Thank you for joining us!
The conversation will begin shortly.

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Please ask your questions through the Q&A feature.

We will answer as many questions as possible at the end of the presentation.

Our presenters will review all unanswered questions after the conversation, and we will distribute their written responses.

This conversation will be recorded.
Talking about Leaving Revisited:
Why we are still Talking about Leaving

presented by
Timothy Weston, Anne-Barrie Hunter, and Elaine Seymour

as part of the SEA Change Institute Discussion Series
moderated by Shirley Malcom

Supported by the Alfred P. Sloan Foundation
Introduction

• Strategies intended to remedy any problem need a theory of change grounded in an evidence-based diagnosis. Without this, they don’t work

• Human problems usually arise from multiple, intersecting causes

• There may be a single, clear, widely-cited explanation, but it is always wrong
The “Problem Iceberg”

Students who left the sciences and students who stayed struggled with the same set of problems.

Problems with students’ learning experiences were dominant.

These problems intersected with other issues, creating distinctive patterns of loss for students in particular groups and disciplines.
Over the last two decades:

Components of our diagnoses have been drawn on to address issues of quality, access, and equity in STEM education:

• improving STEM learning experiences for all students
• reducing deterrents to persistence for students of color and women of all races and ethnicities

As project evaluators and researchers, we have explored:

• whether and how particular initiatives have taken root
• what encourages or limits their spread across departments, institutions and the K-12 system
Why we revisited the original study

The STEM education reform community asked us:

• What has and has not changed in the inter-connected spectrum of problems that we originally identified?
• What new issues have emerged in the changing socio-economic context in which higher education now operates?
• In light of possible changes in the diagnoses, are we still addressing the right issues?

Diagnoses based in ungrounded conjecture re-emerge when older findings are forgotten and new work is not done.
The consequences of STEM student wastage have radically changed

Graduates are urgently needed in a wide range of occupations who are mathematically, scientifically, and technically *competent* to tackle the complex global problems facing us.

The diagnosis we need now: Why students with demonstrated interest and capability in STEM fields may not reach jobs where their skills are critically needed.
Talking about Leaving Revisited: Persistence, Relocation and Loss in Undergraduate STEM Education (TALR)

2012: A new five-year study with financial support from:

• National Science Foundation

• Alfred P. Sloan Foundation
Overview of TALR Study Design

A mixed-methods research design comprised of inter-related studies:

• replicated and augmented the original TAL study
• component studies explored dimensions of persistence risks from different sources of data
• offers the possibility of triangulating findings
Study sites

Data gathered at six of the seven original institutions participating in TAL:

• Three state flagship research-extensive universities
• A comprehensive land-grant university
• A private research-extensive university
• A private liberal arts college
A National and Institutional Study of STEM Field-switching Patterns

Analyses of:

• US Dept of Ed National Beginning Postsecondary Students Longitudinal Study (BPS:04/09)

• HERI’s CIRP data sets
  • to determine current patterns in undergraduate persistence in STEM majors

• Institutional student transcript and attribute data
  • to explore the switching and persistence patterns of STEM majors at the six institutions in our study sample
The Gateway Course-taking Study

Administration of the online Student Assessment of their Learning Gains (SALG) end-of-course survey in a matched set of STEM foundation courses across the six sample institutions

- Providing numeric estimates of the extent of:
  - several types of student learning gains
  - the nature of benefits and problems experienced in these courses
  - written responses to open-ended questions
  - information about other aspects of students’ experiences (e.g., students’ choice of majors and careers)
The Interview Study

Replicates the original *Talking about Leaving* with in-depth semi-structured interviews and focus groups

- What causes switching and relocation; what enables persistence; new sources of information on student decisions

**Switchers**: students who entered college as STEM majors and switched to non-STEM majors

**Persisters**: seniors who remained in their original STEM major
The Interview Study: An Intentional Sample of Switchers andPersisters

346 students interviewed:

- **96 switchers** (28%) and **250 non-switchers** (72%) with entering math scores of 650+ SAT or 28+ ACT
  - biology, math, physics, chemistry, geosciences, engineering & CS
- 64% women; 36% men
- 36% students of color
- 33% sub-set of persisting seniors selected by low “math readiness” scores
Concurrent Collaborating Studies

• A classroom observation study using the Teaching Dimensions Observation Protocol (TDOP) instrument in the same gateway courses where the SALG survey was administered. Led by Joseph J. Ferrare, University of Washington

• A study of “DFWI” rates in four foundation-level STEM courses in 36 institutions demonstrating the impact of ‘severe foundation courses’ on persistence for particular student demographics led by Andrew K. Koch and Brent M. Drake, the Gardner Institute
What proportion of students switch nationally?

Best estimate is 48% (Chen, 2013; Eagan, et al. 2014)

- 28% switch from a STEM to a non-STEM major
- 20% leave school altogether

Switching from STEM to non-STEM majors has fallen from the 1990’s

- 44% (original CIRP data) to 28% (NCES)

Comparisons with the original TALR are complicated by different sampling methods between times for HERI survey; estimates are somewhat old too
National patterns in switching

Patterns of switching in Chen (2013) study were similar to TALR

- Biology highest, engineering lowest rate of switching
- Women switched at higher rates than men
- Poor preparation in mathematics predicted switching
- While students of color switched more than white students, their switching was better predicted through academic variables such as GPA in regression models
Which students have the greatest risk of switching in our transcript study?

- Women switch at higher rates than men (18% v. 11%)
- Students with low SAT/ACT math scores switch at much higher rates: lowest quartile v. highest (25% v. 7%)
- Students who experience academic duress the first year, switch at higher rates: no DFWI v. one DFWI (12% v. 23%)
- Math (24%) & biology/life science majors (20%) switch the most; engineering students switch the least (8%)
Which racial/ethnic groups have the greatest risk of switching?

African-American, Hispanic, and multi-racial students switched at higher rates than White students and Asian American students.
Risk assessed by regression analysis

- Regression weighs multiple factors at once and finds the independent contribution of each variable.
- Significant variables included most of the differences seen previously: gender, poor grades & incompletes, GPA and math scores.
- However, neither racial/ethnic group or URM status by themselves predicted switching in regression analysis; other academic factors such as SAT/ACT math score did a better job of prediction. This was also true in the NCES analysis.
Gender differences within racial/ethnic groups

- There were some big differences in switching rates by gender and race-ethnicity.
- 41% of URM women in lowest math score quartile switched.
What else affects risk?

• Academic year
  • Half of all those who switched did so the first year, 80% by the end of the second year
• Switching varied substantially by institution (8% to 28%)
• Low-academic performers transfer to and stay longer in **undeclared/undeclared majors** at higher rates than higher-achieving students
**TAL v. TALR:**

**Then and now**

<table>
<thead>
<tr>
<th>National STEM switching rate dropped from 44% to 28%</th>
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<tbody>
<tr>
<td>A further 20% quit college after leaving a STEM major</td>
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<tr>
<td>All causes of switching reported in TAL were identified in TALR, but with changes in relative ranking</td>
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<tr>
<td>TALR: Increased complexity in the array of students’ concerns</td>
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<tr>
<td><strong>TAL: 1997</strong></td>
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<td><strong>TALR: 2019</strong></td>
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TAL v. TALR: Then and now
Unchanged: Negative effects of STEM classroom learning experiences

STEM instructor pedagogy
TALR: 96% all switchers, 72% of persisters

STEM curricular design
TALR: 85% switchers, 56% of persisters

Under-preparation
TALR: 64% switchers, 34% of persisters

Conceptual difficulties
TALR: 80% all switchers, 42% of persisters

Difficulty getting timely help
TALR: 80% all switchers, 31% of persisters

Lost interest
TAL: 60% of all switchers
TALR: 61% switchers

All contribute to weed-out losses: 35% switching decisions. The tip of the iceberg.
Marked change

• Discovering an aptitude for a non-STEM field
  From 10% to 76% in switching decisions (from 16th in TAL rank to 1st in TALR); explored by 76% of all switchers

• Loss of confidence
  From 23% to 61% in switching decisions; high also among all switchers (79%) and persisters (44%)

• Competitive class climate
  From 14% to 52% in switching decisions; an issue for 81% of all switchers and 42% of persisters → effects greatest among women of all races/ethnicities, and men of color
Marked change

- Problems in financing college
  From 30% to 70% of switchers and from 23% to 48% of persisters

- Choosing STEM majors for reasons that prove inappropriate
  From 14% to 48% in switching decisions. Created problems for 68% of all switchers and 22% of persisters
Career-related concerns: Far more influential on today’s students’ switching decisions

• Rejection of STEM careers and lifestyles
  
  From 29% in TAL to 58% in TALR

• Switch to non-STEM field offers more appealing career opportunities
  
  From 27% in TAL to 54% in TALR

• System-playing moves to achieve career goals and/or graduate with higher, more competitive GPA
  
  From 7% in TAL to 26% in TALR
**Gender differences: Then and now**

<table>
<thead>
<tr>
<th>Category</th>
<th>TAL: Men (%)</th>
<th>TAL: Women (%)</th>
<th>TALR: Men (%)</th>
<th>TALR: Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Loss of interest</strong></td>
<td>44%</td>
<td>43%</td>
<td>54%</td>
<td>66%</td>
</tr>
<tr>
<td><strong>Poor teaching</strong></td>
<td>39%</td>
<td>33%</td>
<td>46%</td>
<td>49%</td>
</tr>
<tr>
<td>Switchers</td>
<td>94%</td>
<td>97%</td>
<td>71%</td>
<td>72%</td>
</tr>
<tr>
<td>Persisters</td>
<td>71%</td>
<td>72%</td>
<td>55%</td>
<td>59%</td>
</tr>
<tr>
<td><strong>Loss of confidence</strong></td>
<td>27%</td>
<td>20%</td>
<td>51%</td>
<td>67%</td>
</tr>
<tr>
<td>Switchers</td>
<td>71%</td>
<td>84%</td>
<td>71%</td>
<td>84%</td>
</tr>
<tr>
<td>Persisters</td>
<td>37%</td>
<td>49%</td>
<td>55%</td>
<td>59%</td>
</tr>
<tr>
<td><strong>The competitive climate in STEM</strong></td>
<td>26%</td>
<td>4%</td>
<td>46%</td>
<td>56%</td>
</tr>
<tr>
<td>Switchers</td>
<td>74%</td>
<td>85%</td>
<td>30%</td>
<td>52%</td>
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<tr>
<td>Persisters</td>
<td>30%</td>
<td>52%</td>
<td>55%</td>
<td>59%</td>
</tr>
<tr>
<td><strong>Problems of STEM curricular design</strong></td>
<td>42%</td>
<td>29%</td>
<td>34%</td>
<td>30%</td>
</tr>
<tr>
<td>Switchers</td>
<td>95%</td>
<td>82%</td>
<td>95%</td>
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</tr>
<tr>
<td>Persisters</td>
<td>55%</td>
<td>59%</td>
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</tbody>
</table>
Race/ethnicity differences: Then and now

• TAL: ethnographic analysis of the text data distilled racial/ethnic differences in students’ experiences in STEM majors

• Overall, difficulties of persistence for students of color not significantly different from 20 years ago
Race/ethnicity differences: Then and now

**Under-preparation**
- TALR: 35% SoC, 13% white students
- Switchers: 73% SoC, 60% white students
- Persisters: 41% SoC, 31% white students

**Difficult transition to college**
- TALR: 73% SoC, 31% white students
- Switchers: 96% SoC, 86% white students
- Persisters: 78% SoC, 45% white students

**The competitive ethos of STEM**
- TALR: 62% SoC, 49% white students
- Switchers: 88% SoC, 79% white students
- Persisters: 60% SoC, 32% white students

**Loss of confidence**
- TALR: 69% SoC, 59% white students
- Switchers: 92% SoC, 74% white students
- Persisters: 59% SoC, 35% white students
Convergence within the “Problem Iceberg”

Men and women, regardless of race/ethnicity, cite nearly three-quarters of all “iceberg” factors in persistence difficulties. This is a shared experience—and it’s a big iceberg.
Other Changes: Then and now

- Fewer accounts of overt sexist behavior
- Fewer accounts of overt racist behavior
  
  *Increased reports of micro-aggressions*
Conclusions: Then and now

- Factors contributing to switching out of STEM majors 20 years ago are predominately the same today.
- TALR results show that multiple issues were reported by larger percentages of students.
- More students are experiencing more of the same issues suggesting students’ experiences have converged over time—regardless of gender or race/ethnicity.
- Findings did not differ significantly by type of institution.

Switchers and persisters are not different types of student.
TALR: Entering an uneven playing field

Heather Thiry, Tim Weston, and Raquel Harper

TALR analysts discuss the consequences for college transition and survival in the early stages of STEM majors that arise from disadvantages of social class, race, ethnicity and gender, including:

• under-preparation in the K-12 system
• problems arising from choice of majors or career pathways
• the need to work while in college
Questions
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Tuesday, July 21 8am Pacific/9am Mountain/10am Central/11am Eastern