

Introduction

- Biology increasingly relies on sophisticated quantitative tools and techniques, necessitating further training of biology students (AAAS 2011), but low student engagement hampers successful and effective integration of quantitative skills into modern curricula (Wachsmuth et al. 2017).

Self-Efficacy

(Bandura 1997, Bong & Saalvik 2003)

- **Self-efficacy** is a student's beliefs about their ability to succeed at a given task. This can impact their **engagement** and **performance** on the task.

- **Group work** can increase student engagement (Hodges 2018), but **it is unclear how students experience the various sources of self-efficacy through group work.**

Sources of Self-Efficacy

(Bandura 1997, Butz & Usher 2015)

- Mastery Experiences**: Experiencing success at the task through their own effort and achievement
- Vicarious Experiences**: Comparing their own ability or success at the task to that of their peers
- Social Persuasions**: Receiving feedback or guidance from others about their performance
- Physiological States**: Emotions they associate with the task (e.g., fear, anxiety, enjoyment, etc.)

Research Question

When working together in small groups to complete quantitative biology tasks, what sources of self-efficacy do introductory biology undergraduate students draw from which affect their math self-efficacy?

How do the sources of self-efficacy differ between high and low self-efficacy students?

Design and Methodology

- Small groups of students (3-5) in two introductory biology classes (n = 311) completed quantitative biology assignments in-class**
 - Solving Hardy-Weinberg Equilibria
 - Modeling Population Growth/Decline
- Students completed 5-pt Likert-scale surveys before and after each group work assignment**
 - Asked students to report their confidence in completing a problem similar to those on the assignment
 - **High Self-Efficacy (HSE):** score of 4 or 5
 - **Low Self-Efficacy (LSE):** score of 3, 2, or 1
 - Asked students after each assignment to describe experiences during the group work which increased and decreased their confidence in solving the problem
- Qualitatively coded student responses for specific group work experiences**
 - Process coding: used '-ing' verbs to describe experiences
 - **21 codes** were developed based on theory prior to the coding process as well as patterns which emerged throughout
 - Categorized coded experiences by the four sources of self-efficacy
 - Responses which did not clearly indicate or relate to a source were excluded from the analysis

Results

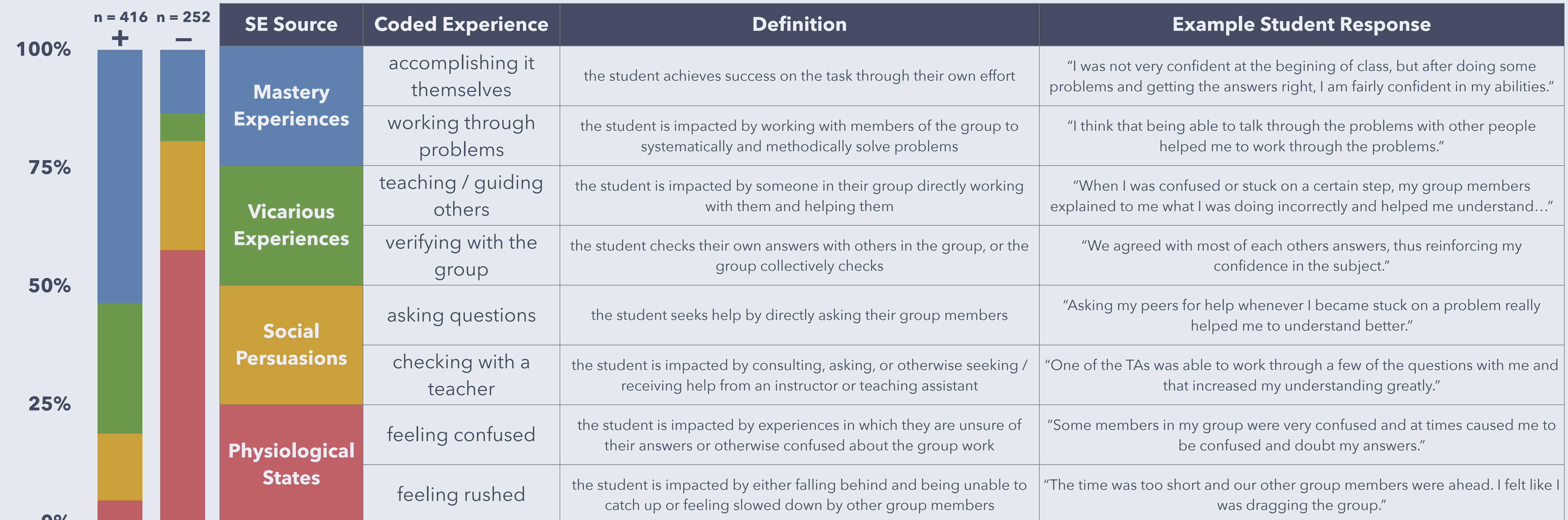
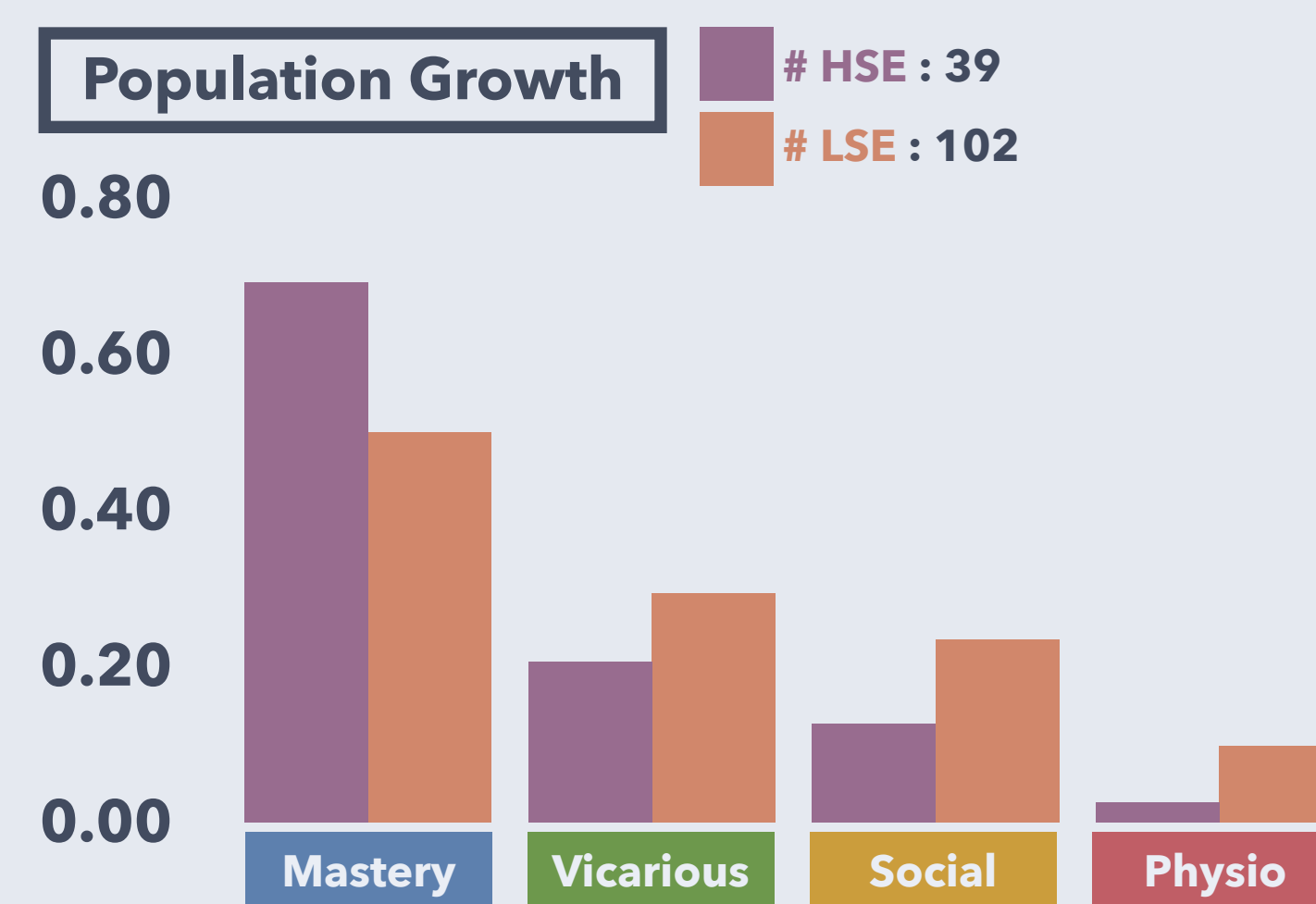
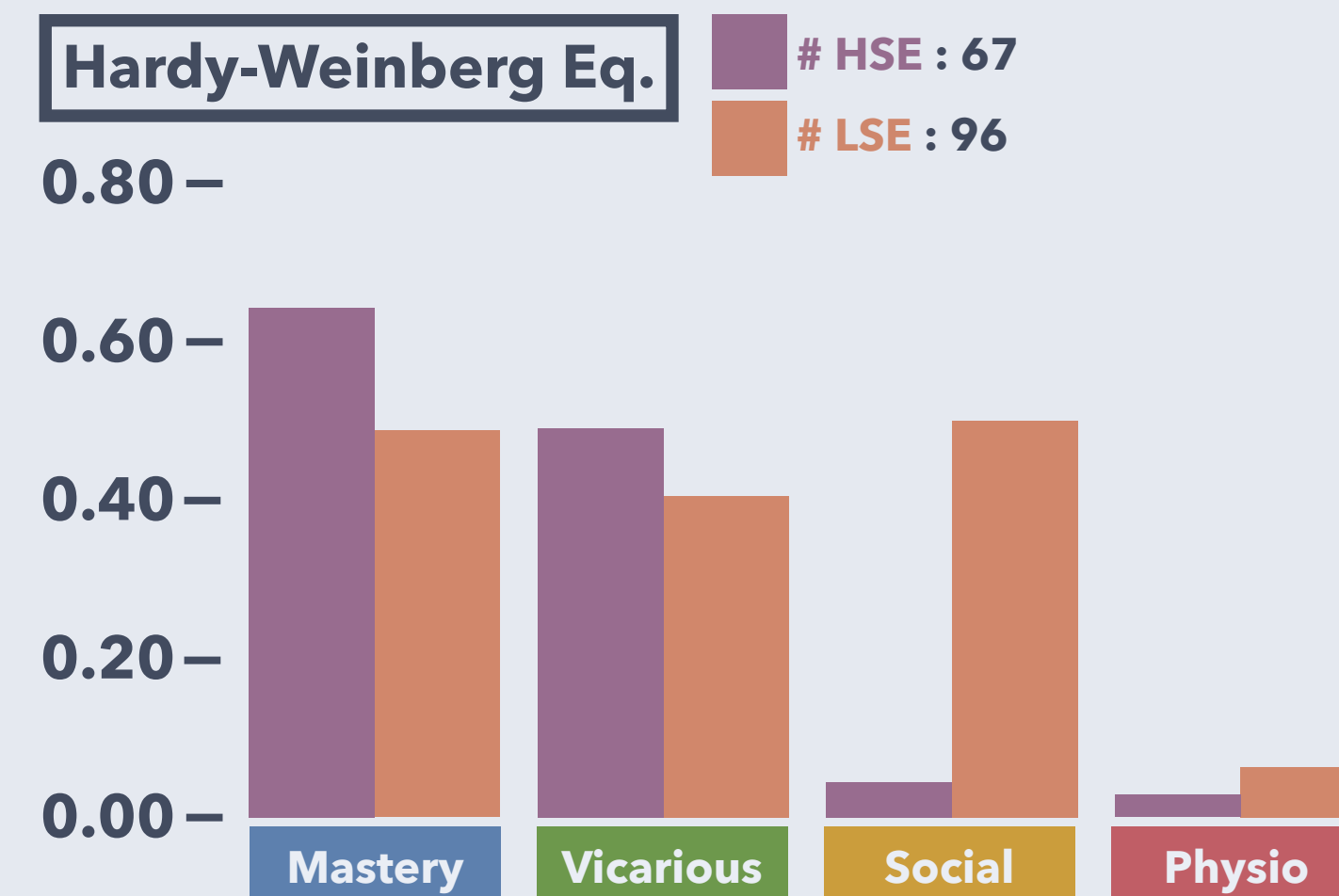


Figure 1: Proportions of self-efficacy scores within increased confidence responses (+) and decreased confidence responses (-). Codes were categorized by source; listed here are the two most prominent codes within each source. "Teaching/guiding others" was coded as a **vicarious experience** if a student received help from their group; on a few occasions, if a student was instead teaching or guiding their group members, their response was coded as a **mastery experience**.

+ Increased Confidence



- Decreased Confidence

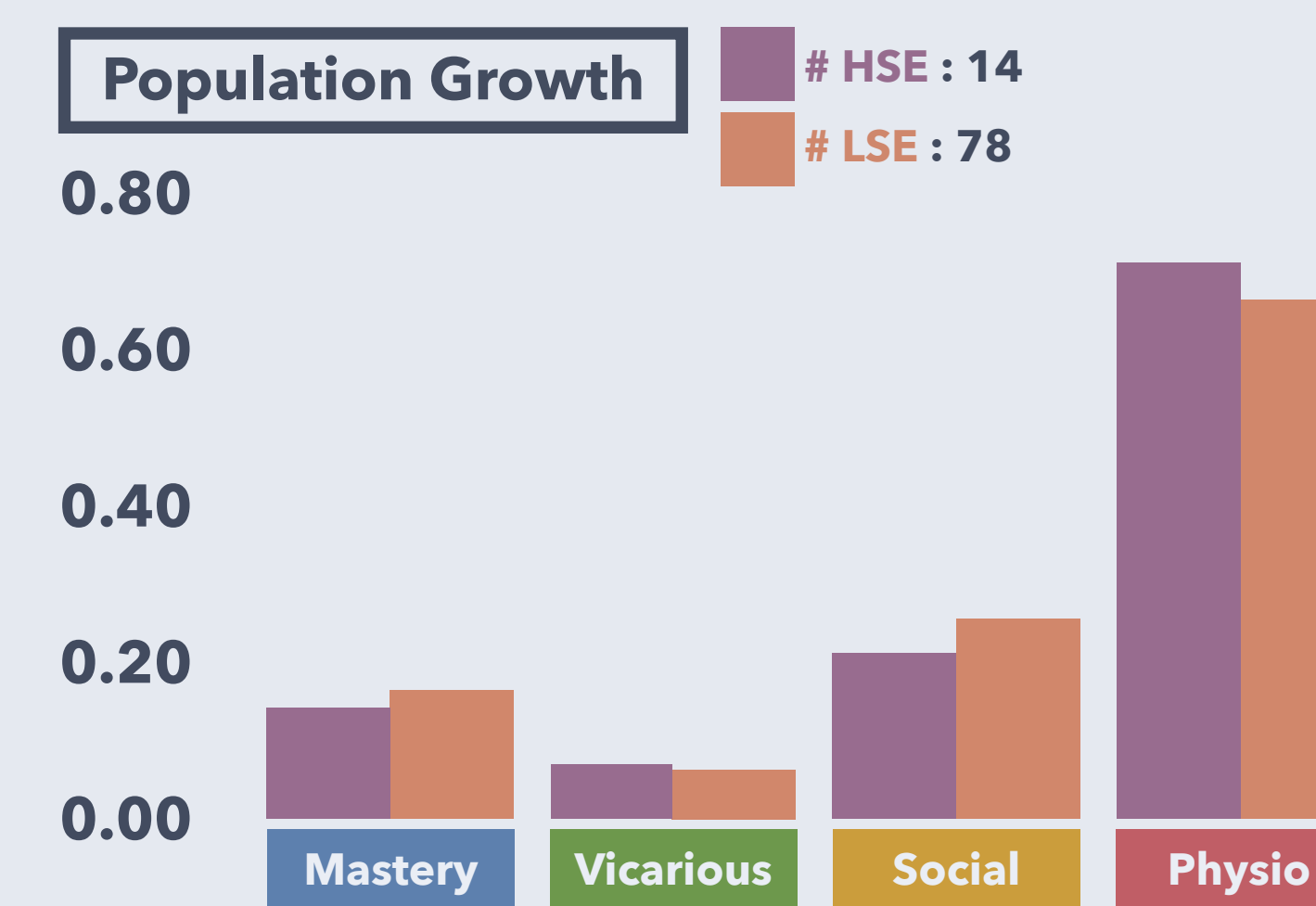
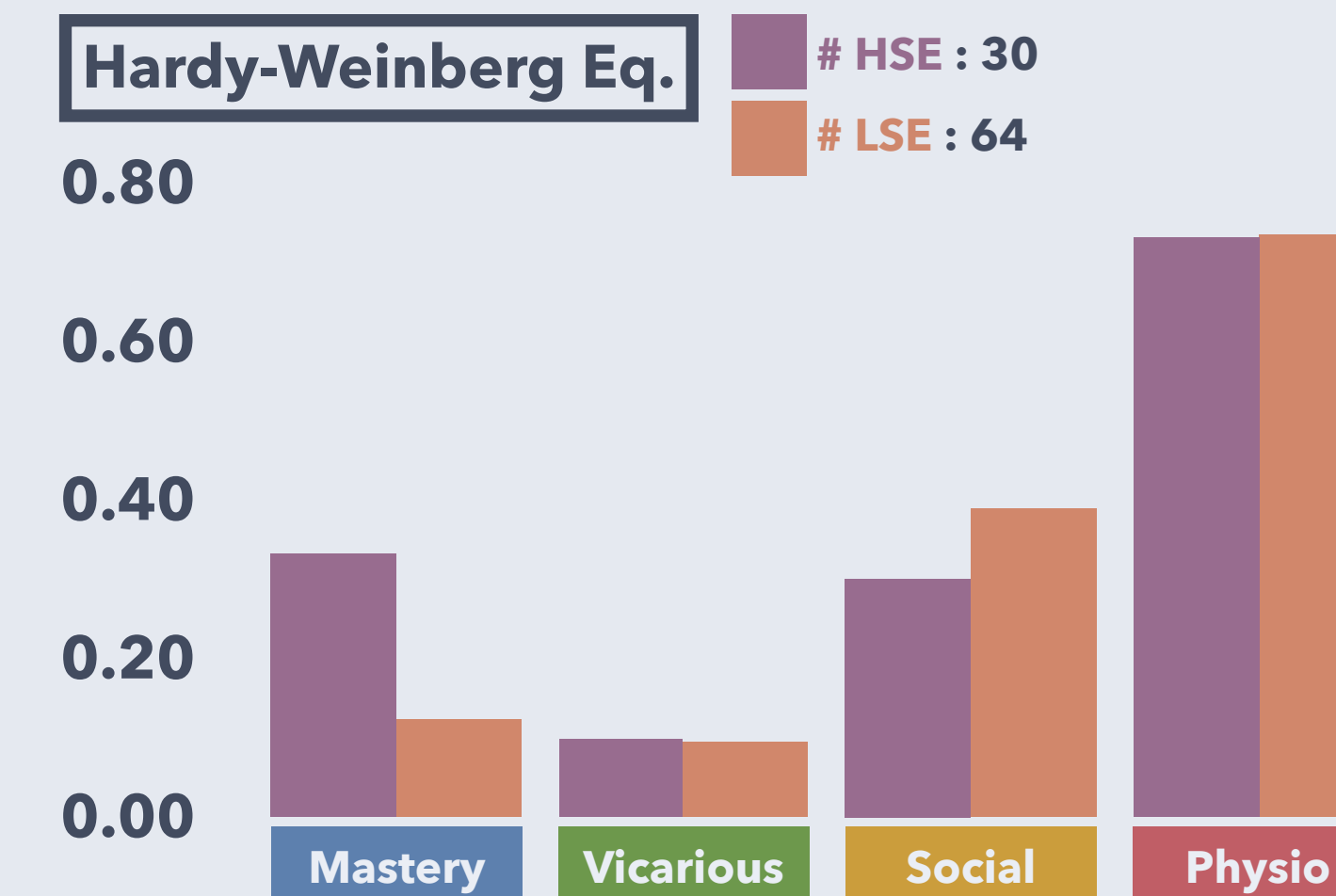


Figure 2: Proportion of High Self-Efficacy and Low Self-Efficacy students who reported a self-efficacy source across experiences which increased or decreased their confidence.

LSE students frequently reported **mastery and vicarious experiences** as well as many **social persuasions** which increased their confidence. However, HSE students relied primarily on only **mastery and vicarious experiences**. HSE and LSE students reported similar frequencies of each source when discussing decreases in confidence. Fisher's Exact Tests were performed and adjusted using the Holm-Bonferroni Correction Method for Multiple Comparisons.

Conclusions

More confident students respond positively to experiences which build and reinforce their success. By creating opportunities for confident students to excel, instructors can further bolster their accomplishments and even encourage them to guide their peers.

Less confident students further benefit from open communication and support. By promoting collaboration and discussion, instructors can alleviate some of the pressure facing these students and given them more approachable opportunities to seek help from their peers.

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