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with

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Specialties

Reflecting on a Decade of Investigations of Science Faculty with Education Specialties (SFES):

*Differentiation from DBER, Variation across Institution Types,
and Perseverance despite Negative Bias*

Kimberly Tanner, on behalf of...

The SFES – Science Faculty with Education Specialties – Research Team
Seth Bush, California Polytechnic State University, San Luis Obispo
Michael Stevens, Utah Valley University
Kimberly Tanner, San Francisco State University
Kathy Williams, San Diego State University



Access to SFES Bibliography

kdtanner@sfsu.edu
@kimberlydtanner

NSF (DUE)-1228657



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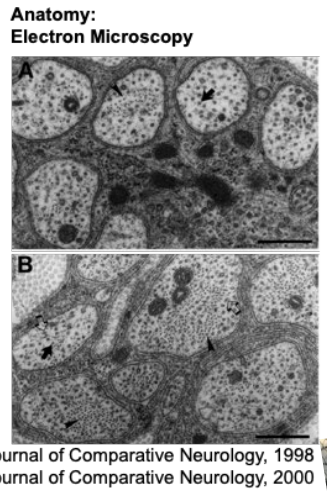
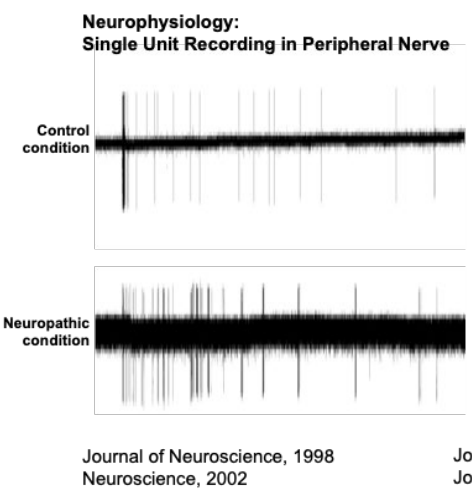
Specialties

Kimberly Tanner

First-generation college-going, Neuroscientist by training

Professor of Biology

SFES (Science Faculty w/Education Specialty), **DBER** (discipline-based education research)



The Science Education
Partnership & Assessment Lab
San Francisco State University



Ideas that drive my efforts in higher education...

- Talented individuals continue to leave and feel excluded from scientific fields
- Personal characteristics predict who leaves science, which is unacceptable
- Great science requires diverse perspectives and thinking
- Few scientists have formal training in effective and inclusive teaching
- ***Long ago observation that...***
Natural science departments appeared to be cultivating science faculty who might address these issues...

“The largest gain in learning productivity in STEM will come from convincing the large majority of STEM faculty that currently teaches by (only) lecturing to use any form of active or collaborative instruction...”

– James Fairweather,
Michigan State University
Higher Education Researcher

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Poll Question

Which of the following best describes your familiarity with the phenomenon of SFES: Science Faculty with Education Specialties?

- A. I have NOT heard the term “SFES” before today.
- B. I have heard the term “SFES” before today, but I’m not sure what it means.
- C. I’m familiar with the term “SFES,” but I do NOT identify as an SFES.
- D. I’m familiar with the term “SFES,” and I DO identify as an SFES.
- E. I’m not sure... isn’t SFES the same thing as DBER?!?

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Driving Questions

1. What are the origins of these investigations of education-focused science faculty?
2. How has the SFES phenomenon changed over time?
3. How have education-focused science faculty identities differentiated?
4. How might negative bias from peers and administrators influence these identities?

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Origin Story

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May 5-6, 2006

CSU Systemwide Science Education Colloquium Strand B: Engaging the Disciplines

Seth Bush, California State Polytechnic, San Luis Obispo

Kathy Williams, San Diego State University

Michael Stevens, CSU Stanislaus

Kimberly Tanner, San Francisco State University

James Rudd, CSU Los Angeles

Nancy Pelaez, CSU Fullerton

- Group of faculty who discovered we'd either been hired into or transitioned to bring a focus on science education within our departments
- Natural Sciences—Chemistry, Biology, Physics, and Geosciences
- Administrators present asked “what do you do and how can I hire someone like you?!”
- Left the meeting with outline of a hiring guide, draft survey tool, plan to collaborate going forward
- Motivated – initially and still – to provide systematic research evidence about this phenomenon, to check assertions regularly made that are not grounded in evidence

Who are we?!? How did we define SFES?

...defined as science faculty who take on specialized roles in science education within their discipline...

CBE—Life Sciences Education
Vol. 5, 297–305, Winter 2006



Feature

Approaches to Biology Teaching and Learning

On Hiring Science Faculty with Education Specialties for Your Science (Not Education) Department

S. D. Bush,^{*†} N. J. Pelaez,^{*‡} J. A. Rudd,^{*§} M. T. Stevens,^{*||} K. S. Williams,^{*||}
D. E. Allen,^{*#} and K. D. Tanner^{*@}

[†]California Polytechnic State University, San Luis Obispo, CA 93407; [‡]California State University, San Bernardino, CA 92415; [§]California State University, Los Angeles, CA 90032; ^{||}California State University, Turlock, CA 95382; ^{||}San Diego State University, San Diego, CA 92182; [#]University of California, San Diego, CA 92037; and [@]San Francisco State University, San Francisco, CA 94132

**The SFES
Hiring
Guide,
LSE, 2006**

**Appendix has
questions for
departments to
consider when
hiring an SFES...**

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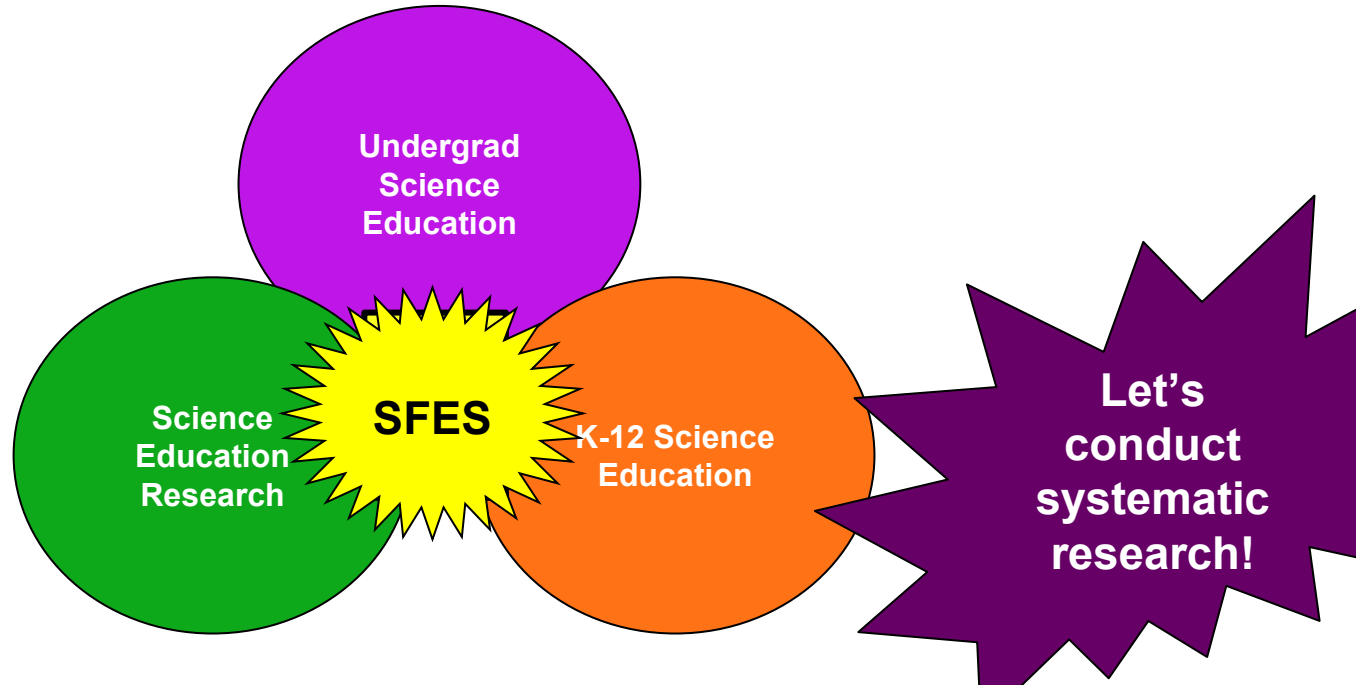
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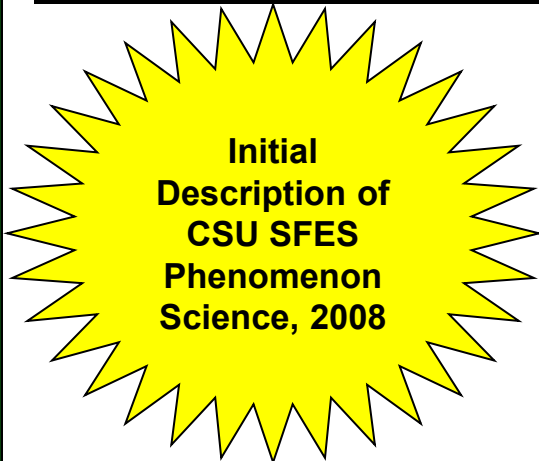
Why the term **SFES**? A Purposefully Inclusive Approach

SFES – Science Faculty with Education Specialties – was a purposefully “big tent” approach, intended to capture the range of science education activities that were occurring...



What does SFES phenomenon look like in California State University system?

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Participant Sample

N=59

California State University (CSU) system
Biology, Chemistry, Geosciences, Physics

Survey Methods

- carefully crafted 111-question survey
- multiple rounds of piloting and refinement
- attention to measurement validity
- power analyses to gauge ability to detect differences in sub-populations
- consults with social scientists on finding "hidden populations"
- care in aligning claims with evidence
- analyses by discipline - no differences



THE PIPELINE

Science Faculty with Education Specialties

Career dynamics for science faculty with interests in education point the way for developing this nascent career specialty.

S. D. Bush,^{1*} N. J. Pelaez,^{2*} J. A. Rudd,^{3††} M. T. Stevens,^{4*} K. D. Tanner,^{5*} K. S. Williams^{6*}

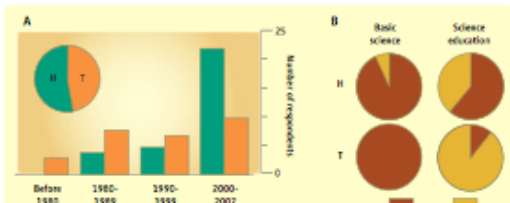
Global efforts to improve science education continue (1, 2). In the United States, primary and secondary (K-12) science education lags on international assessments and struggles to sustain qualified K-12 science teachers and to prepare the next generation of scientists and engineers (2). At U.S. colleges and universities, more than half of entering science majors leave the sciences, most (90%) complaining of ineffective teaching (3). Of those who remain in science, 74% express the same complaint (3). Further work is needed within specific science disciplines to address these

gated SFES numbers, characteristics, training, professional activities, and persistence.

We identified, with the aid of deans, 156 CSU faculty as SFES and invited all 156 to complete a 111-question survey (7), which we

tenure-track faculty ranks (28% assistant, 31% associate, and 41% full professors), and trained extensively as researchers in basic science. We completed Pearson's chi-square and McNemar's tests to compare subpopulations of SFES and to make inferences ($P < 0.05$).

SFES include two subpopulations, those specifically hired as SFES (hired-SFES; $n = 31$, 53%) and those who transitioned to SFES roles (transitioned-SFES; $n = 28$, 47%) from their initial faculty roles [see (A) in chart, left]. Transitioned-SFES had hiring dates beginning in 1970, and hired-SFES had dates beginning in 1970. More were hired after



CBE—Life Sciences Education
Vol. 10, 25–42, Spring 2011

Article

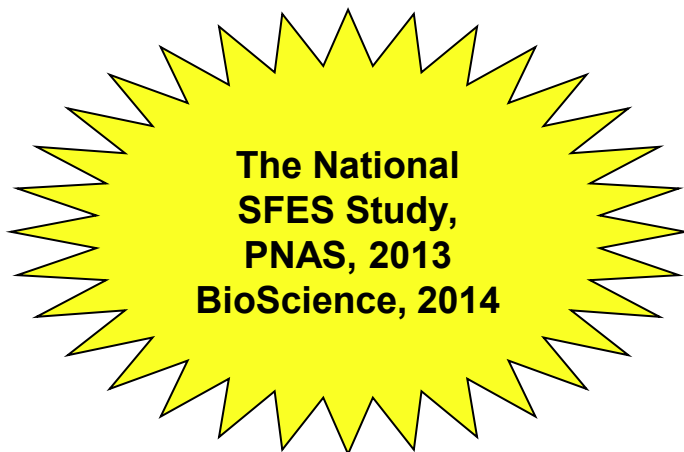
Investigation of Science Faculty with Education Specialties within the Largest University System in the United States

Seth D. Bush,^{†*} Nancy J. Pelaez,^{††} James A. Rudd,^{†§} Michael T. Stevens,^{†||} Kimberly D. Tanner,^{†¶} and Kathy S. Williams^{†#}

*California Polytechnic State University, San Luis Obispo, CA 93407; †Purdue University, West Lafayette,



What does SFES phenomenon look like, if it exists, across the U.S.?



Participant Sample

N=289

Biology, Chemistry, Geosciences, Physics

Survey Methods

- careful attention to measurement validity
- power analyses to gauge detection of differences
- thoughtful methods of identifying and participant sample
- care in aligning claims with evidence
- analyses by discipline - no differences
- analyses of institution type - differences

Widespread distribution and unexpected variation among science faculty with education specialties (SFES) across the United States

Seth D. Bush^{a,1}, Nancy J. Pelaez^{b,1}, James A. Rudd II^{c,1}, Michael T. Stevens^{d,1}, Kimberly D. Tanner^{e,1}, and Kathy S. Williams^{f,1,2}

^aDepartment of Chemistry and Biochemistry, California Polytechnic State University, San Luis Obispo, CA 93407; ^bDepartment of Biological Sciences, Purdue University, West Lafayette, IN 47907; ^cDepartment of Chemistry and Biochemistry, California State University, Los Angeles, CA 90032; ^dDepartment of Biology, Utah Valley University, Orem, UT 84058; ^eDepartment of Biology, San Francisco State University, San Francisco, CA 94132; and ^fDepartment of Biology, San Diego State University, San Diego, CA 92182

Edited* by Bruce Alberts, University of California, San Francisco, CA, and approved March 5, 2013 (received for review November 4, 2012)

Misalignments: Challenges in Cultivating Science Faculty with Education Specialties in Your Department

SETH D. BUSH, NANCY J. PELAEZ, JAMES A. RUDD II, MICHAEL T. STEVENS, KIMBERLY D. TANNER, AND KATHY S. WILLIAMS

The National
SFES Interview
Study,
PLOS ONE, 2014

Participant Sample

N=50

Random sample, stratified by institution type
Biology, Chemistry, Geosciences, Physics

Interview Methods

- 1-hour phone interviews
- 2 researchers conducted interviews
- interview protocol probed: perceived impact, training, satisfaction, nature of position, identity, motivation, views on SFES
- quantification of emergent themes
- attention to inter-rater reliability
- care in aligning claims with evidence

RESEARCH ARTICLE

Fostering Change from Within: Influencing Teaching Practices of Departmental Colleagues by Science Faculty with Education Specialties

Seth D. Bush^{1☉‡*}, James A. Rudd, II^{2☉‡}, Michael T. Stevens^{3☉‡}, Kimberly D. Turner^{4☉‡},
Kathy S. Williams^{5☉‡}

1 Chemistry and Biochemistry Department, California Polytechnic State University, San Luis Obispo, California, United States of America, 2 Department of Chemistry and Biochemistry, California State University, Los Angeles, California, United States of America, 3 Department of Chemistry, Oregon State University, Orem, Utah, United States of America, 4 Department of Chemistry, University of California, San Francisco, California, United States of America, 5 Department of Chemistry, University of California, San Diego, California, United States of America

☉ These authors contributed equally to this work.
‡ All authors are listed alphabetically on this work.
* sbush@calpoly.edu

And that
was in 2014,
a decade
ago...

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Driving Questions

1. What are the origins of these investigations of education-focused science faculty?
2. **How has the SFES phenomenon changed over time?**
3. How have education-focused science faculty identities differentiated?
4. How might negative bias from peers and administrators influence these identities?

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Poll Question

How do you predict the SFES phenomenon has changed over time?

SFES are more likely to...

- A. have formal training in science education
- B. be in tenure-track positions
- C. transition from traditional faculty positions into SFES roles
- D. both A and B
- E. both B and C

How has the phenomenon changed over time?

PLOS ONE

The 10-Year
National Follow-
Up Study, PLOS
ONE 2024

RESEARCH ARTICLE

Differentiation, adaptation, and perseverance: Maturing conceptualizations of education-focused science faculty in the United States

Seth D. Bush¹ , Michael T. Stevens² , Kimberly D. Tanner³ , Kathy S. Williams⁴ *

1 California State Polytechnic University, San Luis Obispo, San Luis Obispo, CA, United States of America, **2** Utah Valley University, Orem, UT, United States of America, **3** San Francisco State University, San Francisco, CA, United States of America, **4** San Diego State University, San Diego, CA, United States of America

 These authors contributed equally to this work.

* kathy.williams@sdsu.edu

Participant Sample

N=238, across the U.S.

Biology, Chemistry, Geosciences, Physics
59% women, 93% white

Survey Methods

- language of “education-focused science faculty” to probe range of named identities
- survey adapted from published, descriptive question set, face validated in pilots
- National snowball sampling
- Range of institution types and hire dates

Let's make some
predictions and
explore these
results

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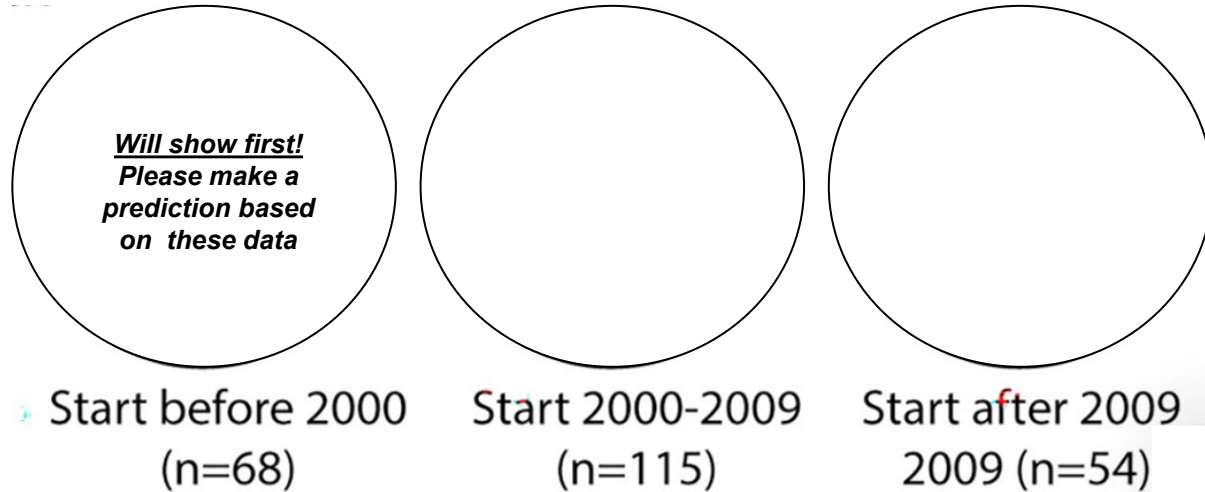
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Making predictions about participants by hire date...



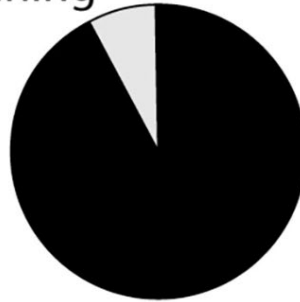
Are there differences with respect to...

- Formal training in science and science education
- Tenure-track vs non-tenure track status
- Hired into role vs. transitioning from traditional faculty position

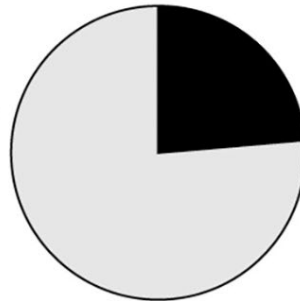
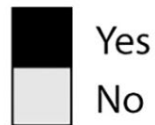
Predictions! Formal training in Science and Science Education...

A. Formal Training

i. Basic Science



ii. Science Education*



Start before 2000
(n=66, 59)

Start 2000-2009
(n=114, 102)

Start after 2009
(n=53, 51)

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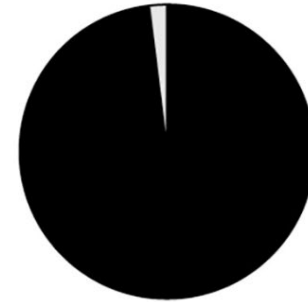
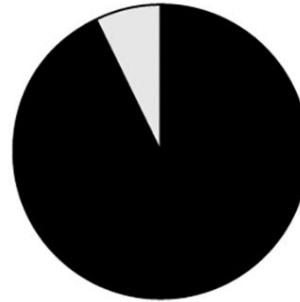
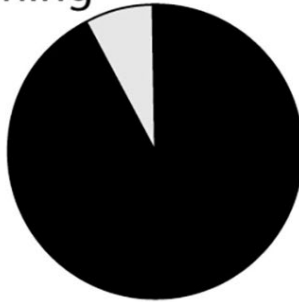
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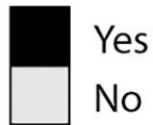
Predictions! Formal training in Science and Science Education...

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Start after 2009
(n=53, 51)

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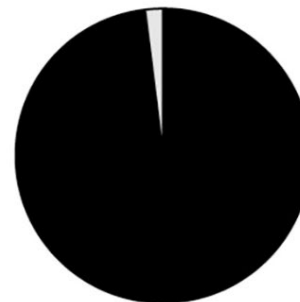
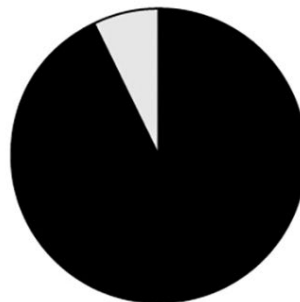
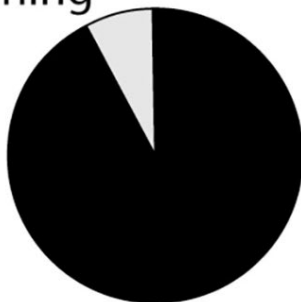
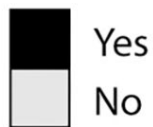
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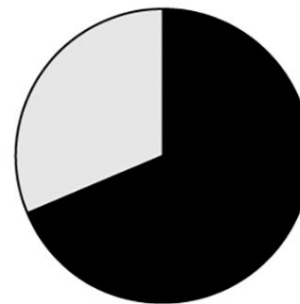
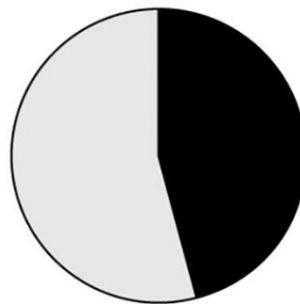
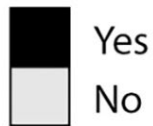
More participants with recent hire dates have formal training in science education

A. Formal Training

i. Basic Science



ii. Science Education*



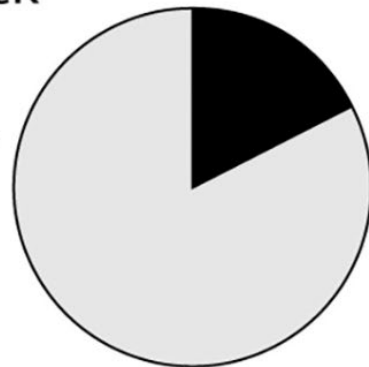
Start before 2000
(n=66, 59)

Start 2000-2009
(n=114, 102)

Start after 2009
2009 (n=53, 51)

Predictions! Participants in Tenure-Track or Non-Tenure-Track positions

Tenure Track*



Start before 2000
(n=68)

Start 2000-2009
(n=115)

Start after 2009
(n=54)

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More participants with recent hire dates in Non-Tenure Track positions

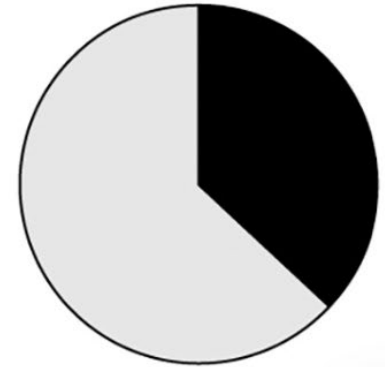
Tenure Track*



Start before 2000
(n=68)



Start 2000-2009
(n=115)



Start after 2009
(n=54)

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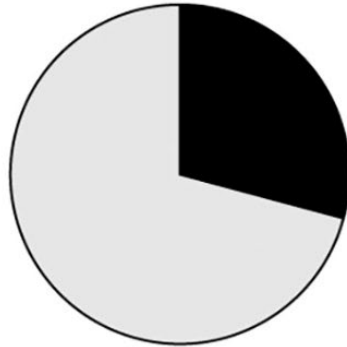
with
Education

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Predictions! Participants Hired or Transitioned to their education-focused role...

Career Path*



Start before 2000
(n=68)

Start 2000-2009
(n=115)

Start after 2009
(n=54)

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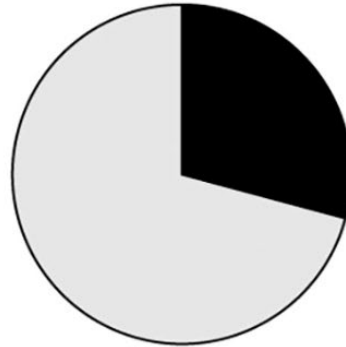
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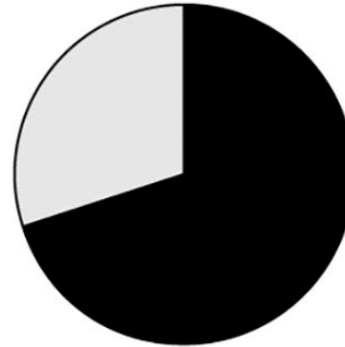
Specialties

Participants with more recent hire dates were hired for rather than transitioned into an education-focused role

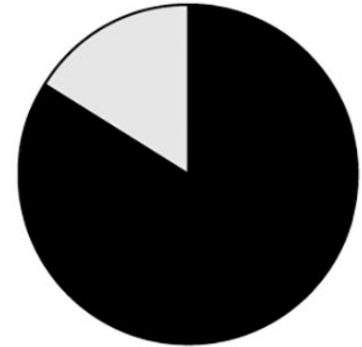
Career Path*



Start before 2000
(n=68)



Start 2000-2009
(n=115)



Start after 2009
(n=54)

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Driving Questions

1. What are the origins of these investigations of education-focused science faculty?
2. How has the SFES phenomenon changed over time?
- 3. How have education-focused science faculty identities differentiated?**
4. How might negative bias from peers and administrators influence these identities?

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Poll Question

SFES = Science Faculty with Education Specialties

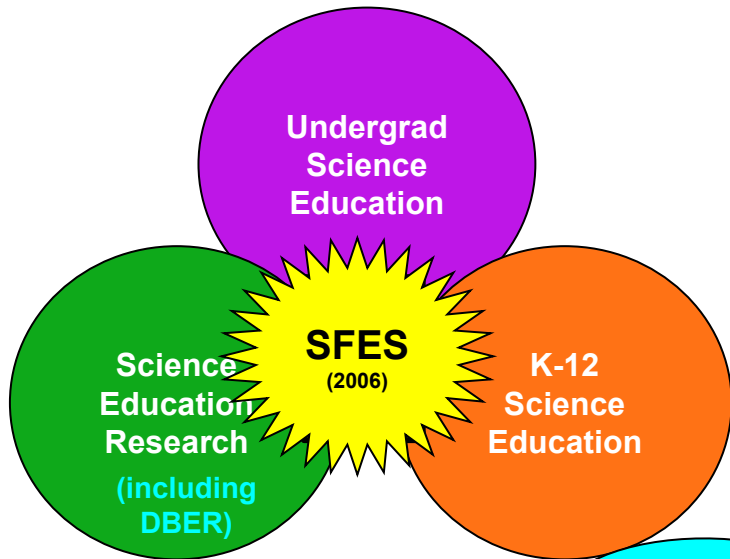
DBER = Discipline-Based Education Researcher

Which of the following best describes your own professional identity?

- A. I identify as an “SFES.”
- B. I identify as a “DBER.”
- C. I identify as an “SFES” and a “DBER.”
- D. I do not identify as either an “SFES” or a “DBER.”
- E. I’m not sure... isn’t SFES the same thing as DBER?!?

Exploring SFES and DBER...

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“The DBER Report”
DBER—Understanding and Improving Learning in Undergraduate Science and Engineering
(2012)



“The committee found ve
Education Specialti
et al., 2006, 2008
research. Thus this
that SFES face in t
for teaching, unusual
scholars in other settings may,

So, how do the characteristics of participants in our recent study vary with their chosen identities – as DBER, SFES, or both?

Science Faculty with
Faculty en...ter (D...sh
science education
... The challenges
... and demands on their time
departmental service. DBER
... context.”

... National Academy of Sciences DBER report

Predictions! Relation of professional identity to position type & career path

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D. Tenure Track*



T/TT (n=157)

Non TT (n=37)

**DBER
Only**

**DBER &
SFES**

**SFES
Only**



E. Career Path*

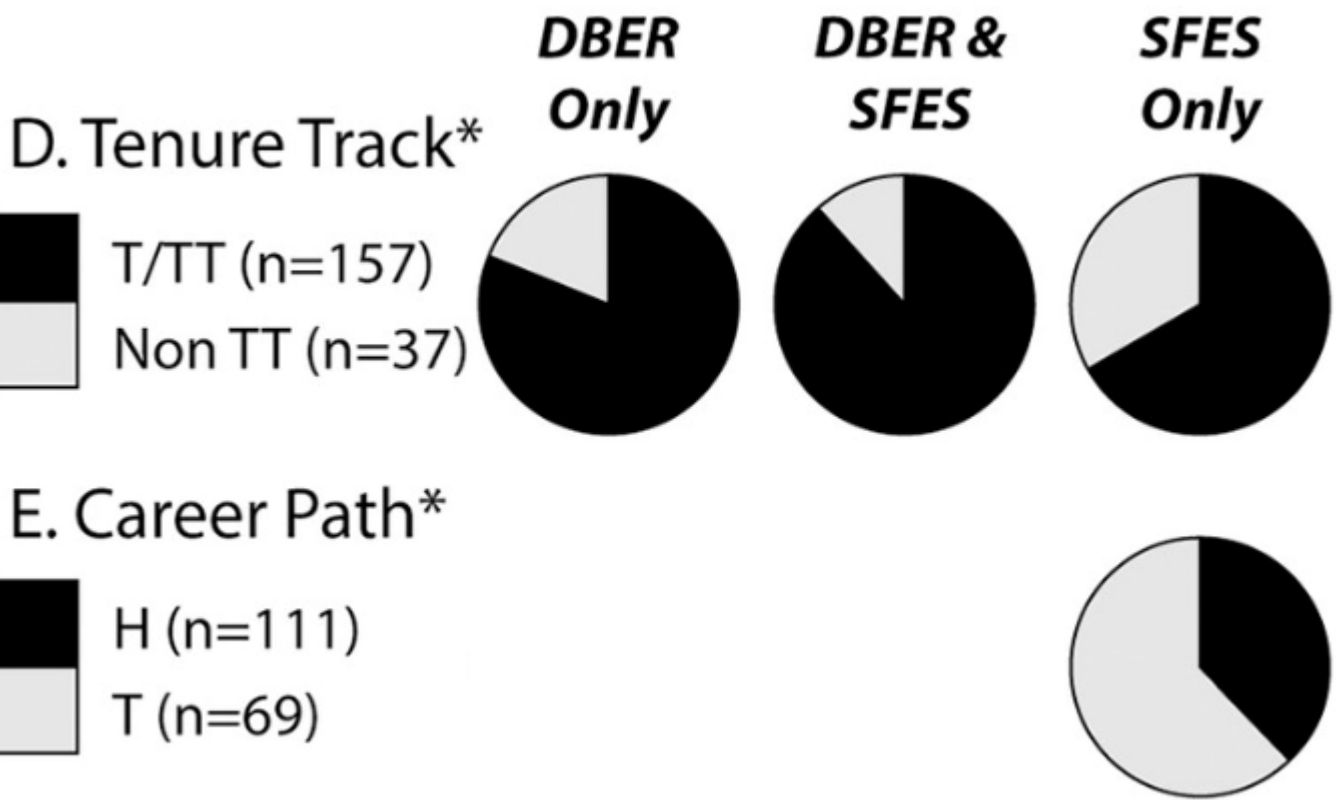


H (n=111)

T (n=69)



Predictions! Relation of professional identity to position type and career path



Professional identities distinguished by tenure & career path

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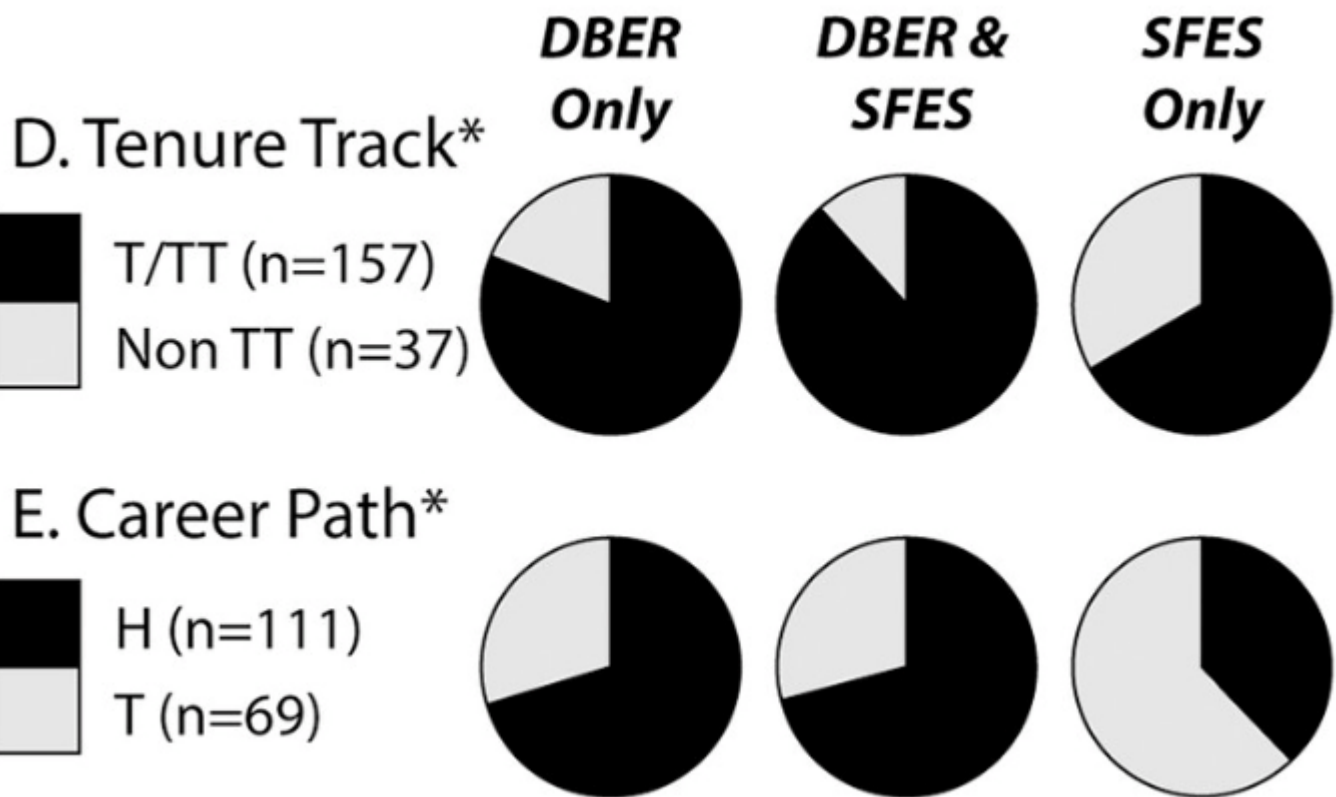
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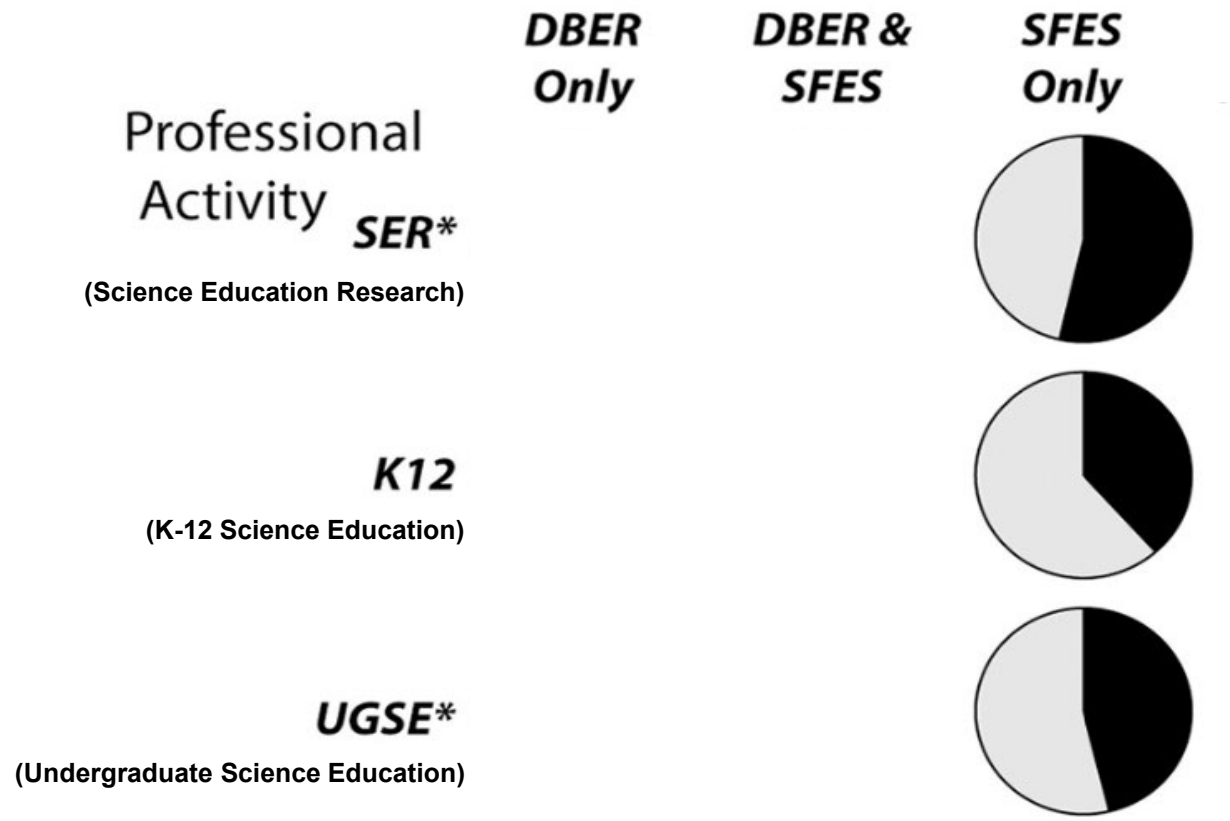
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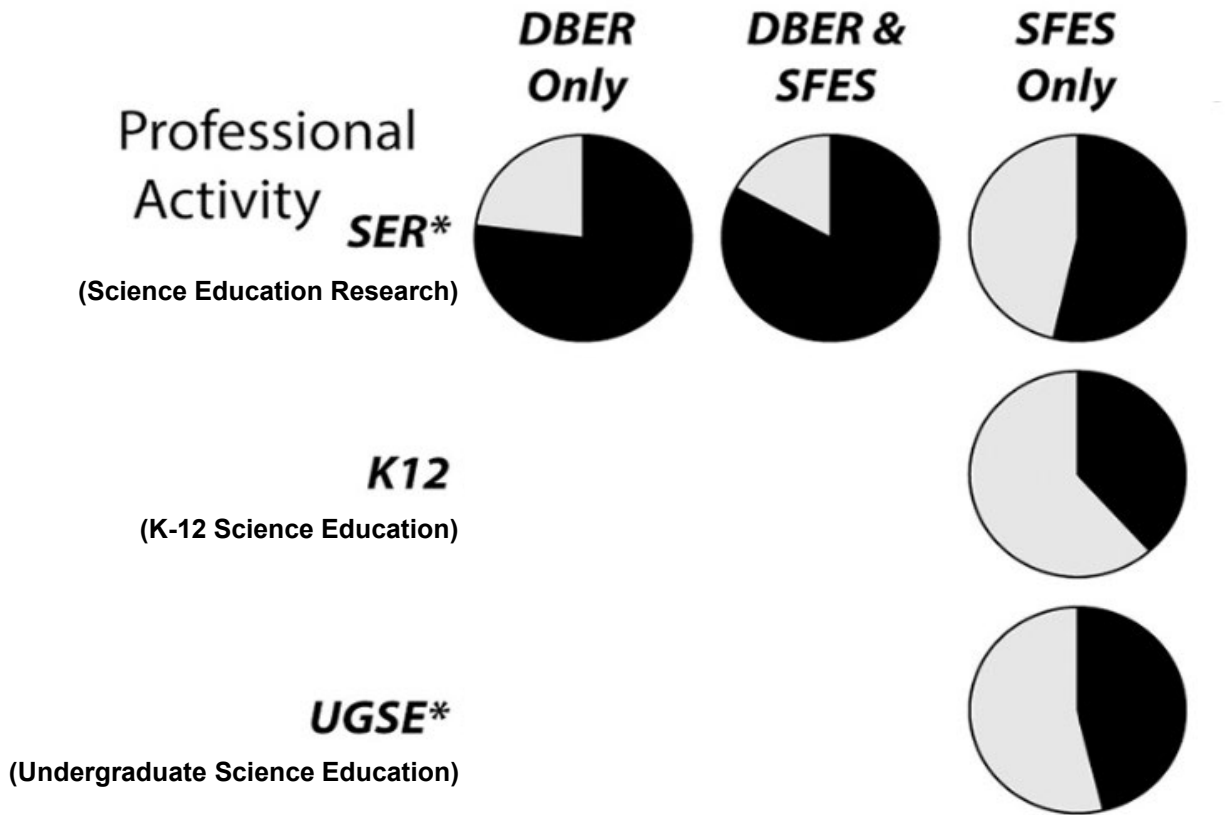
Predictions! Relation of professional identity to professional activities



Yes *Did participants report seeking grant funding as a measure of each professional activity?*
 No

Professional identities distinguished by professional activities

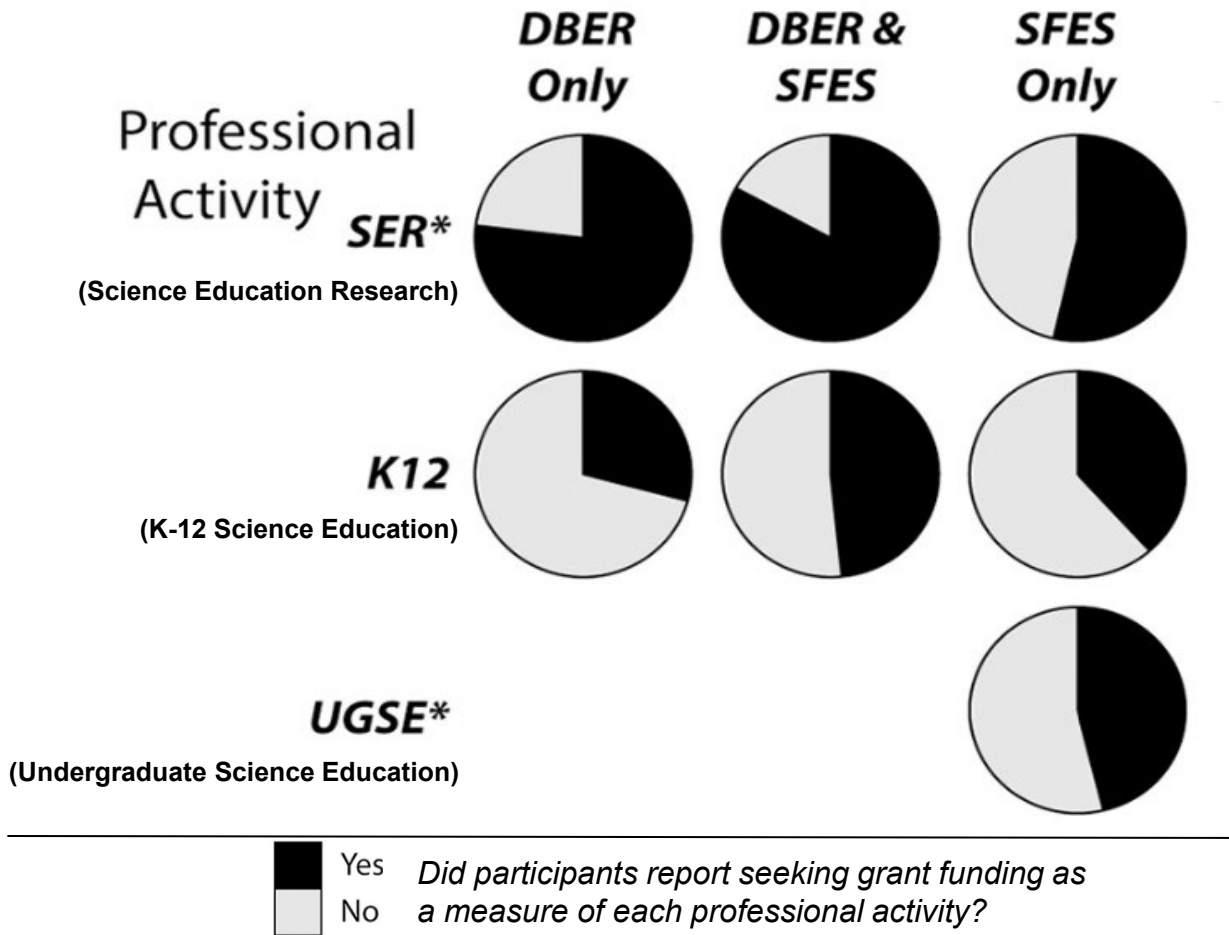
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Yes *Did participants report seeking grant funding as a measure of each professional activity?*
 No

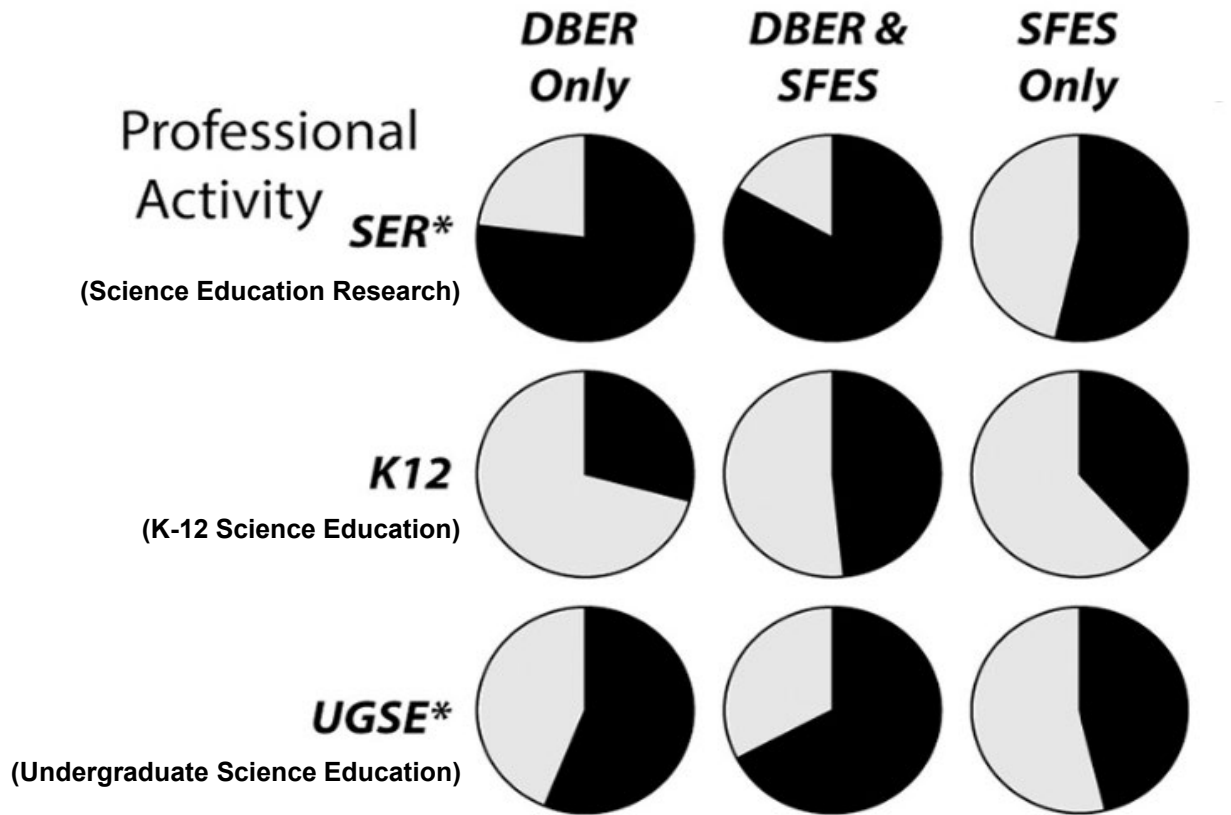
Professional identities distinguished by professional activities

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Professional identities distinguished by professional activities

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Yes *Did participants report seeking grant funding as a measure of each professional activity?*
 No

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Driving Questions

1. What are the origins of education-focused science faculty identities?
2. How has the SFES changed over time?
3. How have education-focused science faculty identities differentiated?
4. How might negative bias from peers and administrators influence these identities?

What really drives how we conceptualize our professional identity?

What might influence whether we introduce ourselves as DBER, SFES, or both?

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Poll Question

In my professional experiences in the biological sciences, I have mostly observed that...

- A. Research activities and Education activities are both viewed as high status.
- B. Education activities are viewed as higher status than Research activities.
- C. Research activities are viewed as higher status than Education activities.
- D. It depends on context...
- E. I'm really not sure...

Potential Influence of Negative Bias on Professional Identity

The CSU Deans' Perspectives Study, LSE, 2020

Participant Sample

N=24, from 22 of 23 campuses
Deans, from colleges overseeing sciences
California State University system

Interview Methods

- 30-minute phone interviews
- 2 researchers conducted interviews
- interview protocol probed: views on SFES, awareness, conceptualization, perceived impact, change over time
- quantification of emergent themes
- attention to inter-rater reliability
- care in aligning claims with evidence

Disciplinary Bias, Money Matters, and Persistence: Deans' Perspectives on Science Faculty with Education Specialties (SFES)

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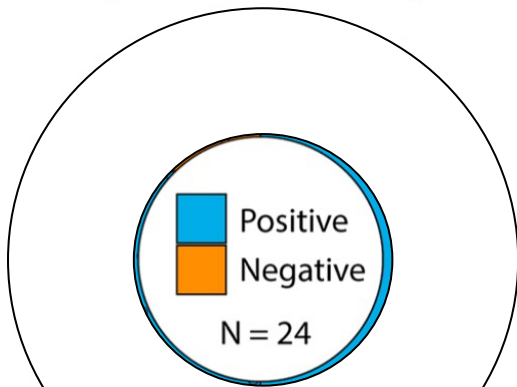
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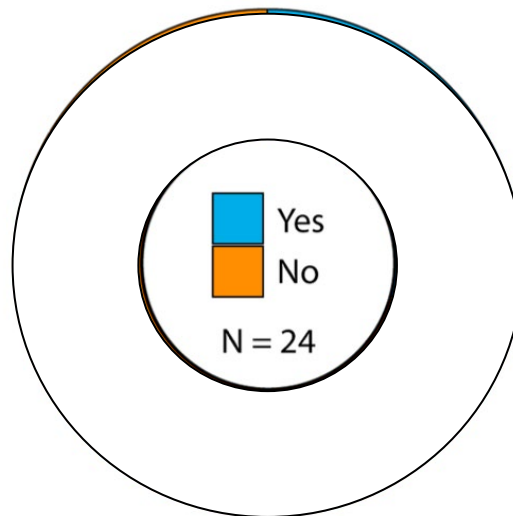
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
Predictions! Perspectives of CSU Deans about SFES and DBER

Impression of SFES phenom.



Negative impression of the DBER field



 SFES lower status

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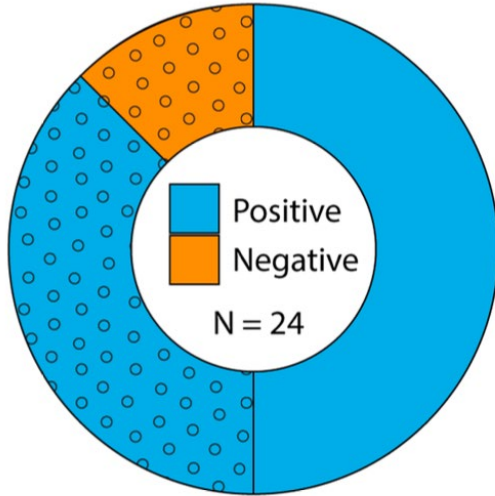
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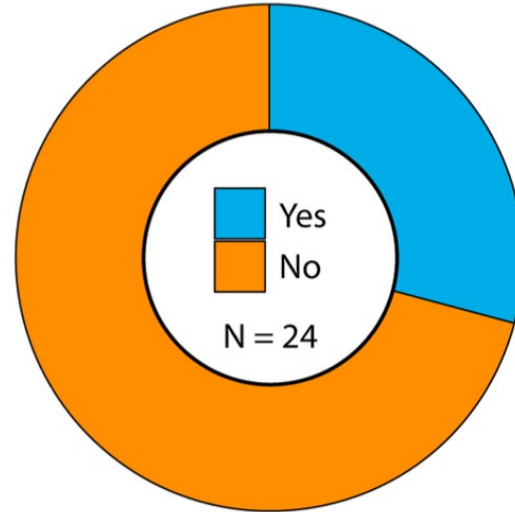
Perspectives of CSU Deans about SFES and DBER

Impression of SFES phenom.



 SFES lower status

Negative impression of the DBER field



Potential Influence of Negative Bias towards 'Education' from Deans

"You know, I'm a scientist, and I've done a lot with education over the years. But I don't want to – for whatever reason – be identified as that. I think there's a bit of a stigma there that the education people are... they're more interested in the... scientists, in general."

How might our conceptualization of our professional identities be shaped by negative perceptions and disciplinary bias about education efforts in the sciences?

"And so, from... and that's the... department. ... students who have... to train the... people, I think, with... pedagogy." – Dean 146

"... And I guess if you want to be completely utilitarian... you could say that once NSF and NIH started focusing on science plus education, then when funds become available, most people follow the money." – Dean 122

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Driving Questions

1. What are the origins of these investigations of education-focused science faculty?
2. How has the SFES phenomenon changed over time?
3. How have education-focused science faculty identities differentiated?
4. How might negative bias from peers and administrators influence these identities?

Ideas that drive my efforts in higher education...

- Talented individuals continue to leave and feel excluded from scientific fields
- Personal choices that leave science departments understaffed
- Great personal and professional opportunities for those who do not
- Few science departments effectively address these issues

How might our conceptualization of our professional identities influence whether and how we disrupt unfairness and exclusion in undergraduate STEM education more broadly?

• ***Long ago observations suggest that natural science departments appeared to be cultivating science faculty who might address these issues.***

"The largest gain in teaching productivity in STEM fields will come from the large STEM faculty who teaches by using innovative methods of using technology to use active or collaborative learning in instruction..."

James Fairweather
Michigan State University
Higher Education Researcher

The immeasurable added value of this project...

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James Rudd, Cal State Los Angeles



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- Finally, we thank our families for on-going patience & support.

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Reflecting on a Decade of Investigations of Science Faculty with Education Specialties (SFES): *Differentiation from DBER, Variation across Institution Types, and Perseverance despite Negative Bias*

Kimberly Tanner, on behalf of...

The SFES – Science Faculty with Education Specialties – Research Team
Seth Bush, California Polytechnic State University, San Luis Obispo
Michael Stevens, Utah Valley University
Kimberly Tanner, San Francisco State University
Kathy Williams, San Diego State University



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