

Gender and Academic Performance in Undergraduate Physics Students: The role of discipline identification, self-efficacy, and perceived recognition.

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Background

Recent studies have suggested that male undergraduate students identify with physics to a greater extent than female students (e.g., Hazari et al., 2010). This identification with physics is formed by multiple factors (see Kalender et al., 2019), such as students' beliefs in their abilities to complete physics-based tasks (i.e., self-efficacy) and the extent to which they believe others recognize them as a physicist (henceforth perceived recognition). This study collected data from students at a UK institution, examining the relationships between identification with physics, self-efficacy, perceived recognition, gender, and academic performance.

Research Questions

1. Are there gender differences in self-efficacy, perceived recognition, identification with physics, and academic performance?
2. What are the relationships between these variables?
3. Are there feedback loops between academic performance and each of self-efficacy, perceived recognition, and physics identification?

Method

- We collected survey responses from 393 students at a single UK institution, at all levels of the undergraduate degree, across three academic years and five timepoints (717 surveys in total).
- We asked about students' identification with physics, self-efficacy, and the extent to which they thought others see them as a physicist (perceived recognition).
- We then matched their survey responses with gender and grades prior to analysis.

Research Question 1: Gender Differences

- We examined the gender differences in the variables in 116 students (77 men, 39 women) at the start and end of an academic year.
- Responses were collected from students at all years of the undergraduate course, from the introductory level to the integrated masters level.
- Despite finding no differences in academic performance ($p=.678$), men reported greater identification with physics ($p=.006$), perceived recognition as a physicist ($p=.047$), and self-efficacy ($p=.005$; see Figure 1).
- These gender effects persisted across the academic year.

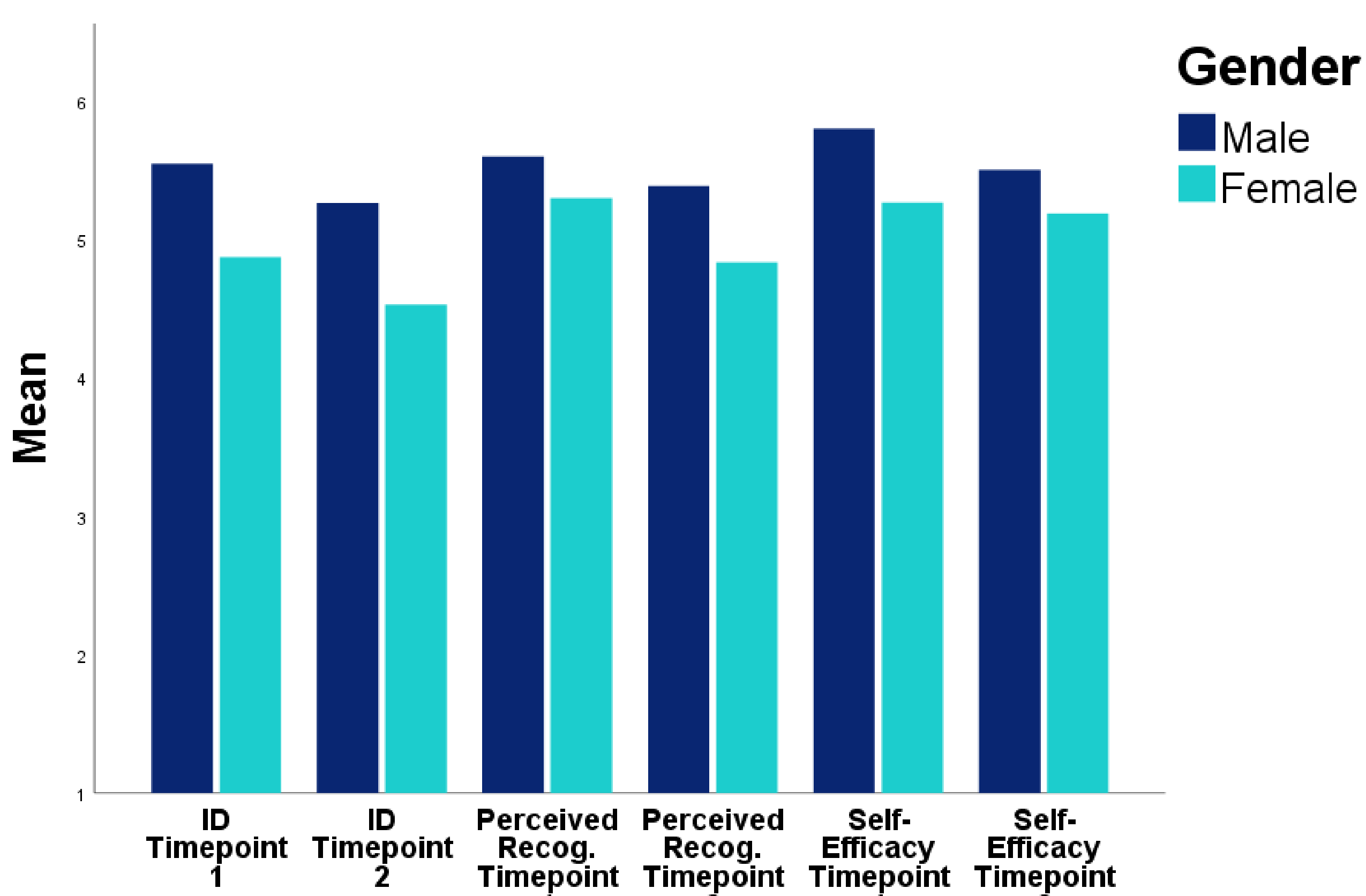


Figure 1. Identification with physics, perceived recognition, and self-efficacy by gender and timepoint. Timepoint 1 is the start of the year and timepoint 2 is the end of the year.

Research Question 2: Relationships Between Variables

- We then examined our full dataset to see the relationships between the variables. To do this we ran a path analysis.
- Our model suggested that there were significant pathways between gender and perceived recognition, identification with physics, and self-efficacy (see Figure 2)
- Self-efficacy and perceived recognition were significantly associated with better grades, but identification with physics was not.
- This model had a strong model fit ($X^2(2)=2.766$, $p=.251$, CFI=.998, RMSEA=.026)

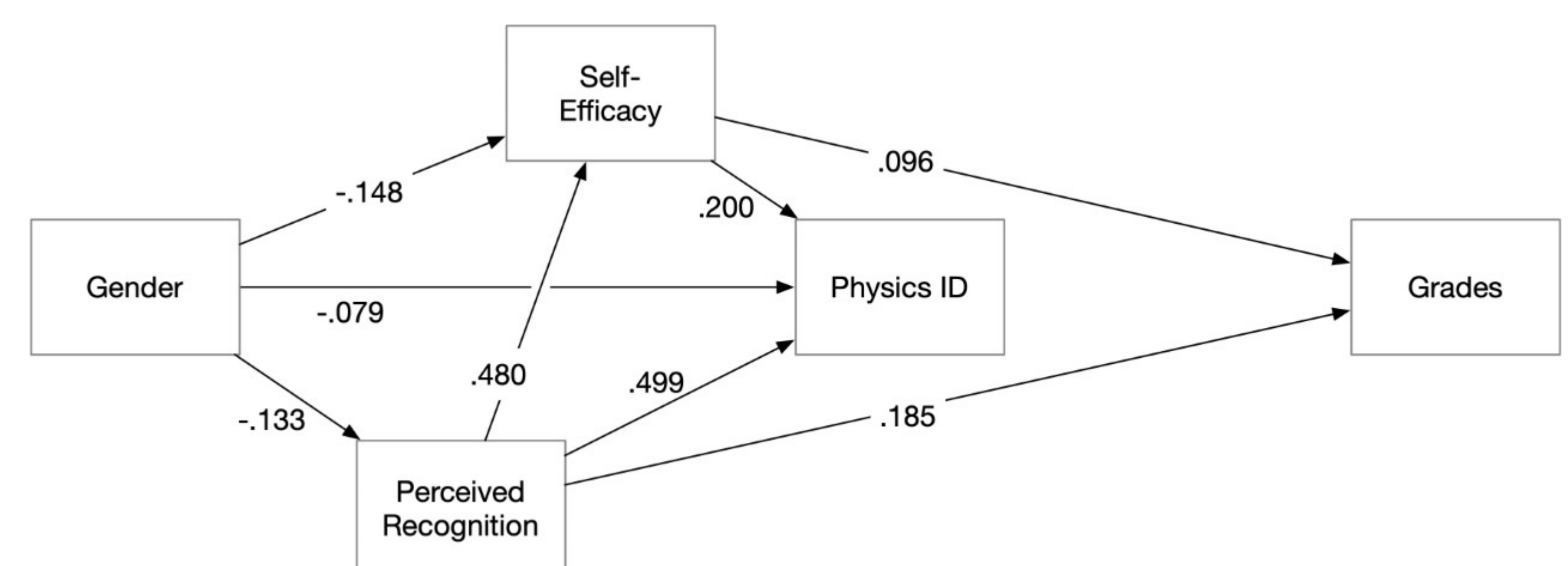


Figure 2. Path analysis showing relationships between variables with standardized regression coefficients. Negative pathways from gender indicates greater scores for men.

Research Question 3: Feedback Loops

- We then investigated whether students receiving their grades back had an impact on their identification, perceived recognition, and self-efficacy in the following semester.
- We examined this in 225 students (148 men, 77 women).
- We found that the grade received predicted students' self-efficacy ($p=.001$) and perceived recognition ($p<.001$), but not identification ($p=.053$), in the following semester.
- The results of analysis 2 and 3 combined suggest that there may be a bidirectional relationship between grades and both self-efficacy and perceived recognition (see Figure 3).

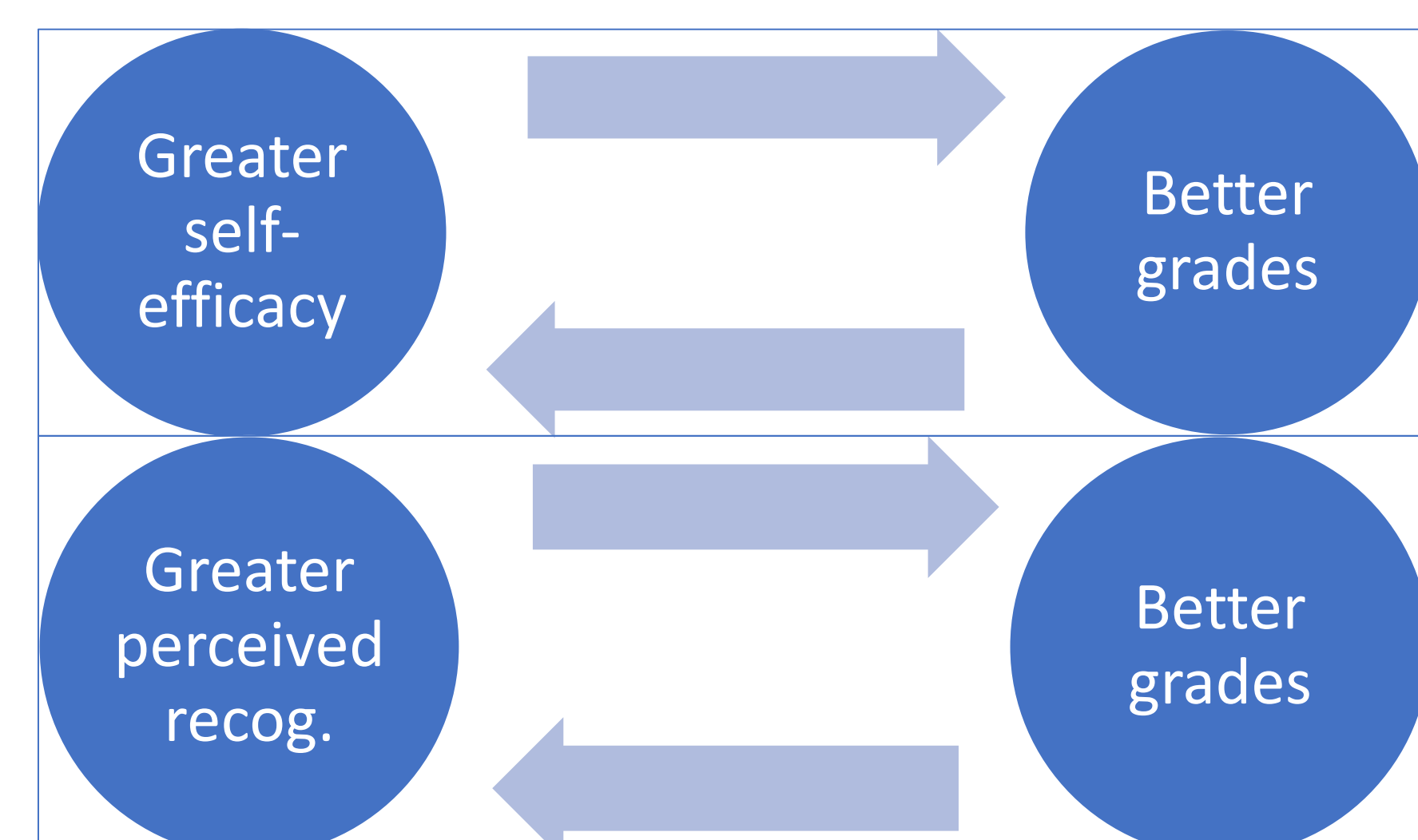


Figure 3. A conceptualization of the bidirectional relationships between self-efficacy and grades, and perceived recognition and grades.

Conclusions

Collectively, the results of the presented research tell a concerning story, with men reporting greater self-efficacy, perceived recognition, and identification with physics (Research Question 1). Moreover, self-efficacy and perceived recognition impacted upon students' grades (Research Question 2). We also found evidence for feedback loops between grades and both self-efficacy and perceived recognition (Research Question 3). Therefore, with self-efficacy and perceived recognition being associated with better grades, and better grades associated with increased self-efficacy and perceived recognition, gender differences in these constructs may develop over time.

References :
 Hazari, Z., Sonnert, G., Sadler, P. M., & Shanahan, M. C. (2010). Connecting high school physics experiences, outcome expectations, physics identity, and physics career choice: A gender study. *Journal of research in science teaching*, 47(8), 978-1003.
 Kalender, Z. Y., Marshman, E., Schunn, C. D., Nokes-Malach, T. J., & Singh, C. (2019). Gendered patterns in the construction of physics identity from motivational factors. *Physical Review Physics Education Research*, 15(2), 020119.