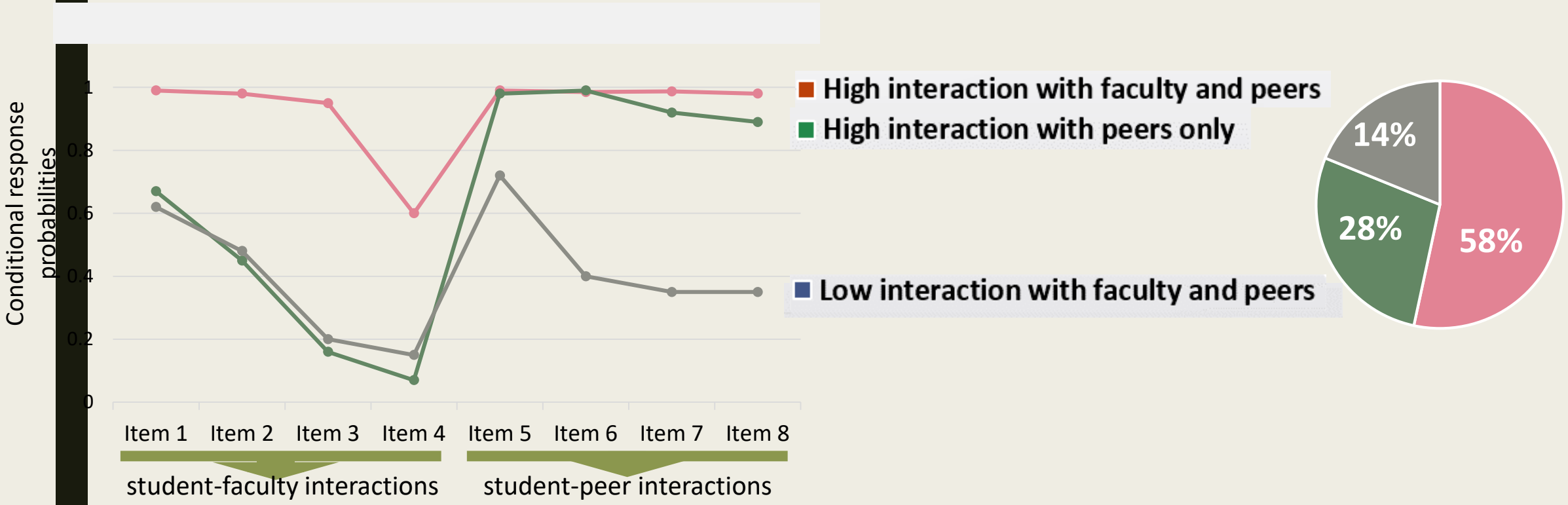
Written **research proposals** or reports using a rubric
Feldon et al. (2011)

Analyses


Pearson's chi-square tests
RQ1
Patterns of student-faculty and student-peer interactions
Latent class analysis
RQ2
Demographic characteristics
(1) international status
(2) gender
RQ3
(1) Research self-efficacy
(2) Research skills
2 × 3 MANCOVA
(Interaction effects, controlling for Year1 research performance and nesting of participants within institutions)

Results

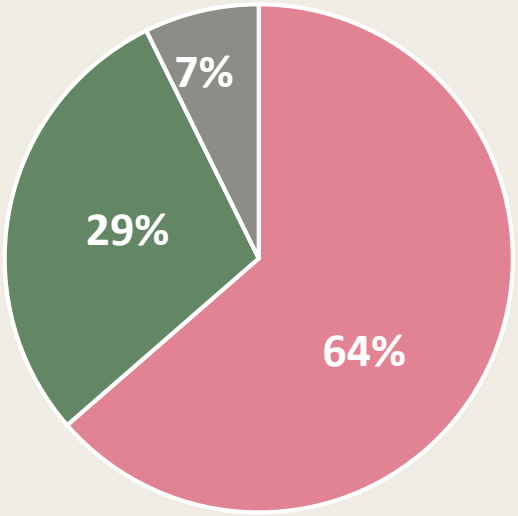
- **Three interaction patterns obtained by LCA**



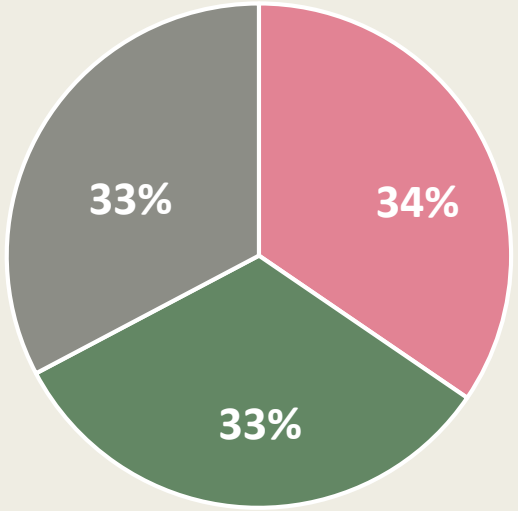
Results

- **Relations between interaction patterns and demographic characteristics**
  - **No difference** in interaction patterns **by gender**, χ^2 (2, 261) = 0.89, p = 0.642.
  - **Significant difference** in interaction patterns **by international status**, χ^2 (2, 261) = 28.79, $p < 0.001$.

Domestic students (N=206)



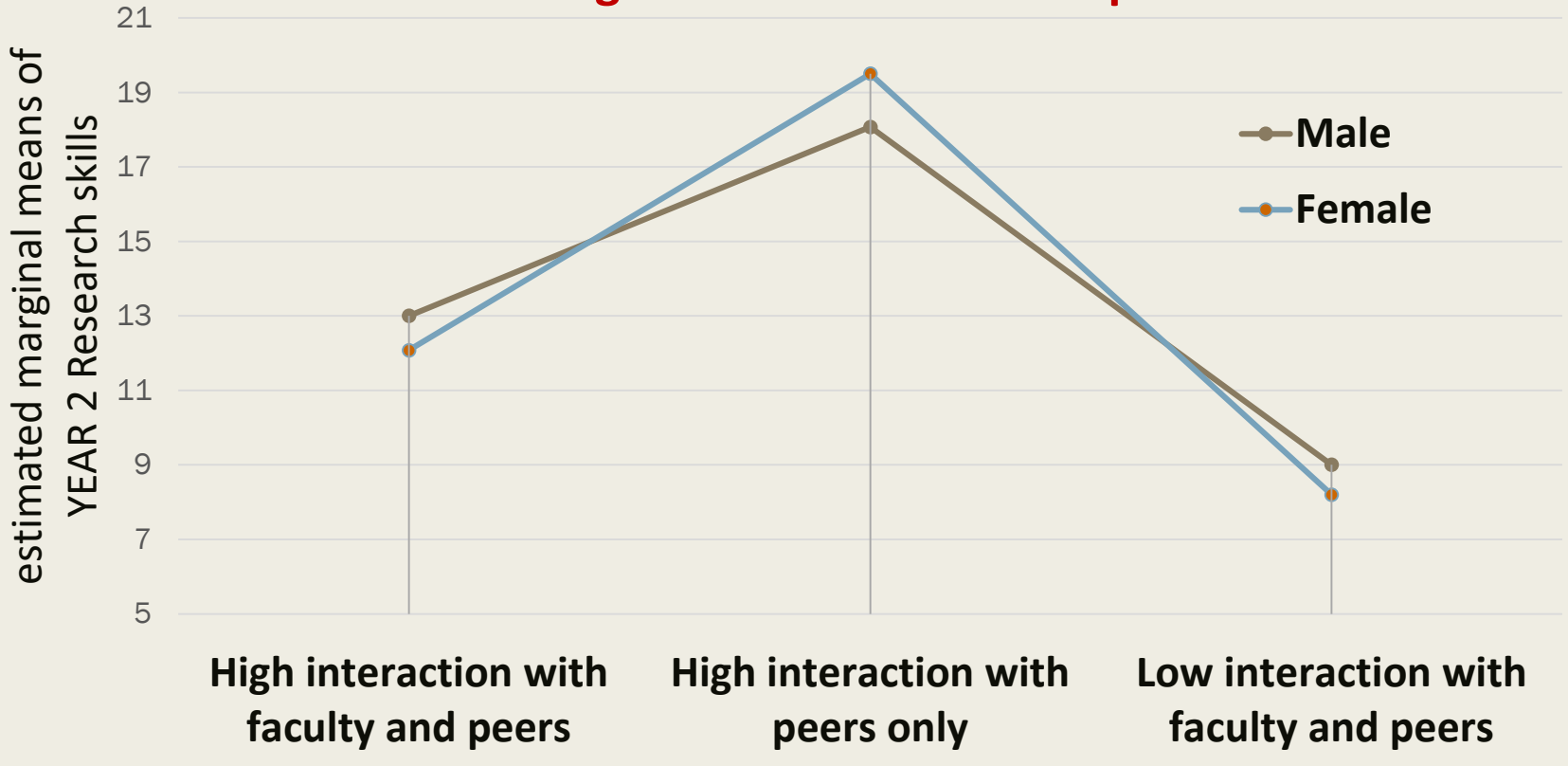
International students (N=55)



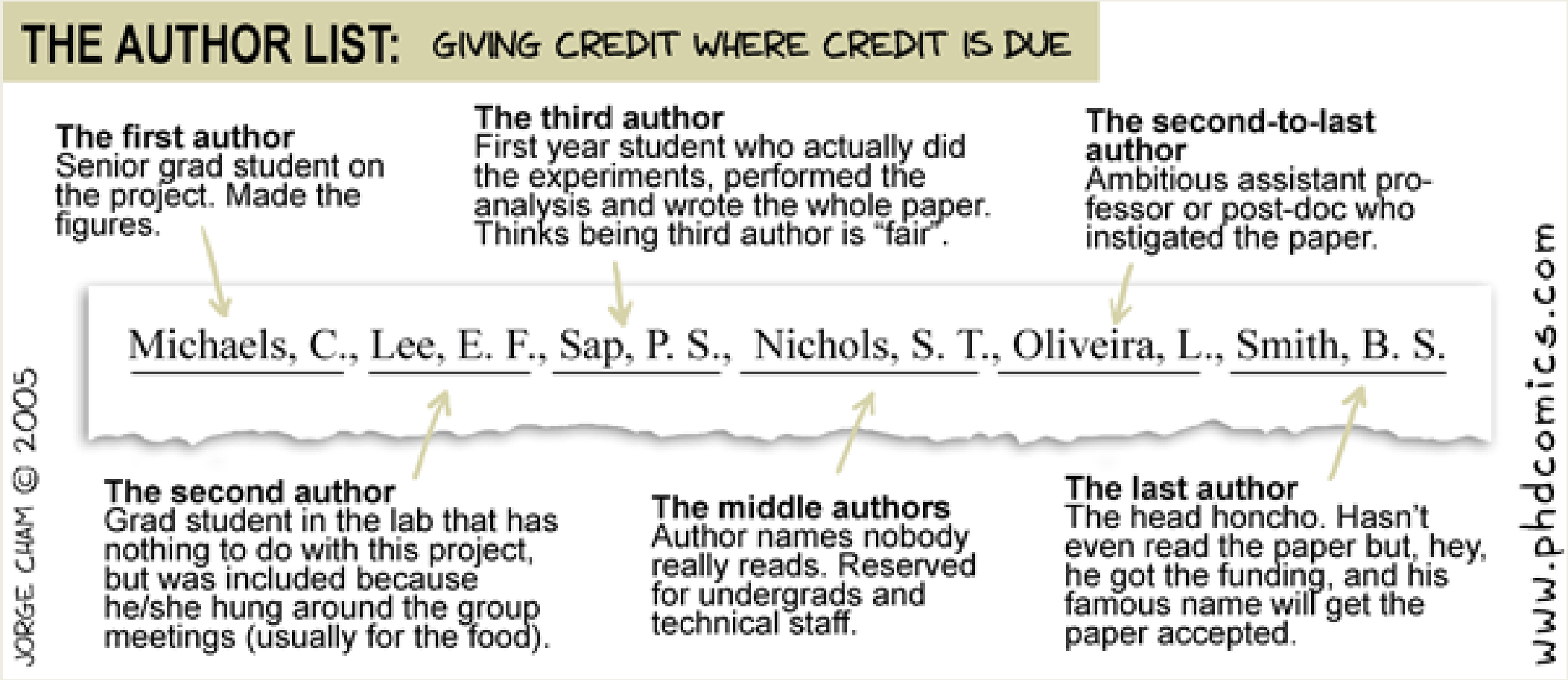
- High interaction with faculty and peers
- High interaction with peers only
- Low interaction with faculty and peers

Results

- **Effects of interaction patterns on research self-efficacy and research skills**
  - **No significant main or interaction effects** on **research self-efficacy**
  - **Significant interaction effect** of **gender and interaction patterns** on **research skills**

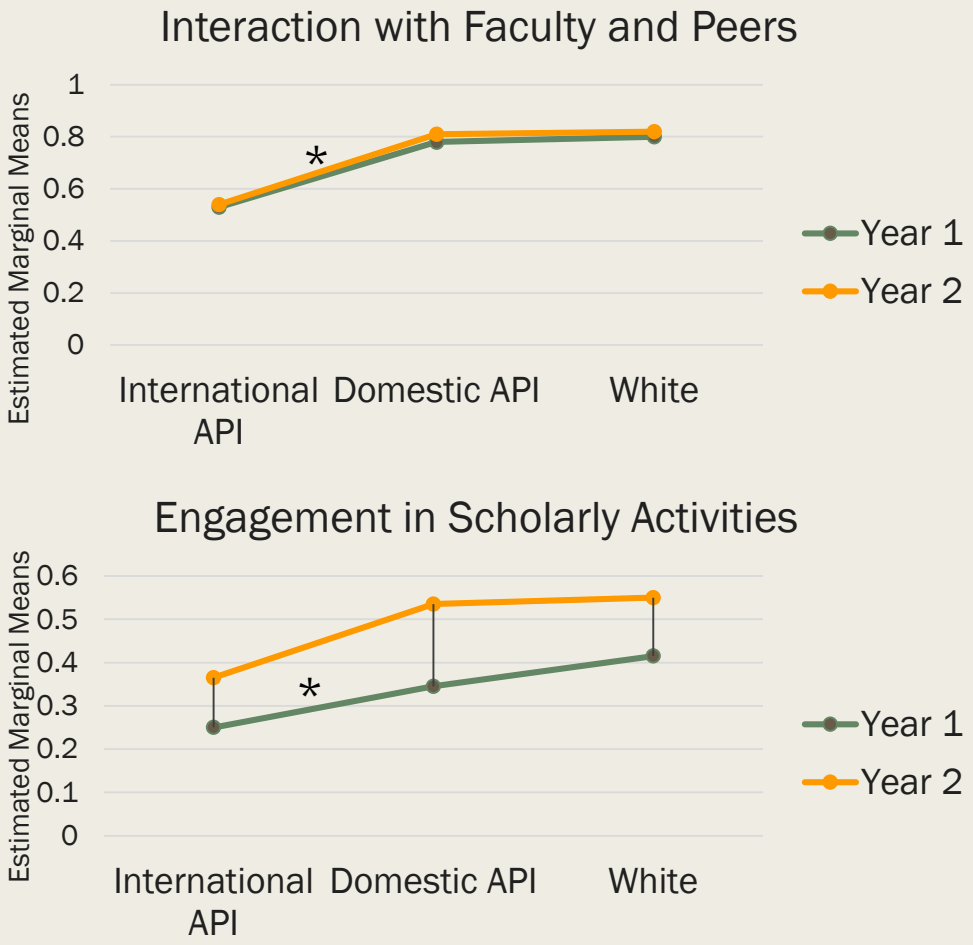


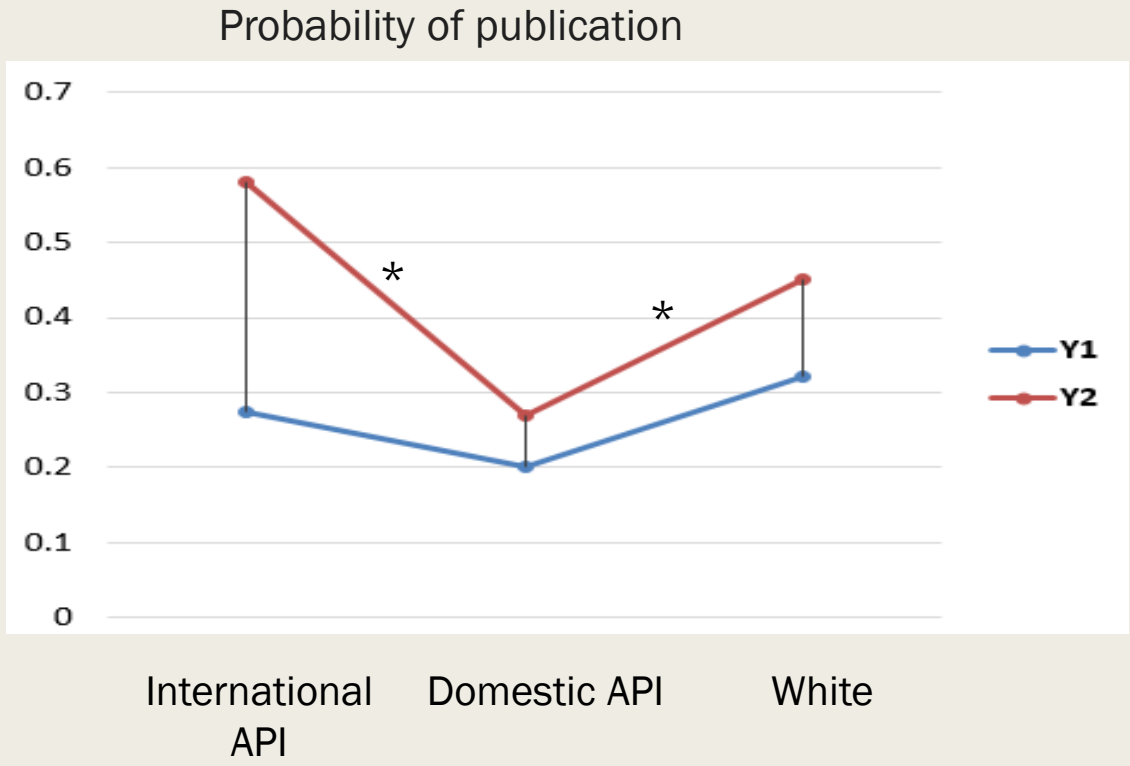
Proposition 2: Publications



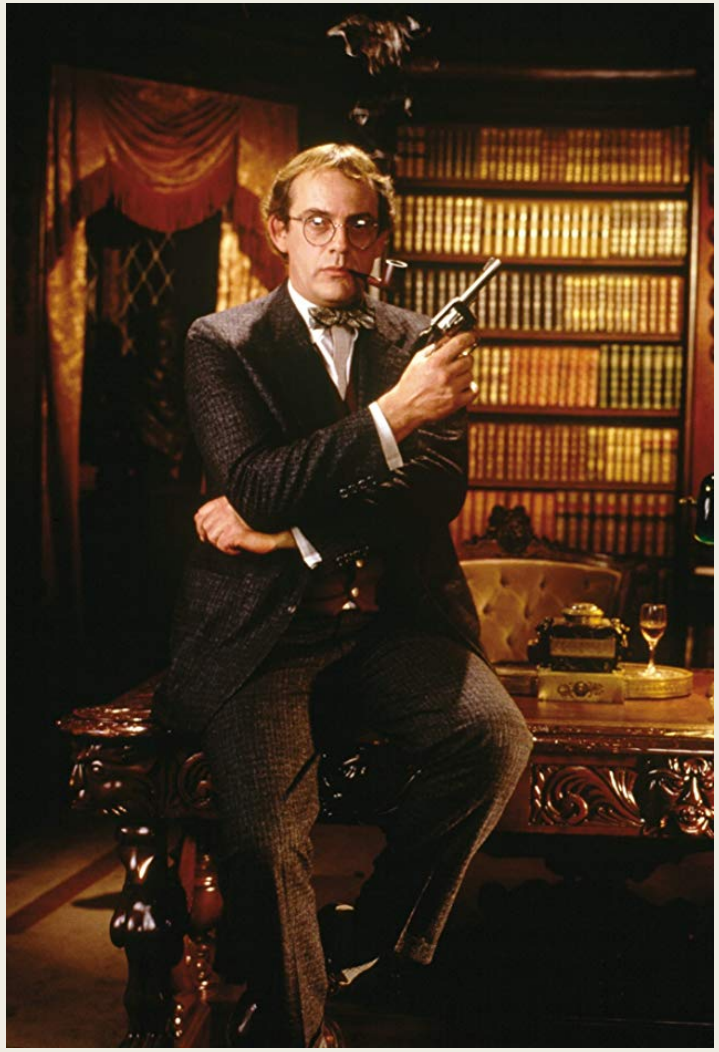
Socialization Does Not Drive Productivity

(Roksa et al., in press; *RSE*)





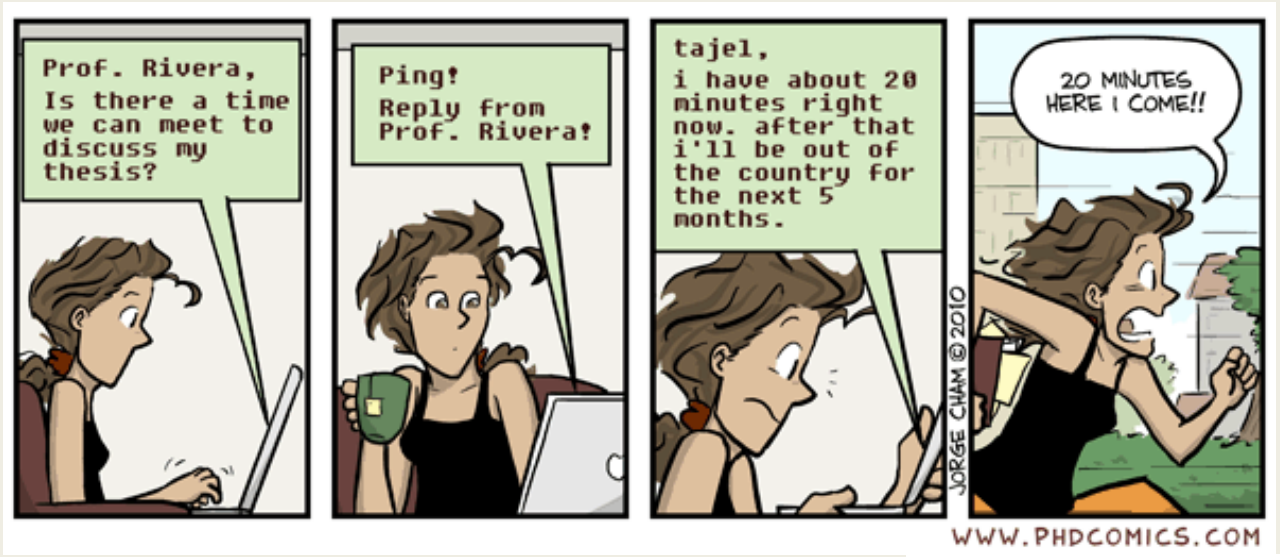
Faculty Mentors

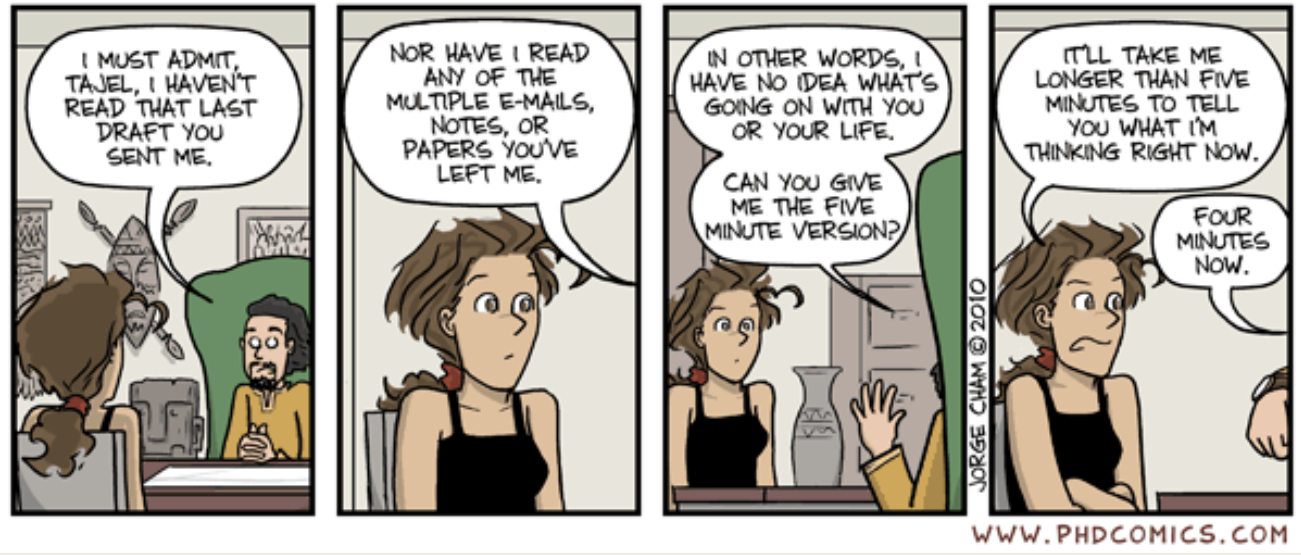


Mentorship

- **Faculty advisor** is considered the most critical agent of the socialization process.
- Doctoral advisor-advisee relationship can be conceptualized as a **cognitive apprenticeship**.
- Positive advising relationships increase **research productivity (i.e., publication) and degree completion** (Green & Bauer, 1995; Paglis et al., 2006)
- **Less is known about**
  - **what contributes** to positive relationships between doctoral students and their advisors
  - how advising relationships affect **individual students' research skills**
  - the extent to which both "cognitive" and "apprenticeship" are evident (Maher et al., 2013; Walker et al., 2009)

Mentorship


Prof. Rivera,
Is there a time we can meet to discuss my thesis?
Ping!
Reply from Prof. Rivera!
tajel,
i have about 20 minutes right now. after that i'll be out of the country for the next 5 months.
20 MINUTES HERE I COME!!
JORGE CHAM © 2010
WWW.PHDCOMICS.COM


I MUST ADMIT, TAJEL, I HAVEN'T READ THAT LAST DRAFT YOU SENT ME.
NOR HAVE I READ ANY OF THE MULTIPLE E-MAILS, NOTES, OR PAPERS YOU'VE LEFT ME.
IN OTHER WORDS, I HAVE NO IDEA WHAT'S GOING ON WITH YOU OR YOUR LIFE.
CAN YOU GIVE ME THE FIVE MINUTE VERSION?
IT'LL TAKE ME LONGER THAN FIVE MINUTES TO TELL YOU WHAT I'M THINKING RIGHT NOW.
FOUR MINUTES NOW.
JORGE CHAM © 2010
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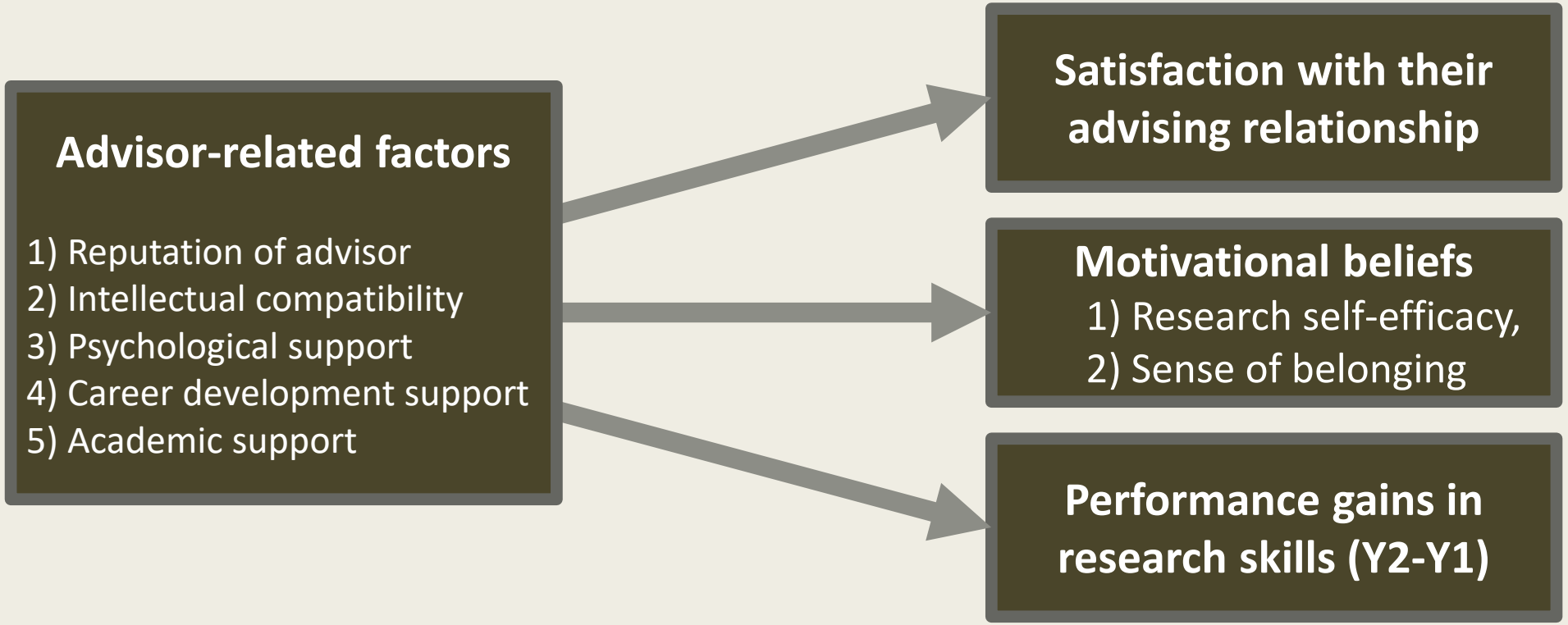
Proposition 3:



Measures (Jeong et al., 2018b; *AERA*)

Advisor-related factors (23 items)

Satisfaction with their advising relationship (7items)

Graduate Advising Survey for Doctoral Students (GASDS) Barnes et al. (2011)

Research self-efficacy (10 items)

"**To what extent do you feel you can** observe and collect data?" Kardash (2000)

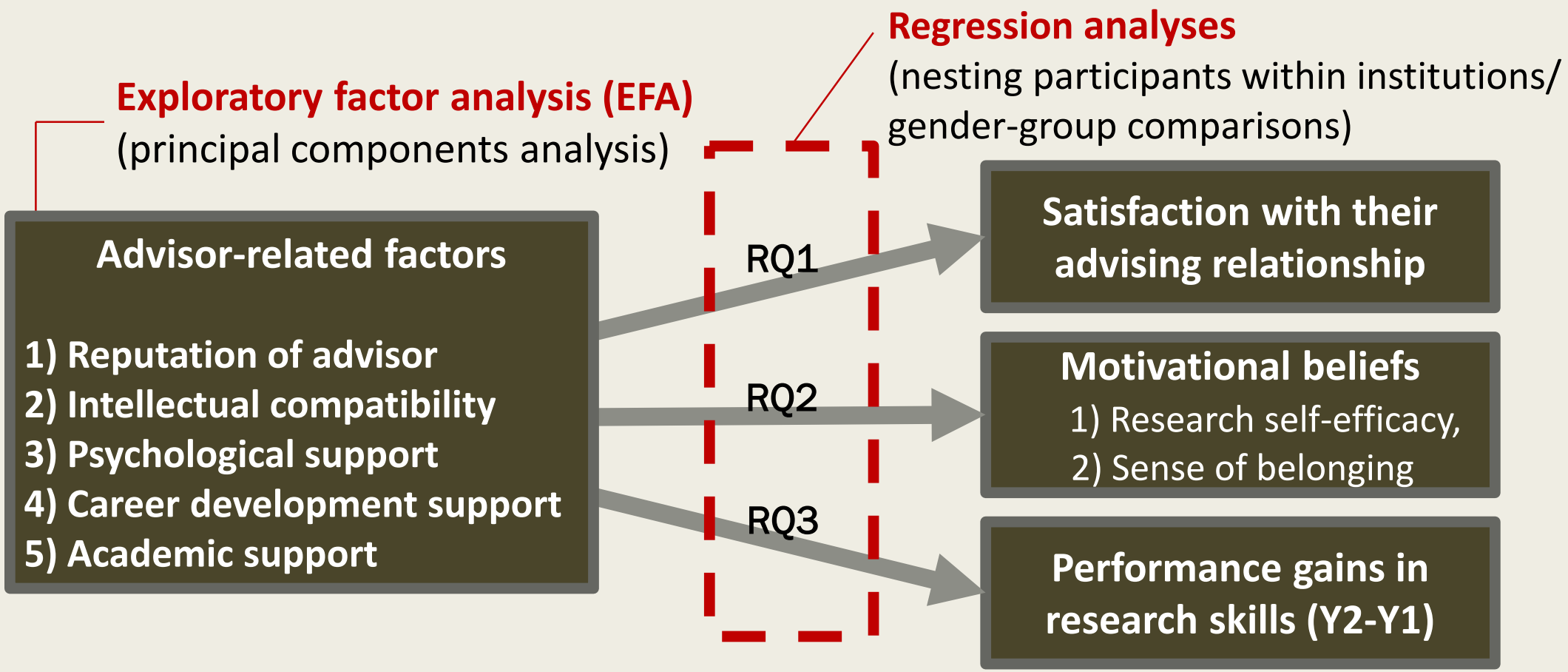
Sense of belonging (3 items)

"I feel that I am **a member of the lab/research group community**" Bollen & Hoyle (1990)

Performance gains in research skills (13 skills)

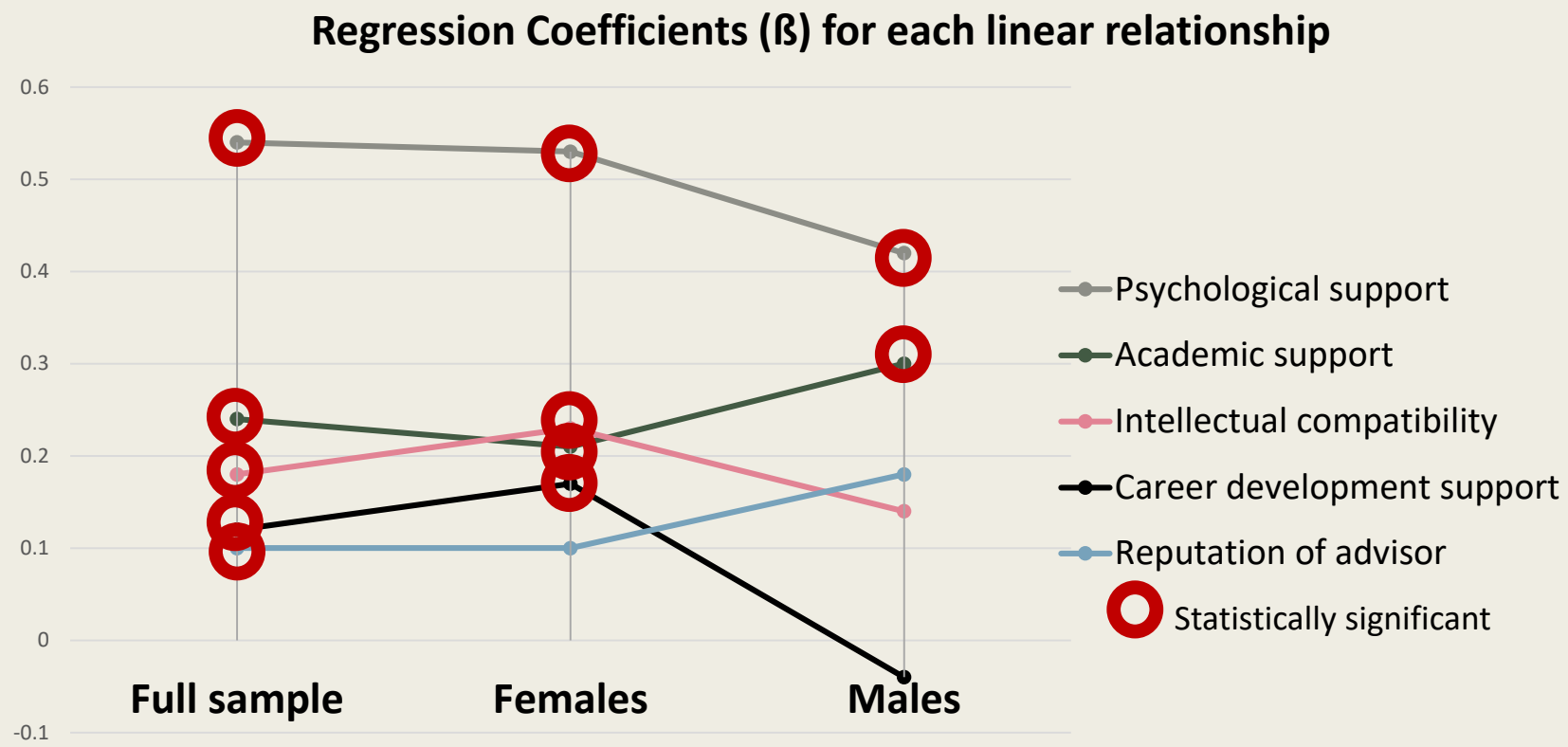
Written **research proposals** or reports using a rubric Feldon et al. (2011)

Analyses


Regression analyses
(nesting participants within institutions/ gender-group comparisons)
Exploratory factor analysis (EFA)
(principal components analysis)
Advisor-related factors
1) Reputation of advisor
2) Intellectual compatibility
3) Psychological support
4) Career development support
5) Academic support
RQ1
RQ2
RQ3
Satisfaction with their advising relationship
Motivational beliefs
1) Research self-efficacy,
2) Sense of belonging
Performance gains in research skills (Y2-Y1)

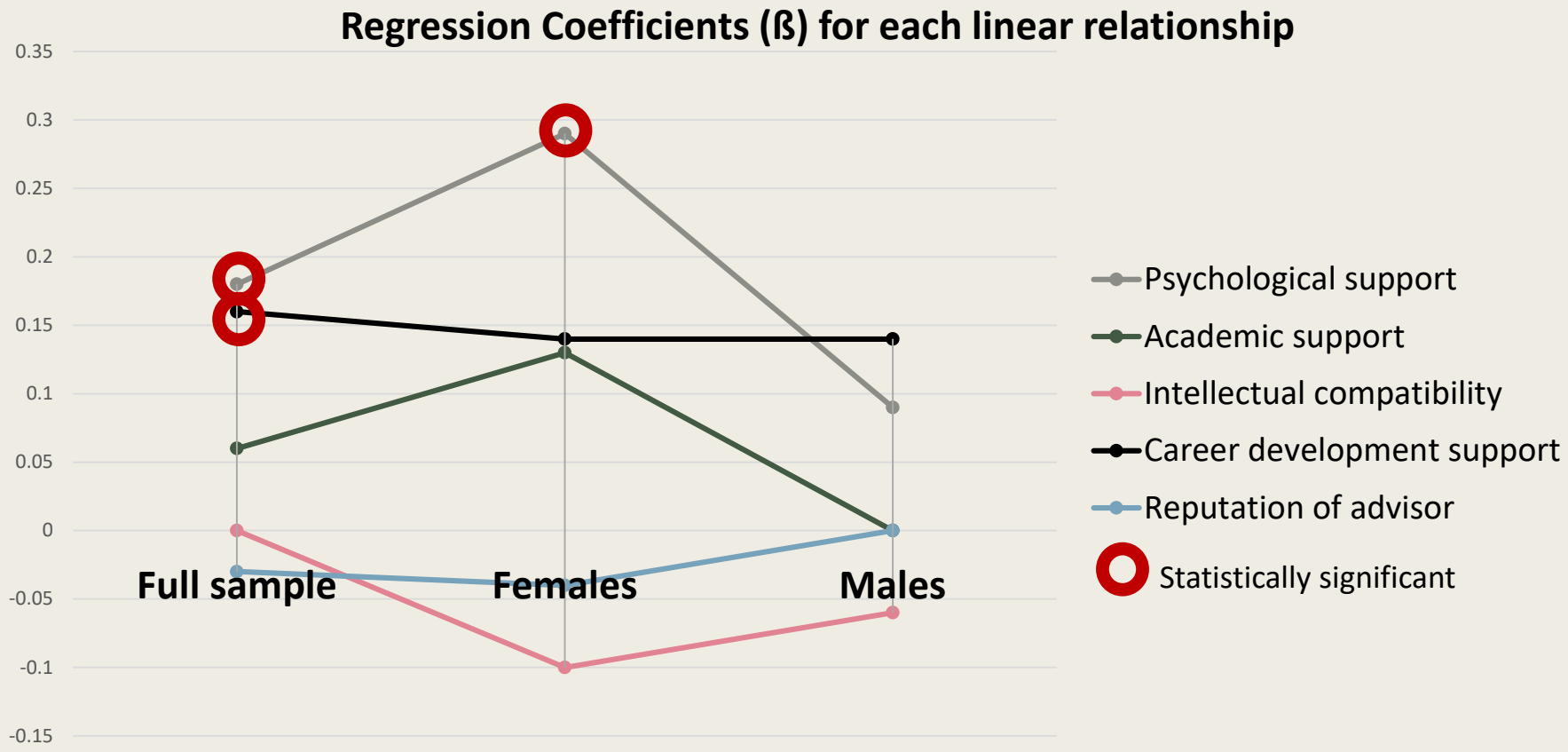
Results

- **Advisor-related factors predicting student satisfaction with advisor**



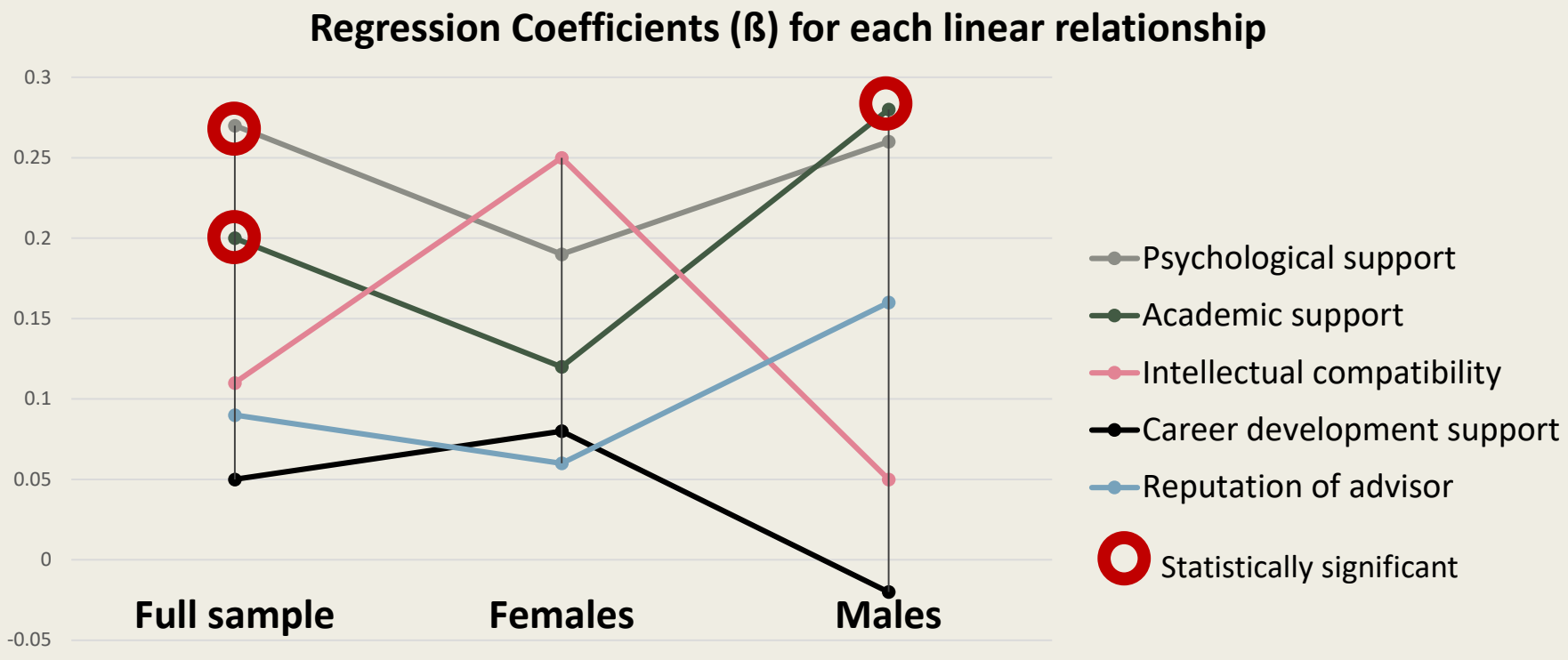
Results

- **Advisor-related factors predicting research self-efficacy**



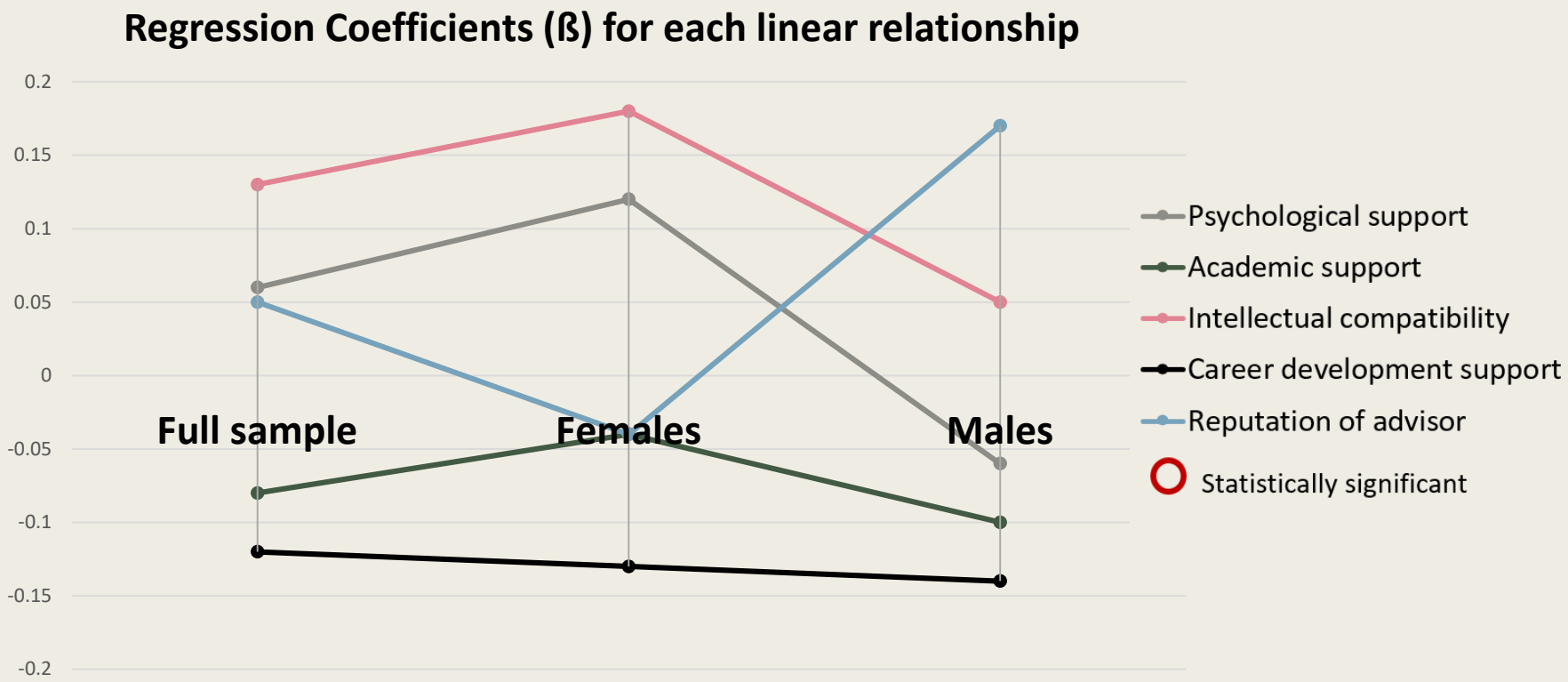
Results

- **Advisor-related factors predicting sense of belonging**



Results

- **Advisor-related factors predicting performance gains in research skills**



Summary of Results

	Satisfaction with advisor	Motivational beliefs		Performance gains in research skills
		Research self-efficacy	Sense of belonging	
Psychological support	Full Female Male	Full Female	Full	
Academic support	Full Female Male		Full Male	
Intellectual compatibility	Full Female			
Career development support	Full Female	Full		
Reputation of advisor	Full			

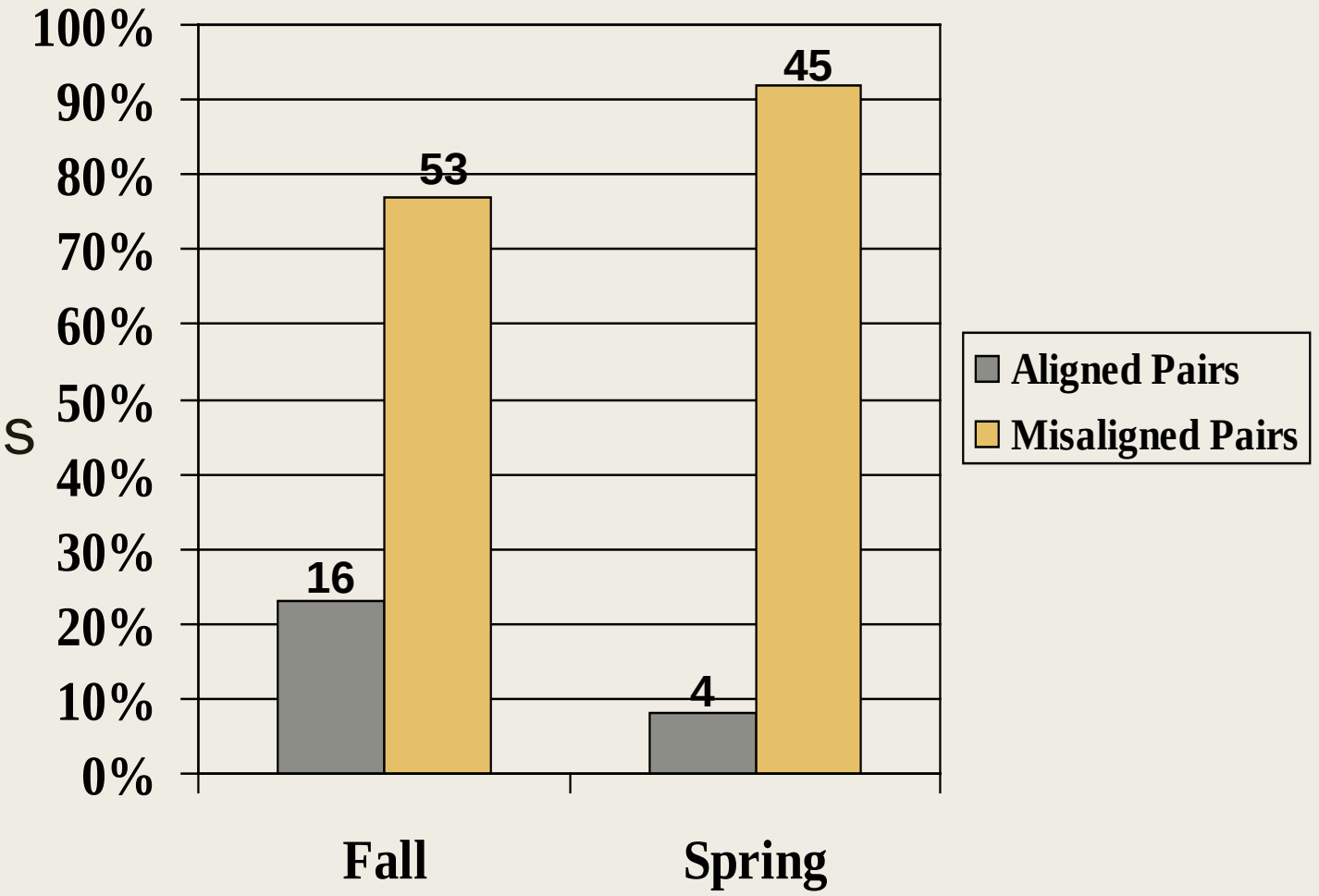
Discussion

- Well-established variables positively **predict advisor satisfaction** but have **little or no associations with other socialization outcomes**
- The **traditional cognitive apprenticeship model** **may not reflect** the varied influences on doctoral student development (Feldon et al., 2015)
- **Cascading mentorship** **(e.g., postdoctoral researchers, senior peers)** may drive central figures in doctoral students' day-to-day experiences (Golde et al., 2009)

Faculty Mentor Perspectives (Feldon et al., 2015, *AERJ)*

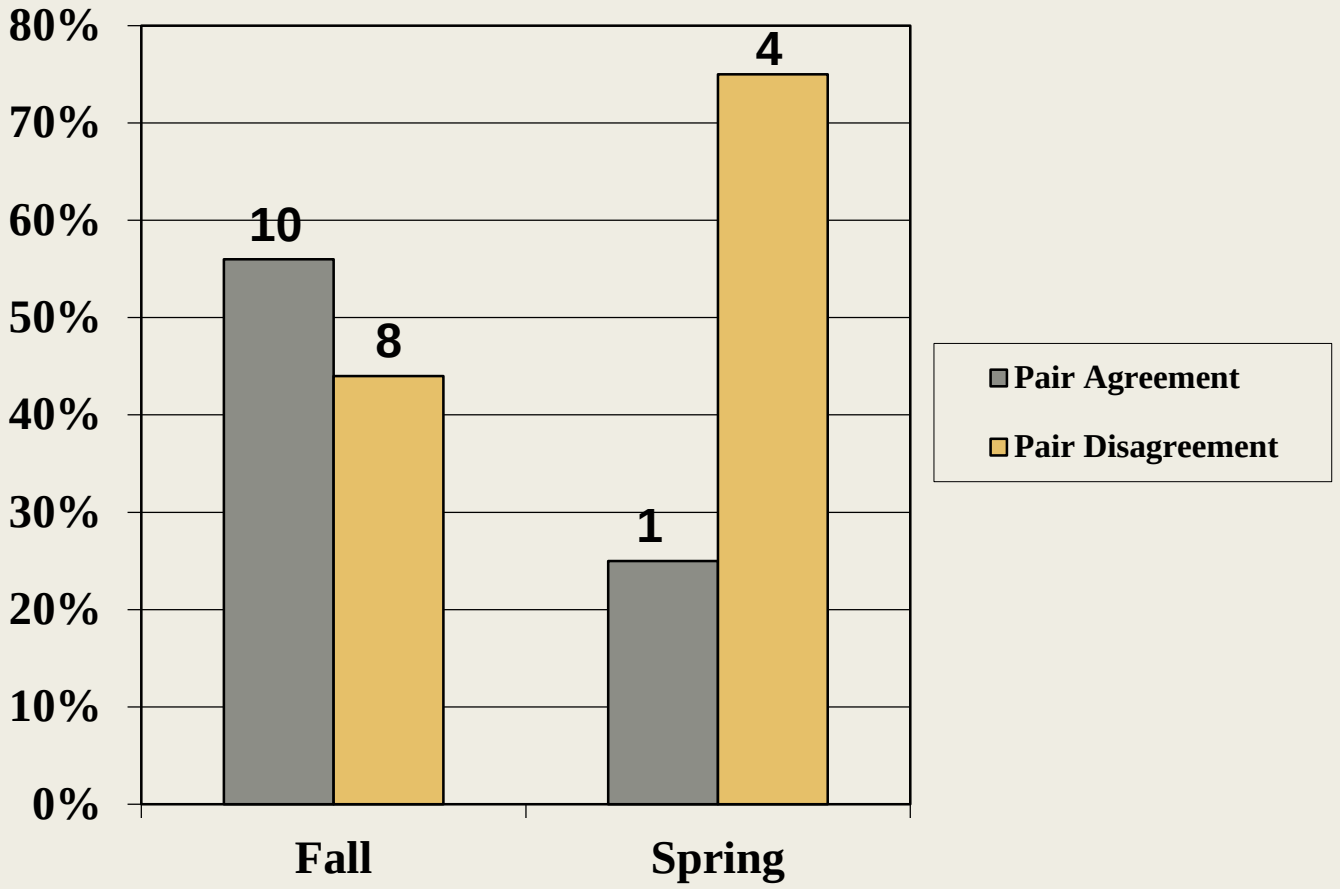
Interviewed 74 intact mentor-mentee pairs

Most pairs mentioned unrelated research skills as strengths or weaknesses



When pairs did align…

Roughly half disagreed on traits as strength or weakness



Mismatches

Graduate Student

> “I don’t feel really comfortable with me being pretty much on my own right now. But right now I really describe myself as a weak researcher who is striving to become a stronger one.”

Research Mentor

> “She understands fully the concepts that she does need to design and complete a study. So, I would say she is strong.”

Agreement: Mentor Perception and Mentee Performance (Fall)

Rubric/Interview Categories	Analysis Skills	Big Picture	Conceptual Knowledge	Critical Thinking	Data Interpret.	Defining Problem	Lit. Review	Math/Stat Skills	Research Design
Intro./ Context		3 / 6	5 / 11				7 / 14		
Testable Hypothesis	3 / 10			2 / 4		2 / 3			
Valid./Reliability	3 / 10			3 / 4					
Exp. Design	5 / 10			3 / 4					8 / 15
Data Selection				2 / 4		2 / 3			
Data Analysis	5 / 10			1 / 4		2 / 3		0 / 6*	
Discussion/ Conclusion	6 / 10			2 / 4	1 / 2	1 / 3			
Limitations/ Significance	4 / 10	2 / 6		2 / 4	1 / 2				
Prim. Lit.			5 / 11				8 / 14		
Mean Congruent	43.3%	41.7%	45.5%	53.6%	50.0%	58.3%	53.6%	0.0%	53.3%

Agreement: Mentor Perception and Mentee Performance (Spring)

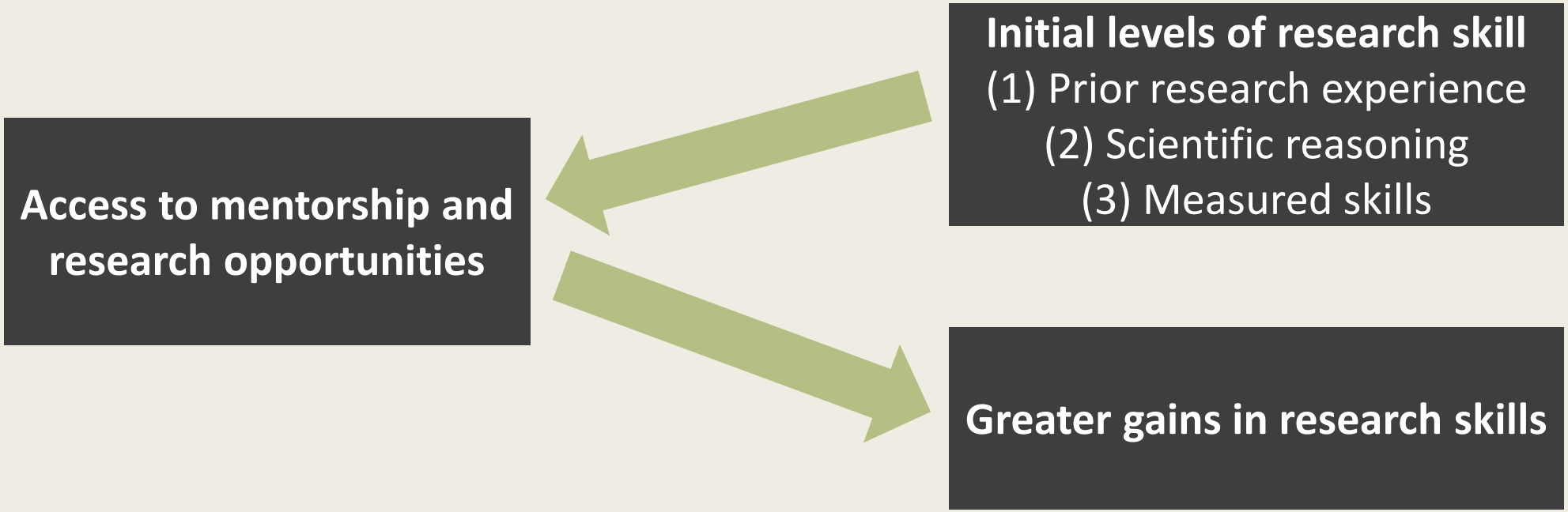
Rubric/Interview Categories	Analysis Skills	Big Picture	Conceptual Knowledge	Critical Thinking	Data Interpret.	Defining Problem	Lit. Review	Math/Stat Skills	Research Design
Intro./ Context		5 / 9	3 / 7				3 / 7		
Testable Hypothesis	1 / 1			0 / 0		0 / 0			
Valid./Reliability	1 / 1			0 / 0					
Exp. Design	0 / 1			0 / 0					0 / 0
Data Selection				0 / 0		0 / 0			
Data Analysis	1 / 1			0 / 0		0 / 0		0 / 6*	
Discussion/ Conclusion	1 / 1			0 / 0	0 / 0	0 / 0			
Limitations/ Significance	1 / 1	6 / 9		0 / 0	0 / 0				
Prim. Lit.			5 / 7				4 / 7		
Mean Congruent	83.3%	61.1%	57.1%	N/A	N/A	N/A	50.0%	0.0%	N/A

Cumulative Advantage

Matthew Effect

- **Initial advantage** tends to beget **further advantage**, and disadvantage further disadvantage, among groups and people through time (Merton, 1968; Rigney, 2010)
- Graduate students who **published early gained legitimacy**, were given **further opportunities** to join new research projects, and had greater interactions with faculty (Gopaul, 2013)
- Students' **incoming** attitudes, objective abilities, and research-related experience **predicted amount of mentoring** provided during the first year (Green & Bauer, 1995)
- **Initial research experience and mentoring** in Y2 of Ph.D. program each positively **predicted cumulative research productivity** after 4 years (Paglis et al., 2006)

Proposition 4:



Measures (Feldon et al., 2016; *AERJ*)

- Prior research experience (survey)
- Lawson's Test of Scientific Reasoning
- ACT Test of Science Reasoning
- **Rubric pre- and post scores**

High performers vs. low performers

- Participants were classified as high or low based on median split for each of 10 skills
- Instances of high and low summed
  - *Sum > 5 “highs” = high performer (n = 36)*
  - *Sum > 5 “lows” = low performer (n = 39)*
  - *20 participants excluded for both sums < 5*
- MANCOVA
  - *IV: High vs. low*
  - *Covariates: prior research experience; scientific reasoning; rubric pre-score*
  - *DV: Rubric post score*

Quantitative Results

	Mean (High)	Mean (Low)	SD (High)	SD (Low)	Mean Difference	Cohen's *d*	% Pop. Sig.	p-value (1-tail)
Introduction	2.219	1.953	0.504	0.486	0.267	0.54	0.890	0.029
Use of Lit.	1.213	0.549	0.614	0.695	0.664	1.01	1.000	0.001
Hypotheses	0.833	0.392	0.453	0.532	0.442	0.89	1.000	0.003
Reliability	1.855	1.360	0.574	0.636	0.495	0.82	0.960	0.002
Design	0.702	0.261	0.471	0.444	0.441	0.96	1.000	0.002
Data Selection	0.226	-0.170	0.430	0.588	0.396	0.77	1.000	0.008
Data Analysis	0.660	0.173	0.573	0.601	0.487	0.83	1.000	0.006
Data Present.	-0.509	-0.976	0.643	0.873	0.467	0.61	1.000	0.026
Conclusions	2.624	2.265	0.697	0.582	0.359	0.56	1.000	0.032
Limitations	4.477	3.969	0.775	0.546	0.508	0.76	1.000	0.005

Qualitative Findings

- Advisor Relationship
  - *Strong, positive relationships across both groups*
    - Most relationships described as close
    - Advisors approachable, available, and ready to assist students' research efforts
    - All participants reported that advisors expected research activities
  - *High performers' advisors held clear expectations of self-direction and productivity*
  - *Low performers' advisors held more flexible expectations*

Qualitative Findings

- Research Activities
  - *High expectations of research activity across both groups*
  - *Co-authoring with advisors did not differ across groups*
  - *Collaborating with faculty other than advisors was more common with high performers*

Broader Themes: Independence

Low Performers

“I am just following my advisor and he is teaching me everything”

“We come up with experiments, what to do, what not to do”

“Big decisions are decided by my advisor”

High performers

“You want to have an idea… he wants you to try to figure it out on your own first”

“There’s a lot of independence involved…a lot expected of you”

“He expects I will figure it out, then I bring to him what I have and he critiques it”

Broader Themes: Derived Meaning

Low Performers

“All I had to do was watch this screen. We had these mice. I counted how many squares they crossed”

“I focused on learning how to manipulate the instruments and just focused on the experiments”

“We keep changing experiments and you do it over and over again.”

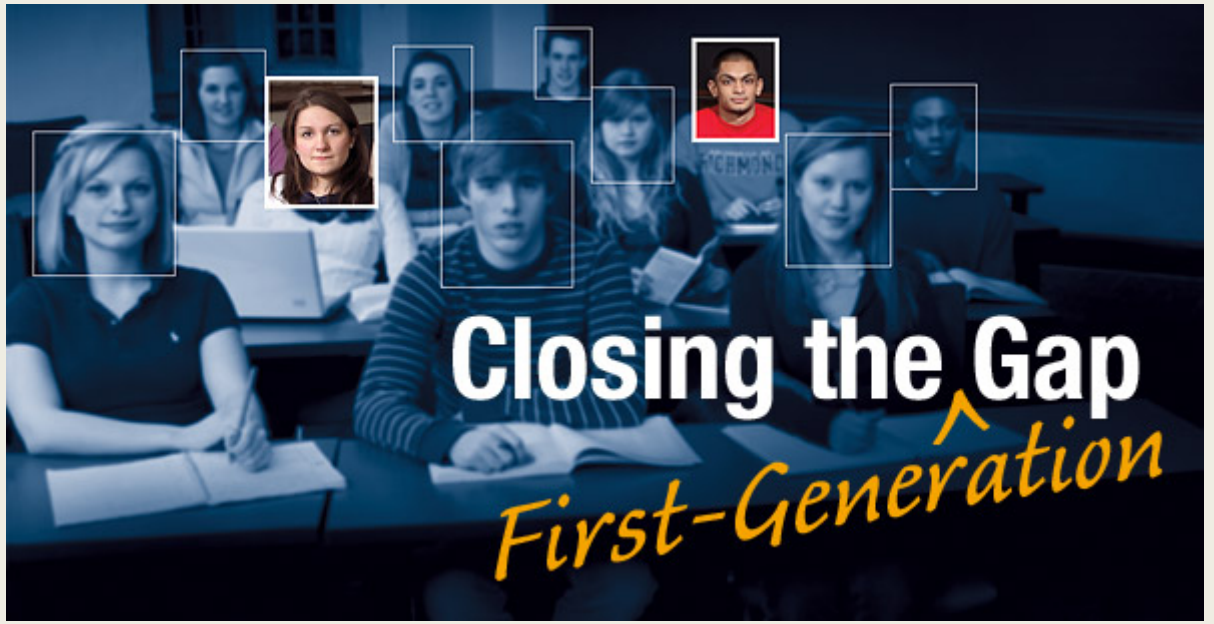
High performers

“The lab works on the main project and I have taken a piece of that as my dissertation. I’m the primary mover of those data”

“By having contributed to so many things, I’ve become a resource to…our lab”

“I’ve learned a lot of new techniques so I’ve enhanced my capabilities.”

Proposition 5:



Experiences by First-Gen status (Roksa et al., 2018; *JHE*)

	First generation	Continuing generation	Statistical significance
Demographics			
Female	0.56	0.62	*ns*
Underrepresented racial/ethnic minority	0.28	0.13	**
Predoctoral experiences			
Scientific reasoning score	18.92	20.08	*
Undergraduate research experience (months)	15.45	17.95	*ns*
R1 undergraduate institution (%)	0.27	0.42	**
Doctoral experiences Year 1			
Socialization			
Participation in scholarly activities (%)	0.41	0.37	*ns*
Interactions with faculty and peers (%)	0.79	0.75	*ns*
Satisfaction with advisor	2.53	2.49	*ns*
Sense of belonging	8.69	8.23	*ns*
Research-related resources			
High research intensity (%)	0.38	0.47	*ns*
Research infrastructure	2.73	2.67	*ns*
Doctoral experiences Year 2			
Socialization			
Participation in scholarly activities (%)	0.56	0.52	*ns*
Interactions with faculty and peers (%)	0.80	0.78	*ns*
Satisfaction with advisor	2.70	2.70	*ns*
Sense of belonging	8.96	9.03	*ns*
Research-related resources			
High research intensity (%)	0.38	0.47	*ns*
Research infrastructure	2.76	2.71	*ns*
Doctoral experiences Year 3			
Socialization			
Participation in scholarly activities (%)	0.64	0.61	*ns*

Outcome by First-Gen status

Table 2. Outcome measures by first-generation status.

	First generation	Continuing generation	Statistical significance
High goal commitment			
Year 1	0.97	0.93	*ns*
Year 2	0.82	0.88	*ns*
Year 3	0.90	0.88	*ns*
High institutional commitment			
Year 1	0.62	0.55	*ns*
Year 2	0.57	0.56	*ns*
Year 3	0.63	0.56	*ns*
Research productivity (any publications)			
Year 1	0.30	0.31	*ns*
Year 2	0.42	0.50	*ns*
Year 3	0.59	0.62	*ns*

Scholarly Productivity

	Year 1	Year 2	Year 3
First-generation	−0.263	−0.664*	−0.185
	(0.295)	(0.290)	(0.334)
URM	0.239	0.355	−0.414
	(0.445)	(0.417)	(0.401)
Female	0.032	0.297	0.060
	(0.279)	(0.227)	(0.291)
Predoctoral Experiences			
Scientific reasoning	−0.038	−0.029	−0.049
	(0.037)	(0.038)	(0.037)
Undergraduate research experience	−0.002	0.008	0.000
	(0.010)	(0.009)	(0.015)
R1 undergraduate institution	0.072	−0.127	−0.647*
	(0.220)	(0.255)	(0.292)
Doctoral Experiences			
Socialization			
Participation in scholarly activities	1.766**	1.571*	1.934**
	(0.663)	(0.687)	(0.737)
Interactions with faculty and peers	1.679*	−0.460	−0.430
	(0.805)	(0.556)	(0.918)
Satisfaction with advisor	0.236	−0.249	0.134
	(0.333)	(0.434)	(0.346)
Sense of belonging	−0.027	0.104	0.075

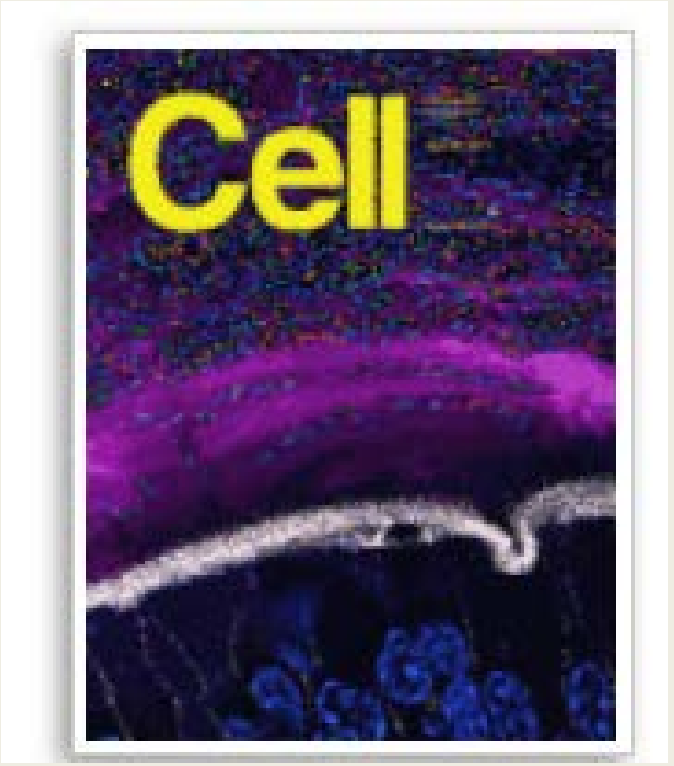
Supplemental interventions

Growing Popularity of Short Format Interventions

- Boot Camps (aka “nanocourses”)
  - *2 days - 2 weeks long*
- Summer Bridge Programs
  - *4-6 weeks long*
- Typically focus on mathematical computing and statistical analysis
  - *May also target: research design, scientific writing*
- NSF and NIH currently have $27.8 million in active awards supporting these types of interventions

High Levels of Enthusiasm and Endorsement

Vale et al. (2012)



Gutlerner & Van Vactor (2013)

Major Rationales for Use

- Accelerate graduate student skill development
- Increase the efficiency of curriculum
  - *Finish coursework earlier*
  - *Get students into labs for supervised research faster*
- Develop skills that students may not pick up along the way

However…

- Only two sources of supporting data
  - *Anecdotal enthusiasm (Vale et al., 2012; Gutlerner & Van Vactor, 2013)*
  - *Post-only surveys of student satisfaction (Stefan et al., 2015)*

- No control or comparison group
- No measures of learning
- No measures of impact on socialization
- No measures of scholarly productivity

Measures (Feldon et al., 2018; *PNAS*)

- Demographics
- Research Experience Self-Rating scale (self-efficacy measure, Kardash, 2000)
- Rubric-scored writing samples (intraclass correlations ≥ 0.75 for all planks)
- Counts of peer-reviewed journal articles, conference papers, and published abstracts
- Weidman & Stein's (2003) instrument eliciting perceptions of department collegiality

Total N = 294; 48 (16.3%) indicated via survey participation in boot camp or bridge program during summer preceding or following first year of Ph.D. program

Measures

- Campus Climate and Commitment Survey (perceptions of academic and intellectual development, PhD goal commitment, and institutional commitment; Nora & Cabrera, 1996)
- Perceived Cohesion Scale (sense of belonging to the research community; Bollen & Hoyle, 1990)
- Graduate Advising Survey for Doctoral Students (function of advisor and time to degree; Barnes et al., 2011)
- Research Infrastructure subscale of the Student Research Experience Questionnaire (Ginns et al., 2009)

Statistical Analysis

- Compared outcomes on all measures in Year 1, Year 2, Y1-Y2 gains
  - *115 separate comparisons*
  - *Accounted for multiple comparisons using False Discovery Rate (Benjamini & Hochberg, 1995) which is more liberal than Bonferroni correction*
- Analyses conducted using Mplus 7.4
  - *Controlled for nesting within institution to prevent biased parameter estimates*
  - *Used the multiple-group analysis function to ensure that the assumption of homogeneity of covariate regression slopes was met through parameter estimate constraints while appropriately handling missing data*
  - *Gender used as covariate*

Findings (part 1)

- Across 115 separate comparisons, only 2 had $p < 0.05$
  - *# of abstracts published in Y2*
  - *Gain in # of abstracts published from Y1 to Y2*
- BUT…
  - *Differences favored participants who did <u>not</u> participate in a boot camp or bridge program*
  - *Differences nonsignificant after controlling for familywise error with FDR*
  - *Monte Carlo simulations were ≤ 73% rejection of null hypothesis*
    - Therefore results unlikely to be due to small sample or sampling bias

Findings (part 1)

Variable Name	Coefficient	p-value	Cohen's d	% Significant in Monte Carlo Simulation	FDR Critical Value
Published Abstracts (gain)	0.196	0.002	0.47	73.3%	0.0004348
Published Abstracts (T2)	0.183	0.009	0.41	68.0%	0.0008696
Student Scholarly Encouragement (T1)	0.090	0.056	0.22	30.0%	0.0013043
Perceived Cohesion/Sense of Belonging (T1)	0.584	0.056	0.33	54.3%	0.0017390
Research Infrastructure (T2)	0.139	0.073	0.42	59.4%	0.0021739
Department Collegiality (T2)	0.198	0.097	0.28	41.6%	0.0026087
Perceived Cohesion/Sense of Belonging (T2)	0.462	0.098	0.25	36.1%	0.0030435

Findings (part 2)

- Rival hypothesis:
  - *Boot camps may target “at-risk” students (and therefor NSD is a positive outcome)*

- Re-ran analyses including additional covariates:
  - *Underrepresented racial/ethnic minority status*
  - *International student status*
  - *Quantity of undergraduate research experience*

Findings (part 2)

- Across 115 separate comparisons, only 4 had $p < 0.05$
  - *# of abstracts published in Y2*
  - *Gain in # of abstracts published from Y1 to Y2*
  - *Student Scholarly Encouragement*
  - *Access to Research Infrastructure*

- BUT…
  - *Differences favored participants who did <u>not</u> participate in a boot camp or bridge program*
  - *Differences nonsignificant after controlling for familywise error with FDR*
  - *Monte Carlo simulations were ≤ 67% rejection of null hypothesis*
    - Therefore results (more) unlikely to be due to small sample or sampling bias

Findings (part 2)

Variable Name	Coefficient	p-value	Cohen's d	Percent Significant in Monte Carlo Simulation	FDR Critical Value
Published Abstracts (gain)	0.187	0.005	0.45	67.1%	0.0004348
Published Abstracts (T2)	0.164	0.022	0.38	57.4%	0.0008696
Student Scholarly Encouragement (T1)	0.104	0.024	0.25	37.0%	0.0013043
Research Infrastructure (T2)	0.149	0.048	0.46	64.0%	0.0017391
Perceived Cohesion/Sense of Belonging (T1)	0.547	0.065	0.31	46.6%	0.0021739
Department Collegiality (T2)	0.212	0.077	0.31	44.9%	0.0026087
Research Infrastructure (gain)	0.133	0.083	0.46	63.2%	0.0030435

Discussion

- Findings similar to the few available studies of undergraduate bridge programs (Barnett et al., 2012; Cabrera, 2013; DeRoma et al. 2009; Gleason et al., 2010; Murphy et al., 2010; Walpole et al. 2008; Wathington et al., 2011)
- Two possible explanations for findings:
  - *Spaced vs. massed practice effects*
  - *Targeted topics inappropriate for early career Ph.D. students*
    - Kiley & Wisker (2009) and Timmerman et al. (2013) provide evidence that research skills develop in sequence
    - Per Timmerman et al., data analysis skills among the last to develop

“I had,” he said, “come to an entirely erroneous conclusion which shows, my dear Watson, how dangerous it always is to reason from insufficient data.”

—Sherlock Holmes,
The Adventure of the Speckled Band

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