Industry/University Cooperative Research Centers

A Multivariate Study of Graduate Student Satisfaction and Other Outcomes Within Cooperative Research Centers

Thesis Research

by

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PROBLEM STATEMENT

- Despite graduate education being an objective for CRC programs evaluation there are gaps in research when determining if educational objectives are being satisfied
- Graduate students who participate in CRCs are perceived as having educational advantages
  - Center alumni were rated superior in job performance when hypothetically compared to their organizations' peers by themselves and their supervisors and rated as being more prepared and needing less initial job training by their supervisors (Abt 1997, 1996; Roessner, 1997; Scott, Schaad, & Brock, 1991)
  - Advantages
    - Experiential education, teamwork, soft skills, multidisciplinary experiences, contact with industry
  - Center experiences and advantages to graduate students are for the most part speculative assumptions
- Lack of literature on graduate students' experiences and benefits in CRCs
  - Almost no research on current graduate students
  - Research lacks sophisticated methodology and is global

Purpose of Research

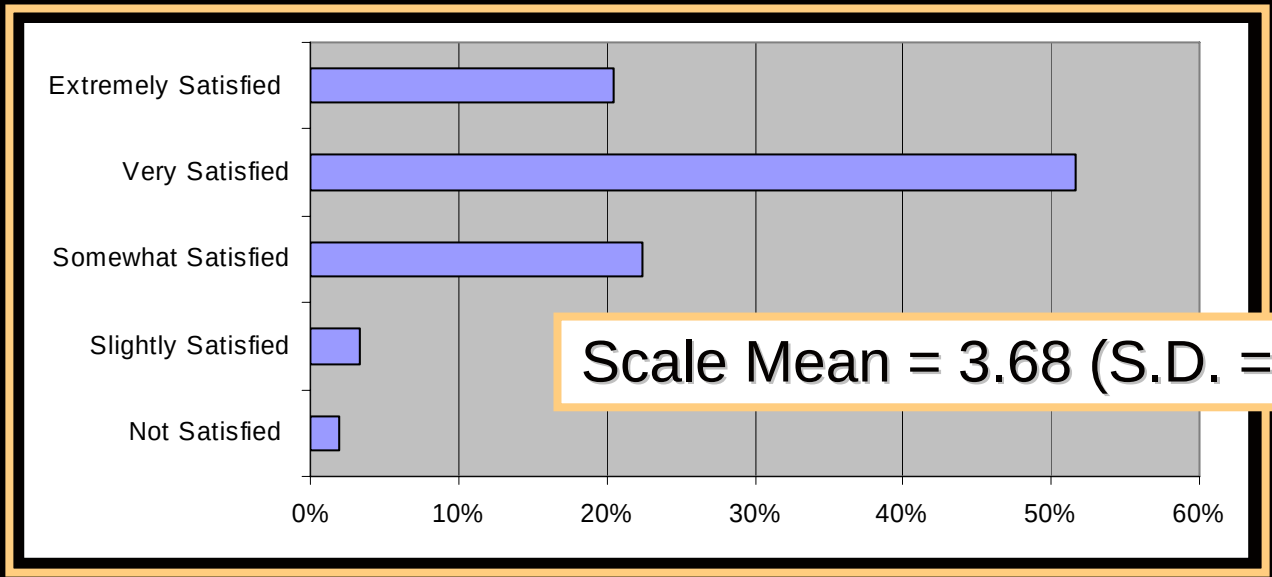
Industry/University Cooperative Research Centers

- Need for more research
  - Understand the mechanisms and experiences that account for the benefits and outcomes of the program
  - “Real time” data, not retrospective
- Assumptions
  - The training experience provided by individual centers varies
  - Those differences have the potential to affect student outcomes
- Purpose of Research
  - To explore benefits, experiences, and satisfaction of current graduate students in cooperative research centers
  - To identify key center mechanisms needed to achieve those educational benefits

Assumptions

Industry/University Cooperative Research Centers

- The training experience provided by individual centers varies
- Those differences have the potential to affect student outcomes



Individual Center Mechanisms to Outcomes

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Predictors

Demographics
•Gender, Age, Ethnicity, Citizenship
Student Characteristics
•Funding, Department, Degree, GPA, Years at University
Center Characteristics

Individual Center

Center Mechanisms
•Center Experiences
•Formal Center Training Activities
•Technical Project Involvement
•Thesis/Dissertation Committee

Interactions: Industry, Center Director, Advisor, Students, etc.

Process/Outcomes

- Satisfaction
- Perceived Skills
  - –Advanced Technical and Problem Solving Skills
  - –Soft Skills
- Organizational Commitment
- Scholarly Achievement
- Competitive Advantage
- Career Goals

Key Question

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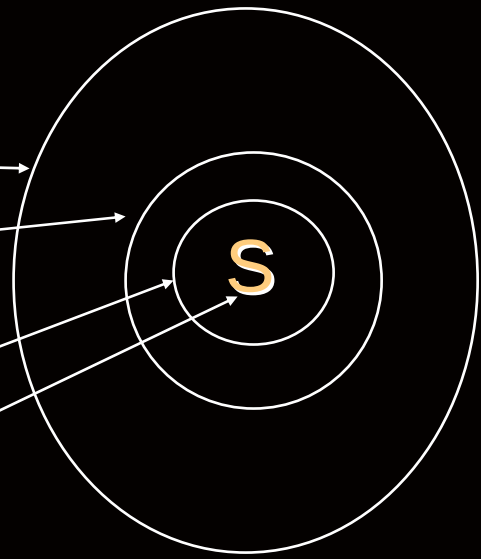
To what extent are these differences attributable to:

- Center-level factors
- Center Project Group-level factors
- Traditional Educational level-factors (Advisor/Committee)
- Individual differences



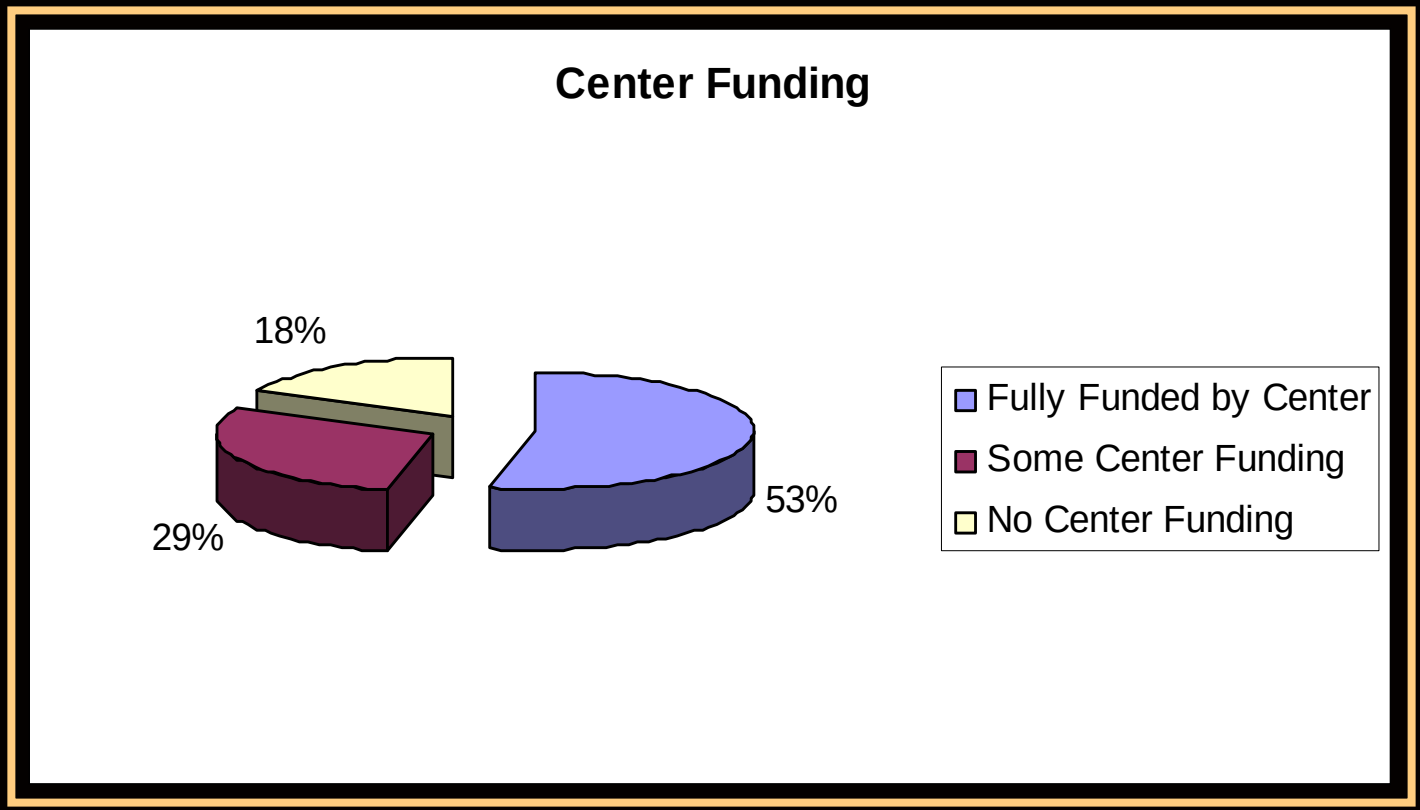
Research Questions & Methodology

Industry/University Cooperative Research Centers

- Primary Research Questions:
  - What is the Center educational experience like?
  - After controlling for significant demographic, student, and center characteristics, to what extent are center experiences and interactions significantly related to graduate students' outcomes?
- Design
  - Predictive study: Multivariate regression
  - Web-based questionnaire
- Response Rate
  - Number of Centers: 34 (89%)
  - 528 sent out
  - 190 total (37% response rate)

Center Funding

Industry/University Cooperative Research Centers



What formal center training mechanisms do center's offer?

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Item	Percentage of centers who offer activity (n = 34)	Mean level of involvement (Range 1-5) (n = 190)	Mean level of involvement if center has mechanism
Regular meetings with your project team	85.3	3.42	3.60 (n = 177)
Regular meetings with your entire center team	79.4	2.54	2.78 (n = 165)
Periodic center industrial advisory board (IAB) meetings	79.4	2.43	3.05 (n = 133)
Scientific/technical seminar series featuring outside speakers (e.g., professors, industry participants)	79.4	2.14	2.32 (n = 164)
Scientific/technical seminar series featuring student speakers (e.g., brown bag, student presentations)	64.7	2.25	2.88 (n = 126)
New academic courses sponsored or developed by the center or center faculty	26.5	1.38	2.30 (n = 56)
Co-op or Internship placements	29.4	1.3	1.84 (n = 68)
Workshops on "soft skills" or non-technical topics (e.g., teamwork, communication, career development, leadership)	14.7	1.23	2.63 (n = 27)
Mentoring (formal mentor assignments)	5.9	1.22	2.56 (n = 27)
Educational interventions targeted at youth (K-12) and sponsored by the center	5.9	1.18	2.30 (n = 27)

Summary of Scales

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Outcomes	M	SD	# of Items	Reliability
Satisfaction (Range 1 – 5)	3.68	0.72	10	0.9
Skills (Range 1 – 5)				
Perceived Soft Skills	3.84	0.61	4	0.8
Perceived Advanced Technical and Problem Solving Skills	3.83	0.66	6	0.88
Organizational Commitment (Range 1 – 5)	3.89	0.84	2	0.89
Predictors				
Technical Project Involvement (Range 1-5)	4.11	0.74	5	0.78
Advanced Formal Center Training Mechanisms (Range 1-5)	2.18	0.74	7	0.68
Center Experiences (Range 1-4)				
*Note: n = 190				

*Principal axis based factor analysis with a varimax rotation

* 0.4 = minimum factor-loading

Center Experiences Measure

Industry/University Cooperative Research Centers

Center Experiences

- *Hypothesized*
  - Multidisciplinary
  - Team based
  - Experiential
  - Technical
  - Soft Skills

- *Results*
  - Multidisciplinary (4 items)
    - Scale Mean = 2.98; S.D. = 0.58
    - Reliability = .76
    - *Example Item: "Working/interacting regularly with faculty from other disciplines"*
  - Experiential (7 items)
    - Scale Mean = 3.2; S.D. = 0.41
    - Reliability = .73
    - *Example Item: ""Hands-on" learning/learning-by-doing approach"*

- Scale: "My involvement in the Center includes…
1 = "Strongly Disagree" to
4 = "Strongly Agree"

Testing the Level of Effects

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- Intra-class correlation was used to test whether variance in various predictors was explained by center affiliation (e.g., were students within centers more alike than students across centers)
- This was not demonstrated
  - » Center-level groupings did not explain variance in key IVs
  - » All results represent individual-level prediction

Predicting Outcomes

N = 190; A statistical significance of $p < .10$ was utilized for exploratory purposes

Satisfaction

Industry/University Cooperative Research Centers

	R Square = .44	
Satisfaction	***B***	**Sig.**
Gender (0 = Female, 1 = Male)	-0.15	0.01
Interactions: Advisor	0.20	0.00
Interactions: Industry Members	0.16	0.01
Technical Project Involvement	0.12	0.03
Multidisciplinary Center Experiences	0.22	0.01
Experiential Center Experiences	0.27	0.00

Organizational Commitment

Industry/University Cooperative Research Centers

	R Square = .40	
Organizational Commitment	***B***	**Sig.**
Ethnicity: Caucaisan vs. Asian/Asian American	0.24	0.00
Interactions: Center Director	0.13	0.05
Multidisciplinary Center Experiences	0.19	0.01
Number of Departments on Thesis/Dissertation Committee: No Commmittee vs. One Department	0.19	0.01
Number of Departments on Thesis/Dissertation Committee: One Department vs. Two or More Departments	0.25	0.00
Experiential Center Experiences	0.35	0.00

Perceived Advanced Technical and Problem Solving Skills & Perceived Soft Skills

Industry/University Cooperative Research Centers

	R Square = .36	
Perceived Advanced Technical and Problem Solving Skills	***B***	**Sig.**
Years at University	0.17	0.06
Interactions: Thesis/Dissertation Committee	0.13	0.05
Number of Departments on Thesis/Dissertation Committee: One Department vs. Two or More Departments	0.16	0.08
Number of Departments on Thesis/Dissertation Committee: No Committee yet vs. One Department	0.22	0.01
Technical Project Involvement	0.23	0.00
Multidisciplinary Center Experiences	0.27	0.00

	R Square= .26	
Perceived Soft Skills	***B***	**Sig.**
Citizenship (0 = Non-U.S., 1 = U.S.)	0.17	0.01
Years at University	0.23	0.01
Interactions: Thesis/Dissertation Committee	0.12	0.07
Interactions: Industry Members	0.15	0.03
Technical Project Involvement	0.28	0.00

Competitive Advantage

Industry/University Cooperative Research Centers

Competitive Advantage	R Square = .23	
	B	**Sig.**
Total Center Funding	-0.16	0.02
Experiential Center Experiences	0.43	0.00

Publications, Technical Reports, & Presentations

Industry/University Cooperative Research Centers

	Publications		Technical Reports		Presentations	
	Pseudo R^2 = .11		Pseudo R^2 = .05		Pseudo R^2 = .05	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Citizenship Status (0 = Non-U.S., 1 = U.S.)	-0.45	.64**				
GPA			-0.27	.77*		
Student Status (0=Graduated Student, 1 = Current Graduate Student)	-0.69	.50**				
Highest Degree Expected to Complete (0 = Masters, 1 = PhD)	0.75	2.11**				
Chemical Engineering vs. Chemistry	-0.89	.41**				
Chemical Engineering vs. Management Information/Other	0.51	1.66*				
Interactons with Advisor					0.11	1.11**
Interactons with Committee	0.15	1.16***	0.14	1.15*		
Advanced Technical Formal Training Mechanisms	0.26	1.29**				
Time Involved In Center	0.26	1.30***			0.21	1.23***
Technical Project Involvement					0.29	1.38***
X^2	98.59, 17, p < .001		22.08, 7, p = .003		50.24, 7, p < .001	

*p <.10, **p <.05, ***p <.01

Relationship of Satisfaction and Experiential Center Experiences for Citizenship and Gender

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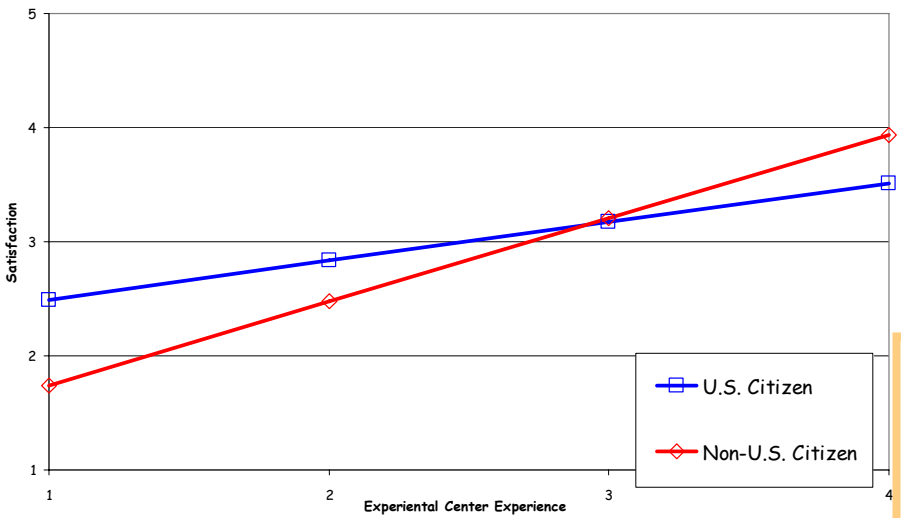

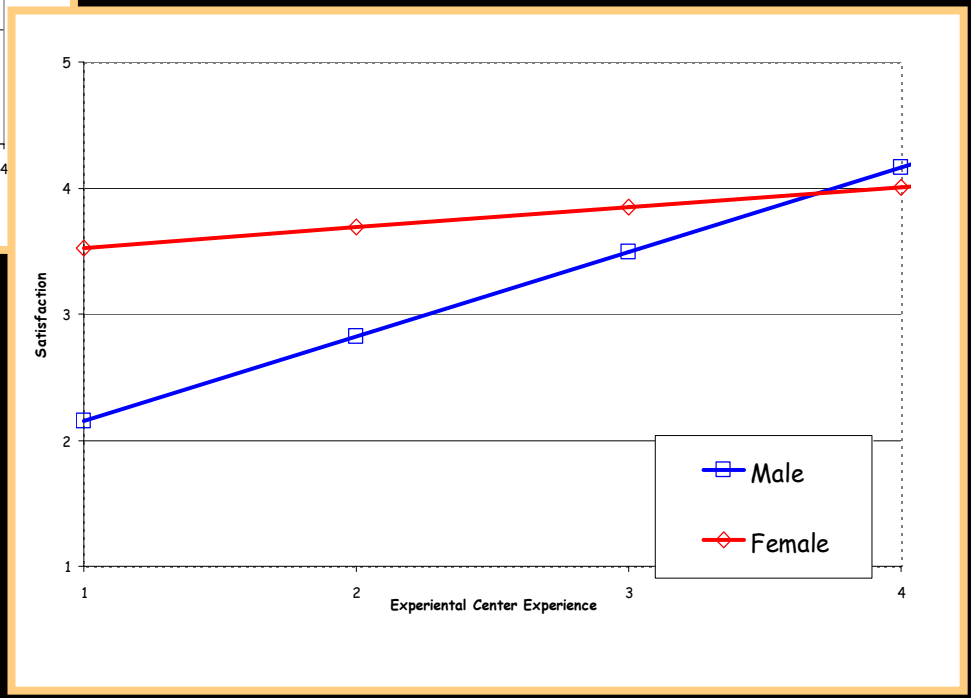

Conclusions

Industry/University Cooperative Research Centers

- Consistent and Powerful Outcome Predictors
  - Experiential Center Experiences
    - » Satisfaction, Organizational Commitment, Competitive Advantage
  - Multidisciplinary Center Experiences
    - » Satisfaction, Perceived Advanced Technical and Problem Solving Skills, Organizational Commitment
  - Technical Project Involvement
    - » Satisfaction, Perceived Advanced Technical and Problem Solving Skills, Perceived Soft Skills, Presentations
- Intriguing Predictors
  - Interactions with Industry, Center Director, Advisor, Committee
- Student experiences predict outcomes but center groupings do not
  - Center training is not homogeneous
    - » Effects may lie at research group and/or advisor level

Future Research

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- Comparison Group
  - Confirm the results are due to center effects and not departmental experiences
- Measures
  - Determine if a student's center experience really is two factors
- Strong basis for causal research in the future
  - Pursue and confirm intriguing findings
  - Pursue and confirm moderator effects
- Centers should consider using some components of the questionnaire to assess student outcomes on an ongoing basis

Practical Implications

Industry/University Cooperative Research Centers

- Center should build on traditional educational practices
  - Interactions with advisor and committee
- Center's educational standards should have:
  - Increased opportunities to interact with industry members
  - Increased collaboration with multiple disciplines
  - Experiential/hands on opportunities
  - Exposure to more of the project's technical aspects

Practical Implications

- Jennifer Schneider, M.S. (May, 2007)
- Working on colleague project on women in science and technology
- Thinking about dissertation evaluating “girls on the run” program

Center Experiences

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Experential Education (Scale Mean = 3.2 (S.D. = .41)	
V.1	Working on scientific problems that are innovative and on the cutting edge
V.2	Opportunities to be a leader
V.3	Relying on the cooperation and collaboration of other principal investigators/scientists
V.6	"Hands-on" learning/learning-by-doing approach
V.8	Receiving an education that encourages me to listen, discuss, evaluate, and to learn from the ideas of others
V.10	Showing how a particular concept can be applied to an actual problem or situation
V.20	Working with people from diverse backgrounds (e.g., ethnicity, gender, nationality)
Multidiscplinary Experiences (Scale Mean =2.98 (S.D. = .58)	
V.13	Integrating and synthesizing information from different fields in solving problems
V.16	Working/interacting regularly with faculty from other disciplines
V.18r	Using knowledge and research from other disciplines ***
V.19r	Frequent interactions with students from other disciplines ***
Negative Statements (Removed)	
V.12r	Few opportunities to develop my verbal and written communication skills
V.17r	Experiences that are rarely applicable to "real-world" situations and problems
V.11r	Rarely applying advanced computer skills
V.18r	Rarely using knowledge and research from other disciplines
V.14r	Not working regularly with state-of-the art equipment and resources
V.7r	Few opportunities to use my creativity when solving research problems
V.5r	An education that rarely requires me to take responsibility for my learning
V.4r	Rarely being knowledgeable about the work occurring on other Center projects
V.19r	Infrequent interactions with students from other disciplines
V.9r	Working alone on projects
Removed Item	
V.15	Being exposed to scientific techniques and expertise that are not usually available in my department