

Concerned or Comfortable in Undergraduate Physics Classrooms: A Multiple Group Analysis Approach

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ABSTRACT

The current study examined the critical yet unexplored question of how students' experiences in class (i.e., social comparison concern and comfort) mediate the relationships between classroom climate (i.e., instructor support, course organization, and academic press) and engagement/achievement and how these relationships differ between genders in an undergraduate physics environment. Results from multiple-group structural equation modeling revealed that three aspects of classroom climate predict students' social comparison concern and comfort in class, in turn, predict their engagement and course grade. Also, significant gender differences in several relations were found. Importantly, females were more likely to be concerned about comparison with others as well as engage in more interactive learning than males under higher perceived instructors' academic press. Conversely, they were less likely to be concerned about comparison with others than males under higher perceived instructor support. These findings may be useful to instructors in creating a course environment that promotes adaptive learning experiences and engagement for females in STEM.

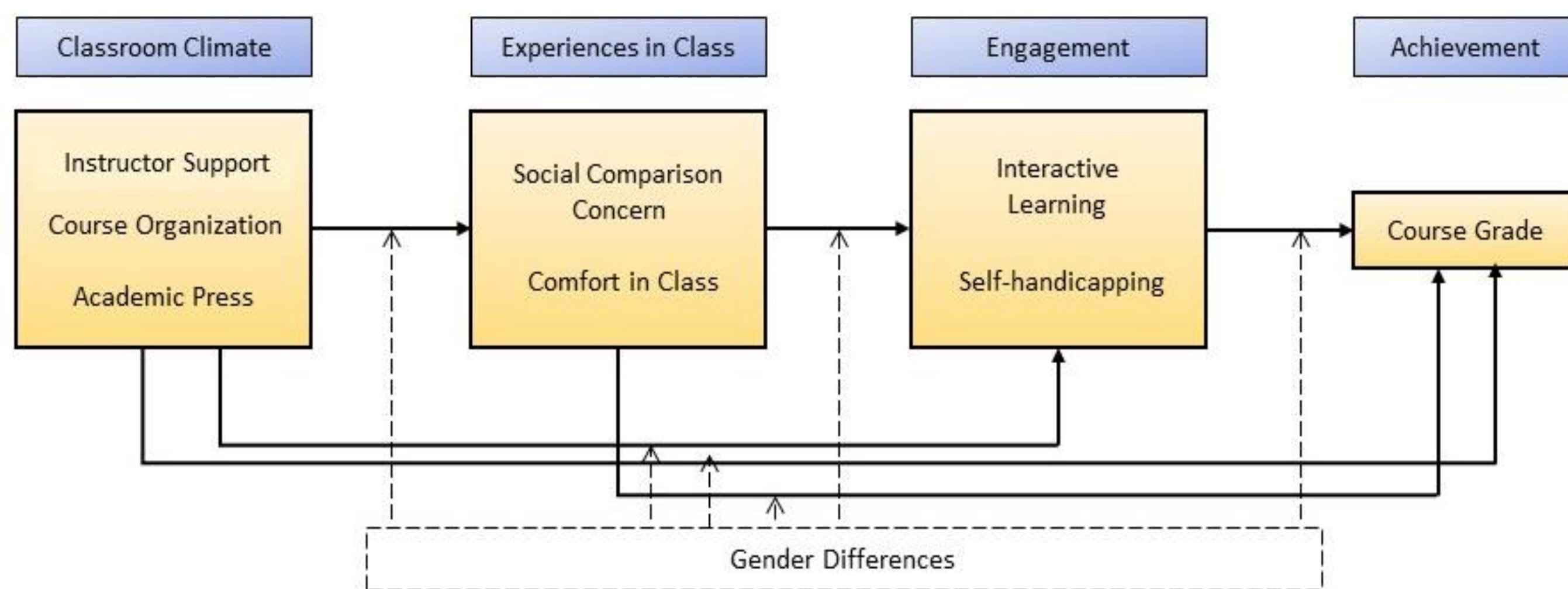
INTRODUCTION

- It is well documented that women in STEM experience more barriers in their learning (Cromley et al., 2016). Thus, the need to investigate both individual and environmental factors that promote positive academic outcomes among women in STEM has increased (Good et al., 2012).
- There is strong evidence that shows the impact of the classroom climate on students' engagement and achievement in college (e.g., Corkin et al., 2014).
- Also, prior studies have found that students' perceptions of their learning experiences (i.e., social comparison concern and comfort) affect their engagement and achievement in STEM, and these perceptions appear to have a differential impact on academic outcomes between genders (Micari & Drane, 2011).
- However, no known studies have investigated gender differences in the role of social comparison concern and comfort in the influence of classroom climate on academic outcomes.

AIMS

We aimed to investigate

- Relations between environmental antecedents (i.e., classroom climate; instructor support, course organization, and academic press), mediators (i.e., social comparison concern and comfort), and outcomes (i.e., engagement and course grade)
- Gender difference in these relationships in an undergraduate physics environment.



METHOD

Participants

- 1,416 undergraduate students (74.5% male, $M_{age} = 19.5$, 71.5% White) enrolled in physics courses

Measures

- Established instruments were administered via online surveys: classroom climate (Corkin, Yu, Wolters, & Wiesner, 2014), experiences in class (Micari & Drane, 2011), interactive learning (Shell et al., 1997), self-handicapping (Urdan & Midgley, 2001), and physics self-efficacy (PALS; Midgley et al., 2000).

	α	Sample Item
Instructor Support	.82	The instructor in this physics class makes an effort to get to know students.
Course Organization	.84	The instructor plans class activities in detail in this physics class.
Academic Press	.83	In this physics class, the instructor gives work that makes students think critically.
Social Comparison Concern	.85	I worry about getting things wrong in front of my peers in this physics class.
Comfort Being Oneself	.81	I feel comfortable offering my own ideas in this physics class.
Interactive Learning	.93	In this physics class, my classmates and I actively share ideas. Some students purposely don't try hard in physics classes so that if they don't do well, they can say it is because they didn't try. How true is this of you?
Self-handicapping	.90	In this physics class, I'm certain I can master the skills taught in class this year
Physics Self-efficacy	.95	

Analytic Approach

- Multiple-group structural equation modeling with full information maximum likelihood (FIML)
- Cluster-robust standard errors were adjusted to address the nested structure of data (i.e., students within sections) while preserving the covariance matrix for estimating parameters (McNeish, Stapleton, & Silverman, 2017)

RESULTS

Model fit statistics for measurement invariance test

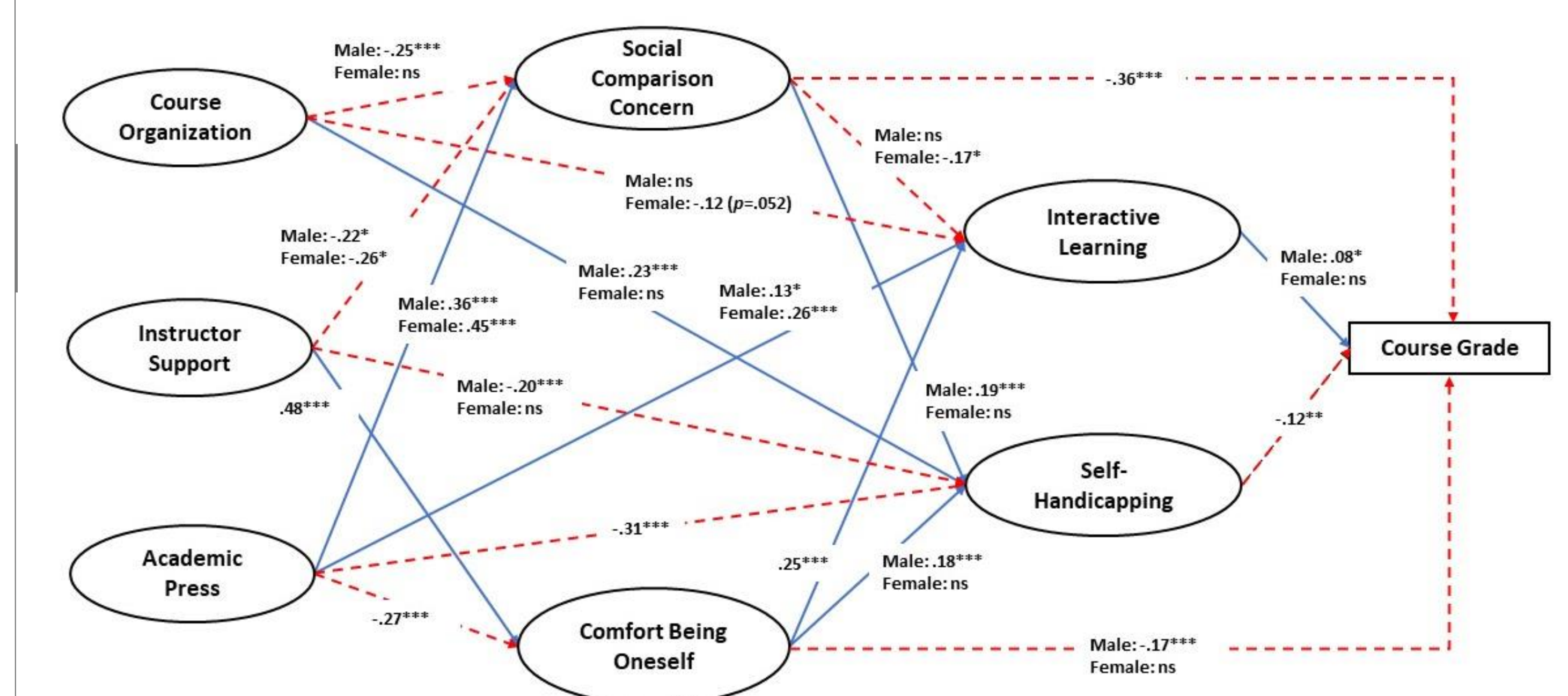
- The structural model displayed good fit for the overall sample.
- Measurement invariance of the latent constructs was confirmed.

Model	χ^2 (df)	RMSEA	CFI	Δ CFI
Baseline Measurement Model				
Entire Sample	-	0.054	0.916	-
Multiple Group Comparisons				
Configural	-	0.038	0.908	-
Metric	49.025 (47)	0.038	0.908	-
Scalar	129.435 (47)	0.038	0.906	- 0.002

Comparisons of significant direct effects among variables across genders

Paths	β (SE)		$\Delta \chi^2$ (1)
	Male	Female	
Course organization →	Social comparison	-.44 (.05)***	6.31
	Comfort in class	.38 (.06)***	3.94
	Self-handicapping	.17 (.05)**	
Academic press →	Comfort in class	-.17 (.02)***	8.81
	Interactive learning	.10 (.10)*	4.77
Social comparison →	Self-handicapping	.15 (.05)**	
Comfort in class →	Course grade	-.12 (.03)***	
Interactive learning →	Course grade	.06 (.03)*	
	Course grade	.03 (.08) (p=.69)	

Structural model by gender



Note. Only significant paths with at least one significant effect at $p < .05$ are shown. Non-significant paths are indicated with "ns". * $p < .05$, ** $p < .01$, *** $p < .001$

Overall relations of variables

- Course organization negatively predicted social comparison concern and interactive learning, while it positively predicted self-handicapping.
- Instructor support negatively predicted social comparison concern and self-handicapping, while it positively predicted comfort in class.
- Academic press positively predicted social comparison concern and interactive learning, while it negatively predicted comfort in class and self-handicapping.
- Both social comparison concern and comfort in class negatively predicted course grade.
- Lastly, interactive learning positively predicted course grade, while self-handicapping negatively predicted course grade.

Gender differences in relations of variables

- Significant gender differences in several relations were found.
- Females were more likely to be concerned about comparison with others as well as engage in more interactive learning than males as they perceive higher academic press from their instructors.
- Conversely, females were less likely to be concerned about comparison with others than were males when they perceive higher support from their instructors.
- Some relations were found to be significant for one gender only.

CONCLUSIONS

- Classroom climate predicts students' social comparison concern and comfort in class, which in turn predicts their engagement and course grade.
- Importantly, the significance and/or magnitude of these relationships are different between genders.
- Instructors' academic press more likely increased social comparison concern, while their support more likely decreased the same concern among females than males.
- Instructors' academic press more likely led females than males to engage in interactive learning.

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