Examining Students' Perceived Autonomy Support as a Source of Self-Efficacy in Mathematics

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Theoretical Framework

- In the academic domain, **self-efficacy** is defined as the belief students hold about their capability to successfully perform and complete academic tasks. Bandura (1997) hypothesized four primary sources of self-efficacy:
    - **Mastery Experiences:** Interpretation of one's own performance
    - **Vicarious Experiences:** Observation of others' performances
    - **Social Persuasions:** Messages received from others (e.g., teachers, parents, friends)
    - **Physiological States:** Emotional and somatic states (e.g., anxiety and stress)

- **Bandura's model** contains important information about how students assess their efficacy; however, other sources, such as **an autonomy supportive environment**, might account for how efficacious students feel.

- **Self-determination theory** posits that humans have a basic psychological need for autonomy to provide the intrinsic motivation needed for optimal functioning (Ryan & Deci, 2000).
    - Students who feel autonomous are intrinsically motivated to perform tasks with a higher degree of aspiration and a sense of choice, without being persuaded by external factors (Jang, Reece, Ryan, & Kim, 2009).
    - When they feel autonomous, students likely also experience a stronger belief in their own competence (Ryan & Deci, 2000).

Purpose of the Study

The primary aim of this study was to examine whether students' perception of autonomy support in mathematics serves as a source of students' efficacy beliefs in mathematics. We sought to address the following research questions:
1. What is the relationship between perceived autonomy support and the hypothesized sources of self-efficacy beliefs among middle school mathematics students?
2. How do Bandura's (1997) theorized sources of self-efficacy influence students' mathematics self-efficacy?
3. Does the inclusion of perceived autonomy support add to the prediction of mathematics self-efficacy, when controlling for the influence of the four sources?
4. Do these predictive models differ for boys and girls?

Method

Participants and Data Sources

Participants were 1,820 students enrolled in Grades 6 to 8 from four middle schools in the southeastern Unites States. Students completed an online survey designed to assess their beliefs about learning and doing mathematics. They were asked to provide judgments about how true or false they found a particular statement along a 6-point Likert-type scale. The survey included the following measures (see Table 1):

- The four hypothesized *sources of self-efficacy* were assessed with a 24-item scale developed by Usher and Pajares (2009) for use with middle school mathematics students.

- Six items from the Learning Climate Questionnaire (Black & Deci, 2000) were used to assess students' *perceived autonomy support*.

- Three self-efficacy measures were used to assess the diverse mathematics efficacy beliefs: *general mathematics self-efficacy* (4 items), *test-taking self-efficacy* (3 items)*, and *skills self-efficacy* (27 items), with a 6-point response scale (1 = *Not confident at all*; 6 = *Completely confident*). All measures adhered to Bandura's (2006) guidelines for constructing self-efficacy scales.

Analyses

Means, standard deviations, and zero-order correlations were calculated for all variables of interest. We then ran three multiple hierarchical linear regression models in which each self-efficacy measure was regressed on the four hypothesized sources (Step 1) and perceived autonomy support (Step 2). The R^2 values of the two models were then compared. Analyses were then run separately for boys and girls.

Table 1
Sample Items Used in the Study

Variable	Sample Item	Cronbach's alpha
General Mathematics Self-Efficacy	In general, how confident are you in your abilities in math?	.881
Mathematics Test-Taking Self-Efficacy	How confident are you that you can do well on standardized tests in math?	.894
Mathematics Skills Self-Efficacy	Multiplication with two digit numbers	.962
Mastery Experience	I have always been successful with math.	.861
Vicarious Experience	Seeing adults do well in math pushes me to do better.	.747
Social Persuasions	My math teachers have told me that I am good at learning math.	.871
Physiological State	Just being in math class makes me feel stressed and nervous.	.862
Perceived Autonomy Support	My math teacher lets me choose what I learn about in math.	.864

Results

Table 2
Means, Standard Deviations, and Zero-Order Correlations for Variables in the Study

Variable	M	SD	1	2	3	4	5	6	7
1. General Math Self-Efficacy	4.77	1.08							
2. Math Test-Taking Self-Efficacy	4.71	1.11	.84						
3. Math Skills Self-Efficacy	5.11	.82	.67	.67					
4. Mastery Experience	4.34	1.14	.61	.58	.48				
5. Vicarious Experience	3.95	0.96	.42	.41	.36	.54			
6. Social Persuasions	3.93	1.27	.54	.52	.44	.74	.61		
7. Physiological State	2.56	1.23	-.48	-.44	-.38	-.65	-.38	-.51	
8. Teacher Autonomy Support	4.17	1.21	.40	.33	.32	.26	.32	.29	-.26

Note. All correlations are significant at $p < .01$ level

Table 3
Hierarchical Linear Regression Results for the Prediction of Mathematics Self-Efficacy

Sources of Self-Efficacy	General Math Self-Efficacy		Math Test-Taking Self-Efficacy		Math Skills Self-Efficacy	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Mastery Experience	.355***	.365***	.341***	.348***	.187***	.192***
Vicarious Experience	.086**	.030	.099***	.060*	.093***	.061*
Social Persuasions	.127***	.103***	.140***	.124***	.084 ***	.071**
Physiological State	-.114***	-.084***	-.089***	-.068*	-.066***	-.049*
Teacher Autonomy Support		.209***		.145***		.118***
F	307.724	299.294	256.138	224.688	157.042	143.385
Model R^2	.404***	.452***	.361***	.382***	.256***	.282***
R^2 change		.048***		.021***		.026***

Note. All regression coefficients represent the standardized beta weights. R^2 represents the variance explained by each model. *$p < .05$, **$p < .01$, *** $p < .001$

Table 4
Hierarchical Linear Regression Results for the Prediction of Mathematics Self-Efficacy by Gender

Variables	General Math Self-Efficacy				General Math Test Taking Self-Efficacy				Math Skills Self-Efficacy			
	Girls ($n = 890$)		Boys ($n = 930$)		Girls ($n = 890$)		Boys ($n = 930$)		Girls ($n = 890$)		Boys ($n = 930$)	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Mastery Experience	.315***	.328***	.400***	.405***	.316***	.323***	.374***	.378***	.171***	.178***	.202***	.205***
Vicarious Experience	.131**	.065	.045	-.001	.154***	.115**	.045	.009	.106**	.072*	.081**	.052
Social Persuasions	.123***	.104**	.129***	.103**	.148***	.137***	.138***	.118**	.083*	.074*	.085**	.069*
Physiological State	-.175***	-.139***	-.025	-.003	-.106**	-.085**	-.035	-.018	-.074*	-.056*	-.055*	-.041
Teacher Autonomy Support		.202***		.210***		.119***		.165***		.102***		.132***
F	181.098	170.787	131.071	131.033	135.693	114.577	120.979	111.193	85.521	72.645	73.685	69.958
Model R^2	.453***	.494***	.363***	.416***	.381***	.395***	.344***	.377***	.273***	.292***	.242***	.275***
R^2 change		.041***		.053***		.013***		.032***		.020***		.033***

Note. All regression coefficients represent the standardized beta weights. *$p < .05$, **$p < .001$, *** $p < .001$

Key Findings

- Correlations among all measures were statistically significant. Consistent with previous research, the highest correlation was found between mastery experiences and general mathematics self-efficacy. The four sources of self-efficacy and perceived autonomy support were significantly interrelated (see Table 2).

- Regression results revealed that all four hypothesized sources significantly predicted mathematics self-efficacy. Mastery experience was the strongest predictor.

- When perceived teacher autonomy support was considered as an additional source, the regression model (Step 2) revealed it to be a significant source of mathematics self-efficacy, explaining a significant proportion of the variance in each type of self-efficacy over that explained by the four Bandura's hypothesized sources.

- Perceived autonomy support explained a significant portion of the variance in both girls' and boys' self-efficacy in mathematics. Girls tended to rely on more sources of efficacy information than did boys.

Conclusions and Implications

- This study combines constructs from two prominent theories of motivation as its conceptual framework. Therefore, our findings may provide a wider lens for education researchers who are interested in the multiple factors that can influence self-efficacy.

- The findings of this research study suggest that in addition to Bandura's sources of self-efficacy perceived autonomy support is *also* a significant source of self-efficacy. Our findings are consistent with other researchers who have found that mastery experience is the most influential source of self-efficacy both for girls and for boys.

- The significance of our findings could play an essential role in initiating discussions and future studies related to the influence of autonomy support on student motivation and offer insights to transform teaching and learning.

References

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