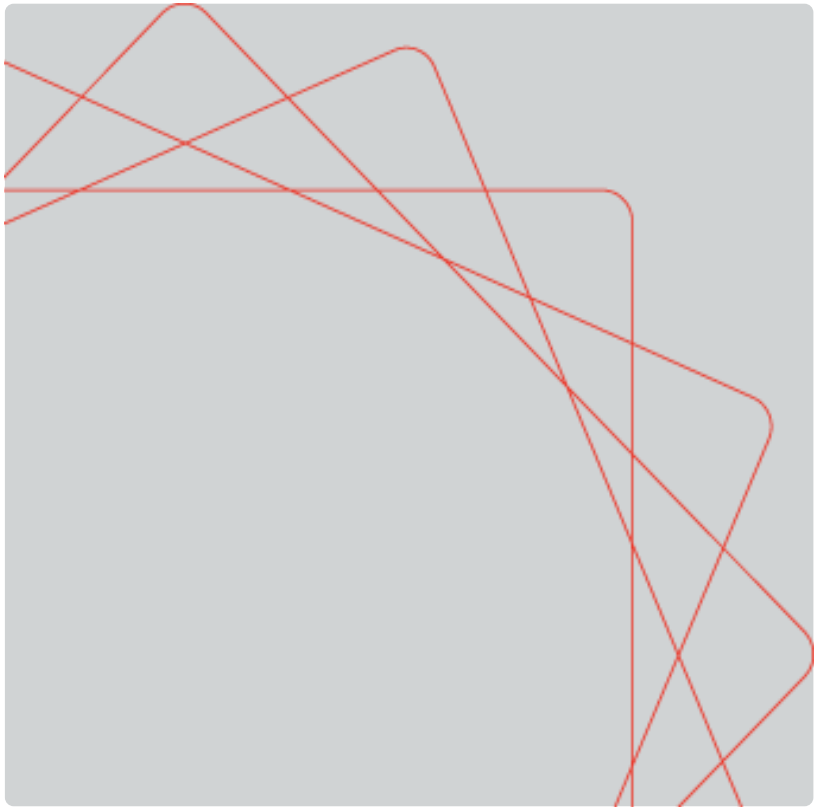
Ten Years of the *Partnerships in International Research and Education (PIRE)* Program

February, 2016

Carter Epstein



Overview

- **NSF's PIRE Program**
- **Evaluation Objectives, Data Sources and Methods**
  - Constructing a project-level comparison group
  - Constructing participant-level comparison group
- **Key Findings**
  - Research outcomes
  - U.S. graduate student experiences
  - U.S. institutional support for graduate students' international opportunities
- **Limitations**

The PIRE program

- Supports intellectually substantive collaborations between U.S. and foreign researchers in which the international partnership is essential to the research effort
- Provides international opportunities to early-career researchers and students
- Awards last a minimum of 5 years
- Per-award funding: $2.5m to $5m per award
- 59 awards were made in the first 4 cohorts (2005, 2007, 2010, 2012)

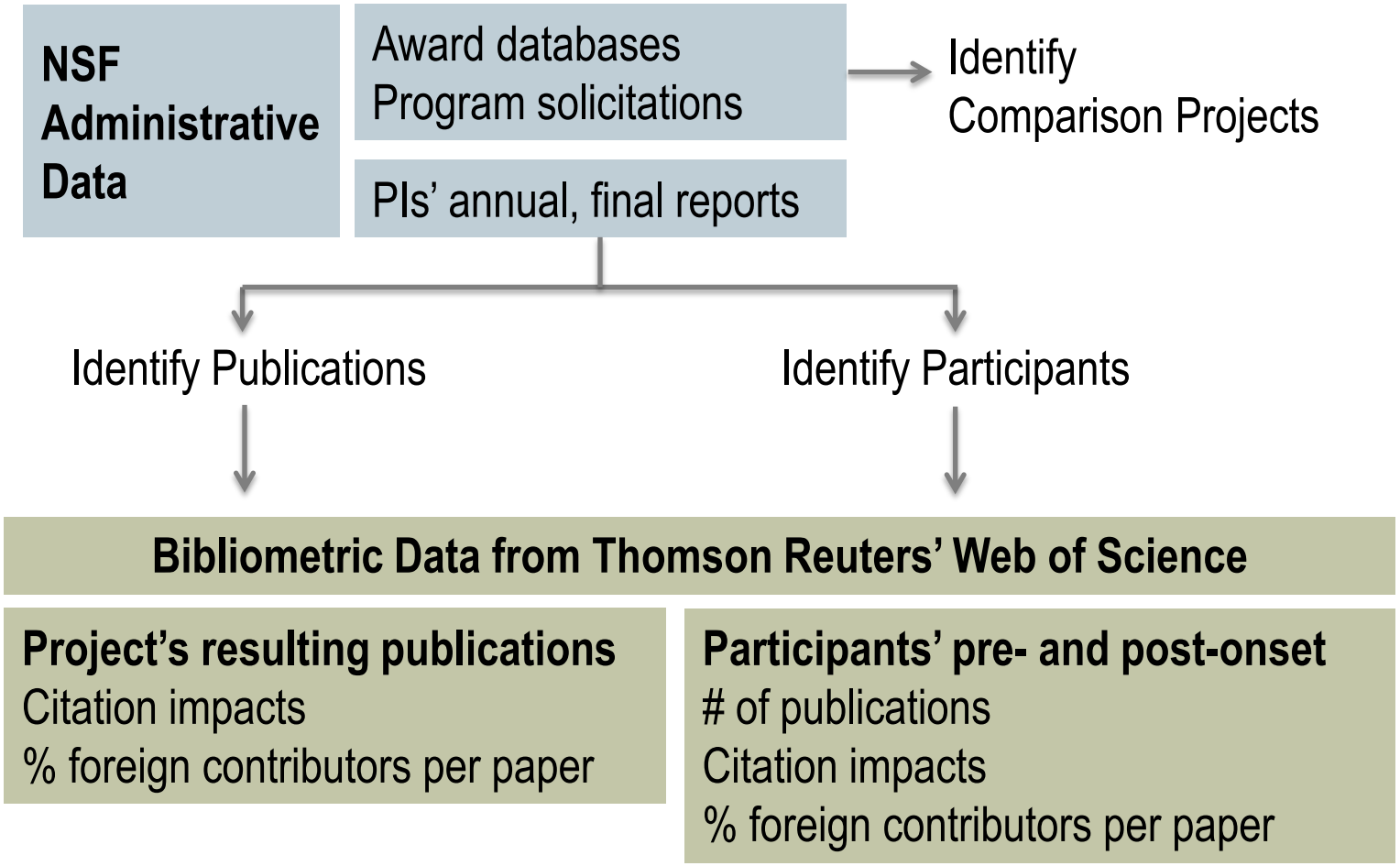
PIRE Program Goals

- Catalyze long-term, sustainable international partnerships
- Prepare next generation of U.S. scientists and engineers for global engagement
- Produce a strong record of research excellence

Evaluation Objectives

- Examine the effectiveness of PIRE using an appropriate comparison group
- Measure the research outcomes of PIRE
- Describe participant experiences

Data Sources (1)



Data Sources (2)

NSF Administrative Data

Award databases
Program solicitations

→ Identify Comparison Projects

PIs' annual, final reports

→ Identify Participants

Survey Data

PIs, Postdocs, Graduate Students, Undergraduates, Foreign Senior Investigators

Participants' Experiences

Collaborations with foreign partners (before, after project)
Travel & activities abroad
Benefits, challenges of participation
Career/educational outcomes

Identifying a Comparison Group

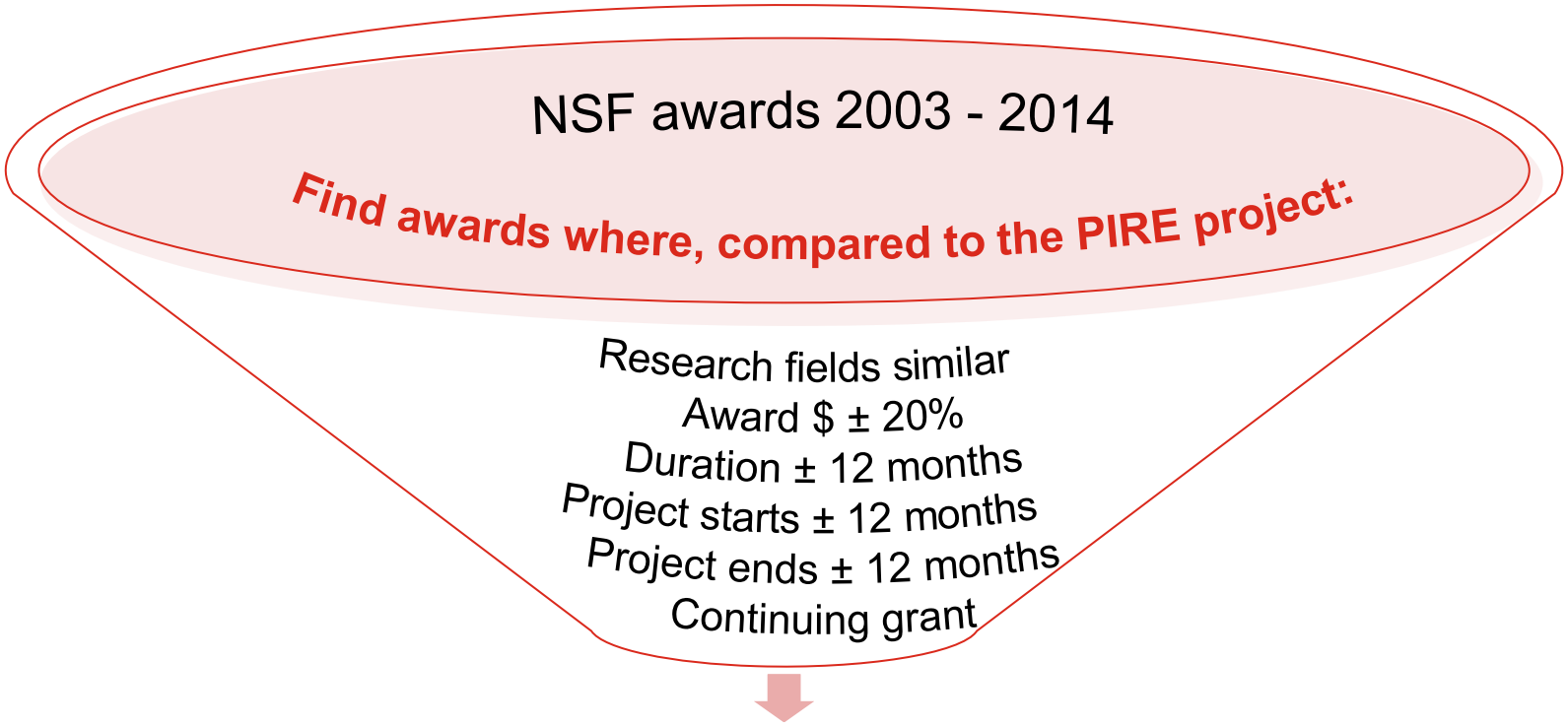
- The purpose of a comparison group is to represent the counterfactual:
- What would occur in the absence of PIRE?
  - How much and what kind of international collaboration?
  - What quantity and quality of research?

Matching PIRE-Comparison Projects

- Goal: Match each of 59 PIRE projects to another NSF-funded project using criteria that were likely correlated with the key outcomes
- We restricted the comparison group to other NSF programs where:
  - International collaboration was possible
  - But international collaboration was *not required* by the NSF program as a condition of award

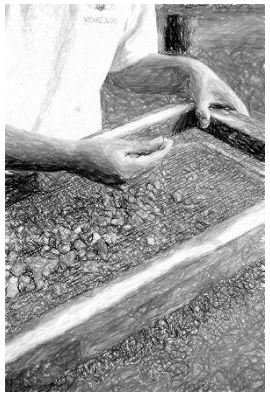
STEP 1

Filter all non-PIRE NSF awards that match a PIRE project on initial criteria:



Initial Candidates for Comparison Group

STEP 2



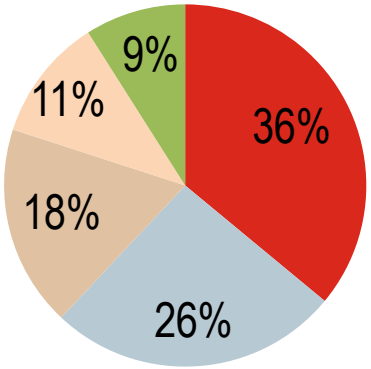
Screen each candidate comparison project

- Scrutinize research fields further:
  - Review project abstract, proposal, reports
  - PhD disciplines of key personnel
- Must be a research grant (e.g., not equipment purchase grant)
- Must include ≥ 2 different institutions (US or foreign)
- Must include graduate student participants
- Program could *allow or encourage* international collaboration, but could not *require* it

STEP 3

- If multiple matches, select grant with closest match on research fields
- If no match, return to Step 1, expand criteria to generate new candidates
  - Add other research fields
  - Expand award amount to ± 25%
  - Expand start, end dates to ± 24 months
  - Expand duration to ± 24 months
  - Add standard grant to eligible award type

Results of Project Level Matching

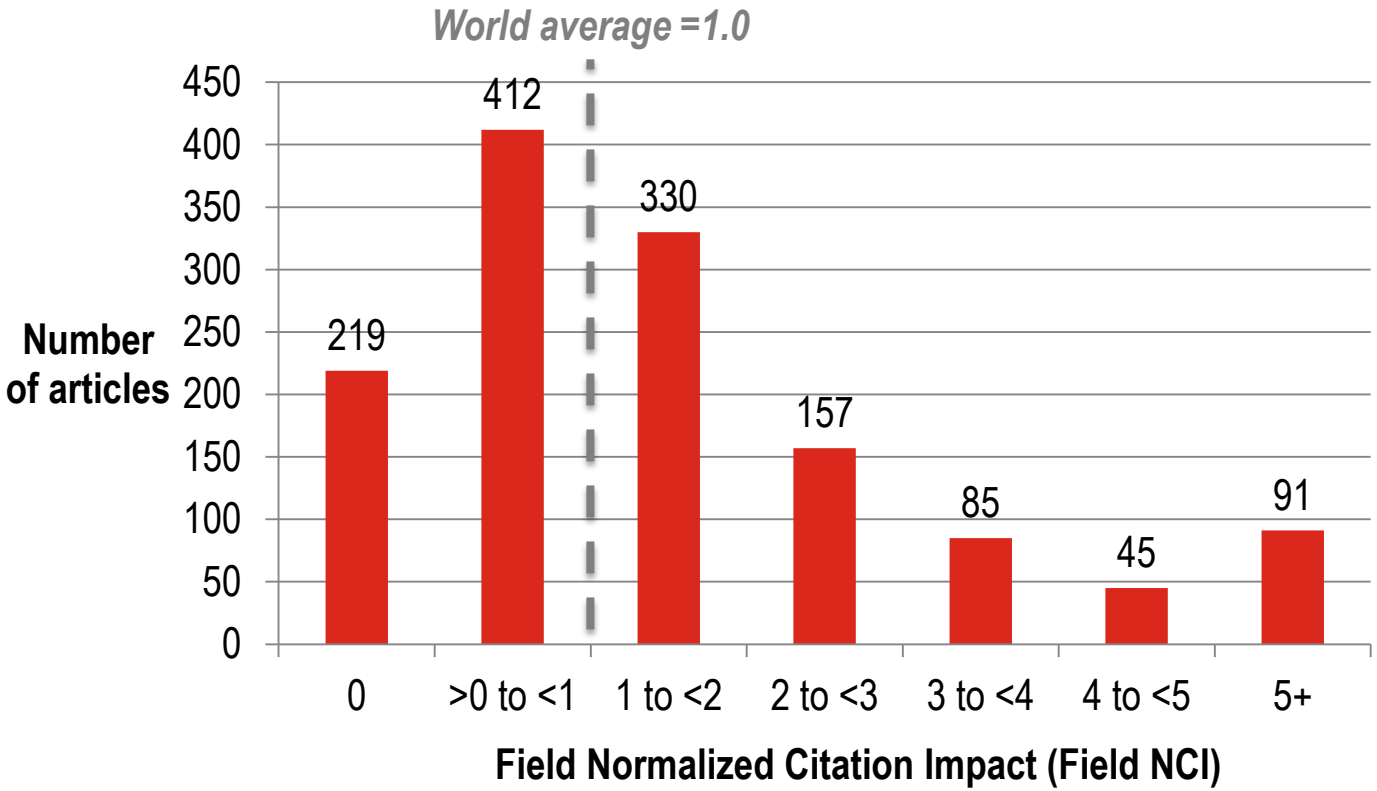


Matched 55 of the 59 PIRE projects

Award amount of the comparison project	Percent
Within 20% of PIRE award	91%
Within 21-25% of PIRE award	9%
Duration	**Percent**
Within 0-12 months of PIRE project's duration	87%
Within 13-24 months of PIRE project's duration	13%
Program's emphasis on international collaboration	**Percent**
Not mentioned in solicitation	56%
Encouraged	29%
Mentioned as optional	15%

Citation Impact of PIRE journal articles

- PIRE articles have above average citation impact (average field-Normalized Citation Impact, NCI = 1.8; 1.0=World average)



PIRE and Comparison Project Journal Articles

- No differences between PIRE, comparison group publication quantity or citation impact (*p>.05*)
- PIRE publications had significantly higher mean percentage of foreign contributors per paper than comparison group (*p<.01*)

Regression-adjusted bibliometric outcomes (N=45 matched project pairs)				
	Mean PIRE	Mean Comparison	Difference	p
Indicator				
Number of articles per project	29	25	4	0.33
Field Normalized Citation Impact (NCI)	1.6	1.7	-0.1	0.62
Journal NCI	1.2	1.3	-0.1	0.45
% foreign institutions on articles produced by matched project pairs	35%	17%	18	< .01
% foreign authors on articles (2009 +) produced by matched project pairs	29%	13%	15	< .01

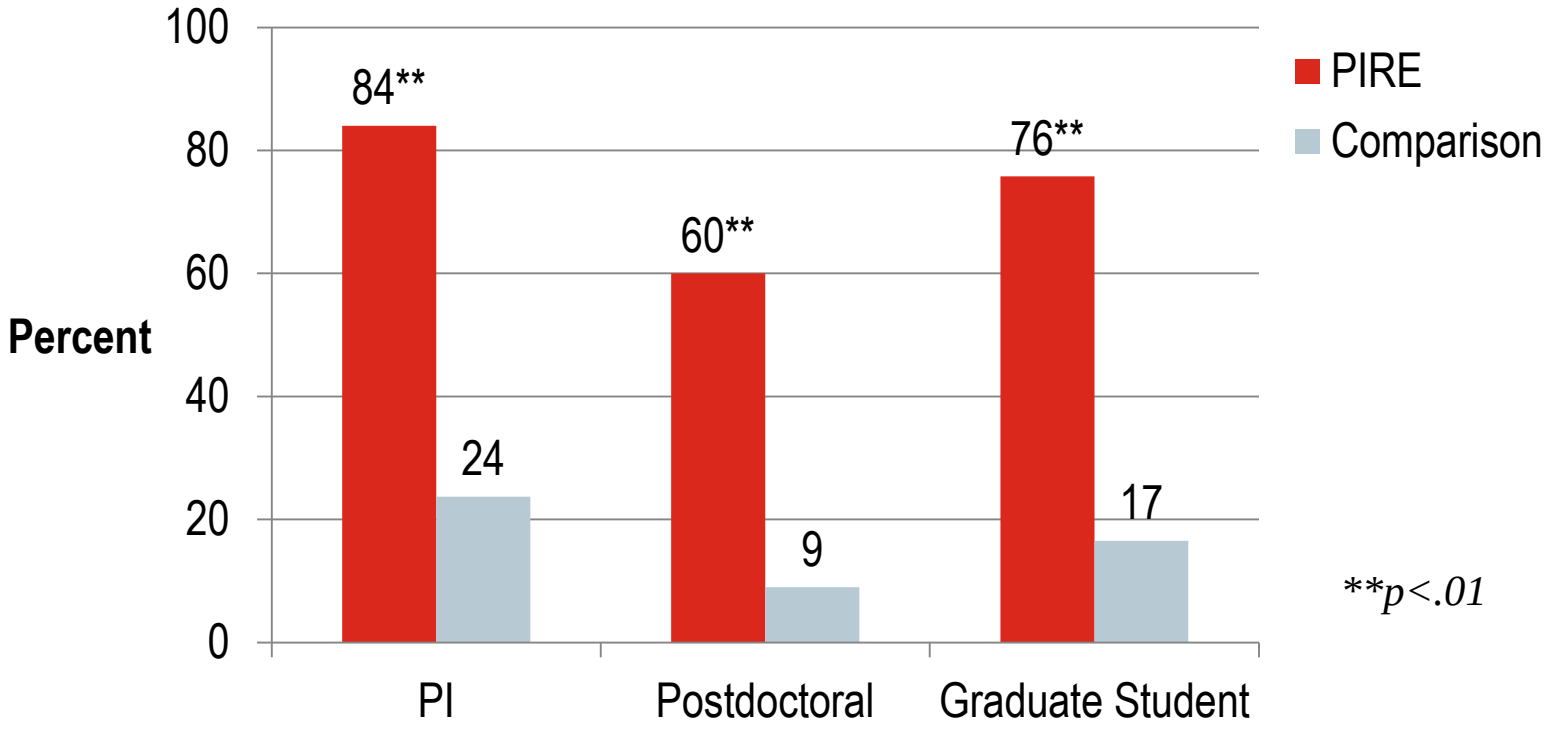
Sources: Annual reports submitted by PIs to NSF; Thomson Reuters' Web of Science

PARTICIPANT EXPERIENCES

Survey Response Rates	PIRE	Comparison
PIs	58%	56%
Postdocs	55%	50%
Graduate Students	**54%**	**47%**

Travel Outside US for the Project

- **Significantly higher percentages of PIRE participants than comparison group participants traveled abroad for their project**

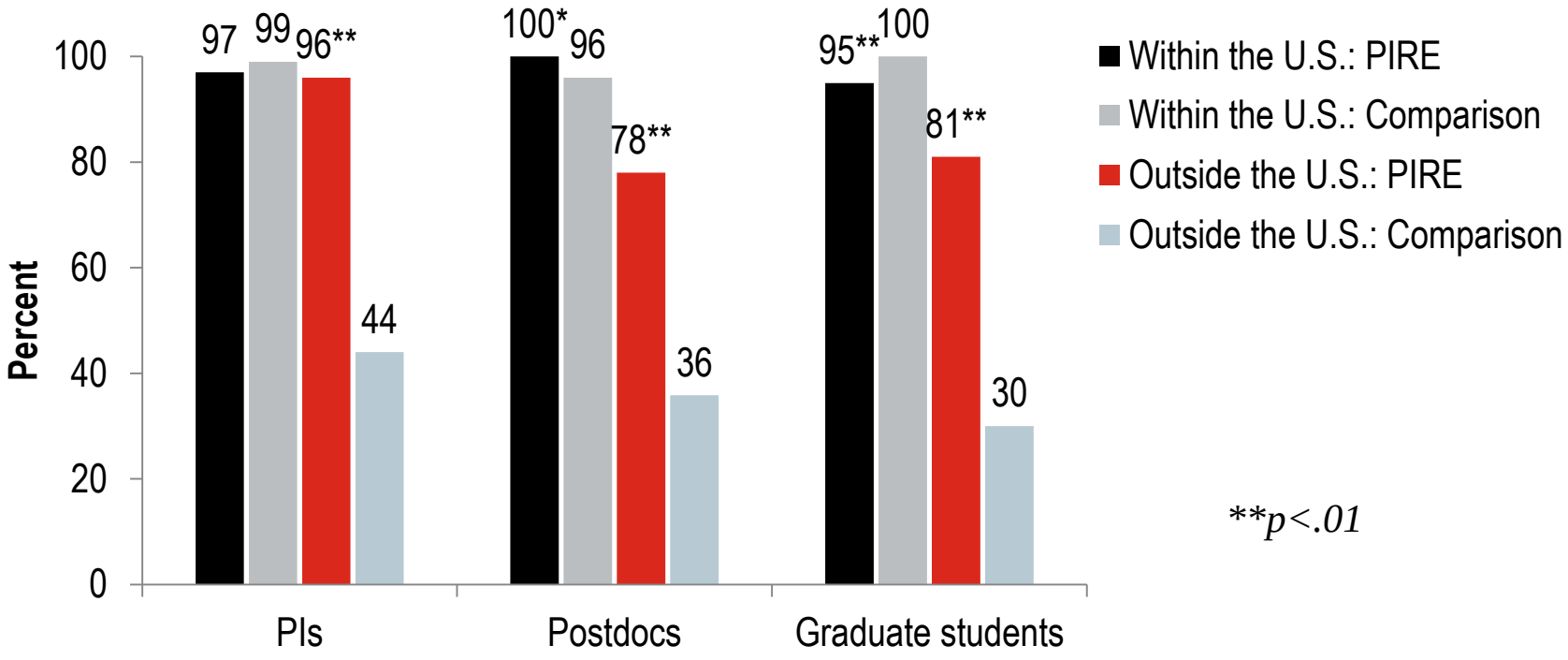


PIRE and Comparison Graduate Students who Traveled Abroad

Of Those Who Traveled Abroad:	PIRE	COMP
Average number of trips abroad	2	2
Average duration of trips abroad, in weeks	11	5
Longest trip abroad, in weeks	13	6

Collaborations During the Project With U.S. and non-U.S. Personnel

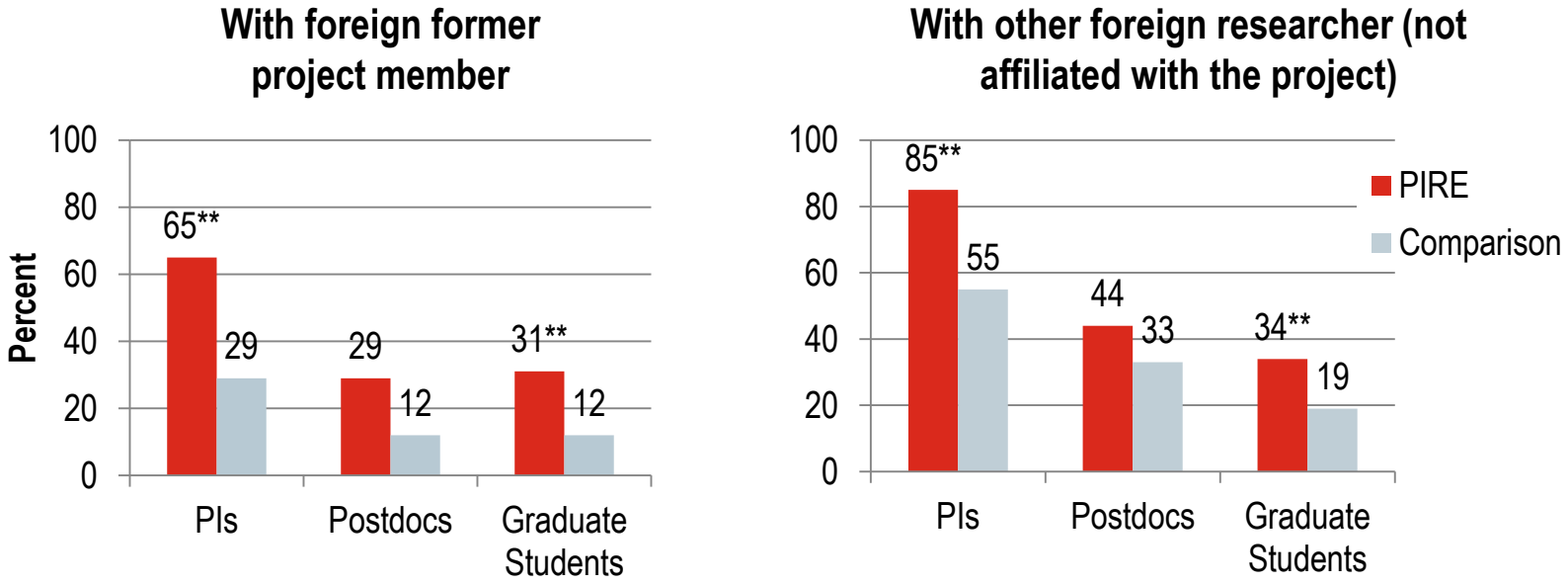
- **Higher percentages of PIRE than comparison group participants collaborated with foreign personnel**



$^{**}p<.01$

Continued Collaborations With Foreign Researchers Post-Project

- **Higher percentages of PIRE PIs and graduate students continued to collaborate with foreign researchers after the project had ended**[a]



[a] *i.e., after the award end date, or after the participant's role in project had concluded. Analyses restricted to those who reported a collaboration during the project with a foreign researcher*

***p<.01*

GRADUATE STUDENTS' RESEARCH OUTCOMES

What effect did PIRE have on its graduate students' research outcomes?

- Compared the difference in pre- and post-onset publication record for PIRE versus comparison graduate students
- Restricted to journal articles published by June 2014 in Thomson Reuters' Web of Science

Matching PIRE-Comparison Participants

- Within matched project pairs, we matched individual participants (postdoctoral researchers, graduate students) on outcomes prior to onset of participation ("pre-onset") in the project
  - Starting year of participation in project
  - Number of publications per year
  - Average citation impact of publications
- Goal: < .25 standardized mean difference

Pre-onset Participant Level Matching

- PIRE-Comparison group graduate students were well-matched on pre-onset measures before testing for post-onset differences in research outcomes

	Pre-onset standardized differences		
	Start Year	N of Publications per year	Average citation impact*
Graduate students	0.20	0.11	0.04

*****Using the average field normalized citation impact across a participant's articles published before participation in the PIRE or comparison project*

Impact of PIRE on Graduate Students' Research Outcomes

- PIRE graduate students produced more annual publications post-onset than comparison group graduate students ($p<.01$)
- No statistically significant difference between PIRE, comparison graduate students' post-onset citation impact

Impact of PIRE on Graduate Students' Research Outcomes

PIRE graduate students' publications had a greater percentage of foreign contributors on average, but this difference was not statistically significant.

	Adjusted Mean Percentage of Non-U.S. Institutional Affiliations for Post-Onset Publications [a]				
Respondent Group	**PIRE**	**Comparison**	**Difference (PIRE – Comparison)**	**Standard Error**	**p**
PIs	16	10	5.8	1.66	.001**
Postdocs	16	12	3.1	5.39	0.57
Graduate students	**17**	**7**	**10.1**	**8.44**	**0.24**

Subsequent Postdoctoral Appointments

Former Graduate Student Participants	PIRE	Comparison	Difference	p-value
Ever had a postdoctoral appointment	60%	70%	-9.4	0.206
Had a postdoctoral appointment outside the U.S.	31%	17%	13.9	0.089

In their own words

The opportunity to observe the way in which research is conducted abroad has helped inform my scientific approach in many ways. Most importantly, I now structure my research being mindful of the methods and techniques that are globally available so that my work can be reproduced outside of the US. My scientific …writing and speaking are much clearer now that I have interacted so closely with international researchers.

-- *PIRE graduate student*

In their own words

Like any field, collaborations are driven by relationships. Relationships are underpinned by trust and understanding between two parties. In the case of "foreign" parties, working and living in an international setting is critical in developing such understanding. Even if one's work remains in the US, it is highly probable that one's colleagues have foreign origins, and shared experiences in foreign countries is one of the most direct routes to developing a positive relationship.

-- *PIRE graduate student*

Limitations

- Because the study used a non-experimental comparison group, interpretation of these results requires caution
- Research outcomes were limited to journal articles, likely under-representing some disciplines' research output)
- Difficult to locate former graduate students, especially those who leave academia

Summary

- PIRE engages postdocs, graduate & undergraduate participants in on-site international research
- PIRE fosters meaningful international collaborations, and participants continue to collaborate globally afterward
- On average, PIRE projects have produced research equivalent in impact to that of other NSF-funded research projects, with greater proportions of foreign co-authorship
- PIRE increases postdocs' and grad students' research productivity and the impact of postdocs' publications.

Acknowledgements

Study participants: PIs, postdocs, graduate students from PIRE and comparison projects, PIRE undergraduates and foreign senior investigators, administrators at PIRE awardee institutions

NSF
John Tsapogas
Amelia Greer
John Snyder
Cassidy Burke
Stephen Burch
Cassandra Dudka
Thurl Frazier

Subject Matter Experts, Working Group
Jonathan Adams, Digital Science
Rajika Bhandari, Institute for International Education
Susan Cozzens, Georgia Institute of Technology
Diana Hicks, Georgia Institute of Technology
Irwin Feller, Emeritus, Pennsylvania State University

Thomson Reuters Scientific
Di Cross, Unni Jensen & Elmer Yglesias

Abt SRBI
Benjamin Phillips & John Sokolowski