SIISP: Self-Efficacy Intervention to Improve STEM Performance

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OBJECTIVES:

- Develop, test, document, and disseminate a practical, scalable **intervention to increase self-efficacy** in university STEM students.
- Develop and validate an efficient **instrument for measuring university STEM self-efficacy**, growth mindset, and perceived academic control in university STEM students.
- Improve **our understanding of the dynamics of self-efficacy** – the factors that lead to growth, especially for traditionally under-represented, at-risk demographic groups.

THE INSTRUMENT:

- 34 Likert scale items gauging **three psychosocial traits**, plus demographic questions:
  - → 20 items targeting **self-efficacy** (in 3 sub-groups);
  - → 7 items targeting **perceived academic control**; and
  - → 7 items targeting **growth mindset**.
- **Iteratively improved** through three revisions.
- **Validated** via exploratory factor analysis, Rasch analysis, and multi-trait multi-method comparison to coded interviews (in progress).
- **Rasch modeling** produces a reliable estimate for each student's trait scores, with uncertainties (±).
- **Efficient and portable**: can be administered online or via scannable paper form; requires ~10 minutes to complete.

THE PROTOCOL:

- Week 1: Solicit informed consent, collect demographics, & **pre-test with survey** ("the instrument") for baseline.
- Week 4 (or shortly after first course exam): **Main intervention** in lab meetings; collect workbooks w/written responses (qualitative data) and subset of questionnaire.
- Week 7: **Follow-up intervention** in class or online; worksheet provides more qualitative data.
- Week 11: **Post-test with survey** for impact of intervention.
- Subsequent academic term: **Delayed post-test** with same survey (third time) for longevity of impact.
- **Timeline is adaptable** to each course schedule.
- Students are quasi-randomly assigned by lab section to either **treatment or control groups**.
- The **control group** receives an alternate intervention about "cultural competency," designed to be relevant and engaging but unlikely to influence instrument responses.

WHAT'S NEXT?

- **Replicate the Spring 2018 results** in Fall 2018, including a third site and much larger population.
- **Validate the survey instrument** against interview data.
- **Polish and package for distribution** the intervention and survey instrument.
- **Seek partners** for implementation and scaling-up research.

See **http://physics.uncg.edu/siisp** for more information, or contact Dr. Stephanie Sedberry-Carrino (**sscarrin@uncg.edu**).

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Why?

- **Self-efficacy** (beliefs about one's ability to perform tasks successfully) is a psycho-social construct that **strongly correlates with academic success**. It is a stronger predictor of student performance than purely cognitive traits.
- Social/psychological interventions are **particularly effective for women and underrepresented minorities** because they mitigate stereotype threats.
- **No practical, replicable interventions exist** to increase university-level STEM students' self-efficacy. Extant interventions are resource-intensive, hard to replicate, and domain-specific.
- **Growth mindset** is a key ingredient for maintaining and strengthening self-efficacy in the face of challenges.

The "persistence cycle": how a growth mindset encourages persistence and the embrace of struggle, leading to success and increased self-efficacy.

THE INTERVENTION:

- **One 30-minute main session** in a lecture, recitation, or lab section, led by a project team member.
- **One 10-minute followup** ~3 weeks later, in-class or online.
- Main session involves interspersed **presentation** (oral PowerPoint), **narrated video, open discussion, and written reactions** in a workbook.
- Focuses on **the science of growth mindset**, its link to academic success, and its **application to taking a hard STEM course**.
- Suggests **concrete strategies and actions** students can try to manifest growth mindset in their behavior (thus encouraging a sense of **academic control**).
- Followup session worksheet asks students to recall key ideas and reflect on whether/how they've adjusted their behaviors.
- Intervention design elements are **based on successful extant interventions** for success/failure attributional retraining and growth/fixed intelligence mindset.

RESULTS & FINDINGS SO FAR:

- Data drawn from calculus- and algebra-based physics at **three North Carolina public universities** with different demographics.
- **Linear modeling was used to test the impact of treatment vs. control** on pre-test to post-test score changes for self-efficacy (**SE**), growth mindset (**GM**), and perceived academic control (**PAC**) – including interactions with institution, course, and demographics.
- Spring 2017: **No statistically significant effects** of treatment vs. control, prompting revisions of instrument & intervention.
- Fall 2017: **Greater increase in GM** for treatment than control (p=0.02). Effect depends on institution (p=0.1).
- Spring 2018: Due to treatment, **significant increase in GM** (p<0.001), **marginally significant increase in SE** (p=0.062), **significant increase in PAC** for calculus-based courses (p=0.01).
- We've also learned much about **the details of delivering an effective self-efficacy intervention**, including mechanisms for increasing engagement, and contextual characteristics of the course and university that mediate success.