

Title:

**Academic self-efficacy and academic self-concept:  
Reconsidering structural relationships**

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## **Abstract**

The current study investigates whether academic (e.g. math) self-efficacy and academic self-concept represent two conceptually and empirically distinct psychological constructs when studied within the same domain, (2) the nature of their relationship (3) their antecedents, and (4) the mediating role and the predictive qualities of both self-constructs for background variables such as gender and prior knowledge and outcome variables such as math performance, math interest and math anxiety. Results indicate that (1) math self-efficacy and math self-concept do indeed represent conceptually and empirically different constructs, even when studied within the same domain, (2) students' academic self-concept strongly influences their academic self-efficacy beliefs, (3) academic self-concept is a better predictor (and mediator) for affective-motivational variables, while academic self-efficacy is the better predictor (and mediator) for academic achievement. In our opinion, these findings underpin the conceptual and empirical differences between both self-constructs as suggested by the literature (Bong & Skaalvik, 2003).

# **Academic self-efficacy and academic self-concept: Reconsidering structural relationships**

## **1. Introduction**

The literature on academic self-efficacy and academic self-concept reflects an ongoing discussion about (1) whether both judgments of self-perceived competence represent two conceptually and empirically distinct psychological constructs when studied with the same domain (e.g., Skaalvik & Rankin, 1996), (2) the nature of their relationship (Bandalos et al., 1995), (3) their antecedents (Bong & Skaalvik, 2003), and (4) the mediating role and the predictive qualities of both self-constructs for background variables such as prior knowledge and outcome variables such as math interest (Pajares & Miller, 1994). Using path analysis, this study aims to help investigate these issues by testing the fit of several alternative models.

## **2. Theoretical framework.**

Academic *self-concept* refers to individuals' knowledge and perceptions about themselves in academic achievement situations (Wigfield & Karpathian, 1991). Academic *self-efficacy* refers to individuals' convictions that they can successfully perform given academic tasks at designated levels (Schunk, 1991). Despite these clear and generally accepted definitions, educational researchers often struggle to identify the precise conceptual, operational and empirical differences between both judgments of self-perceived competence. In fact, some authors (e.g., Pajares, 1996) have suggested that, when studied within the same domain (e.g. mathematics), academic self-efficacy and academic self-concept might well be interchangeable concepts since both essentially measure the same cognitive construct (e.g., self-perceived competence). Other researchers argue that academic-self-concept and academic self-efficacy are clearly distinguishable concepts with differential impact on student motivation, emotion and study behaviour (e.g., Marsh, Walker & Dubus, 1990).

### *2.1 Conceptual and operational differences between academic self-concept and self-efficacy*

On the base of a literature review and especially the analysis of typical items measuring student's academic self-efficacy and self-concept, Bong and Skaalvik (2003) identify, amongst others, the following conceptual and operational differences between both self-constructs.

#### *Central element*

Bong and Skaalvik (2003) state that academic-self-concept primarily indicates one's self-perceived *ability* within a given academic area, while academic self-efficacy primarily indicates one's self-perceived *confidence* to successfully perform a particular academic task. Their argument is based upon the comparison of typical items measuring both constructs. Academic self-efficacy items (Pajares, Miller, & Johnson, 1999) usually start with 'how confident are you...' (e.g. 'that you can successfully solve equations containing square roots'). In contrast, self-concept items such as 'I have always been good at mathematics' are clearly more aimed at measuring students' self-perceived academic ability.

#### *Composition*

Self-efficacy researchers stress the cognitive nature of academic self-efficacy beliefs. Self-efficacy items such as 'How sure you that can solve the following mathematical problems' are designed to tap exclusively into the cognitive aspect of students' self-perceptions. In contrast, some self-concept researchers (e.g., Marsh, 1999) have suggested that students' academic self-concept does not only comprise a self-evaluative/cognitive dimension but also an affective/motivational dimension. This dimension is reflected in operational definitions by items such as "I am proud of my mathematics ability" or "I hate mathematics". However, other researchers (e.g., Eccles, Wigfield, & Schiefele, 1998) have argued that although self-evaluating one's ability gives rise to affective and emotional reactions, these reactions should *not* be considered as part of someone's academic self-concept. Hence, in this study, both academic self-efficacy and self-concept are considered to be judgments of self-perceived competence which are essentially cognitive in nature.

### *Judgment specificity*

Academic self-efficacy is usually measured at *task-specific* level while academic self-concept is usually measured at a more *general* level. This difference in judgment specificity is noticeable even when both self-constructs are assessed in reference to a particular domain (e.g., mathematics)

Mathematical self-efficacy items such as '*How confident do you feel about solving an equation like:  $2(x+3) = (x+3).(x-3)$* ' clearly measure self-perceived competence at a more task-specific level than mathematical self-concept items such as '*Compared with others my age, I'm good at mathematics*' (Marsh, 1999). Admittedly, both judgments of self-perceived competence have also been measured at more general and/or specific levels (e.g., self-efficacy for self-regulated learning, see Zimmerman & Martinez-Pons, 1990; general academic self-concept, Lent, Brown & Gore, 1997). However, the primary reason for not assessing both self-constructs at their '*natural level of specificity*' has been to ensure correspondence between self-appraisals of competence and criterion tasks (e.g., performance).

### *Nature of competence evaluation*

Self-concept beliefs rely heavily on social comparative information and reflected appraisals from significant others (Bong & Skaalvik, 2003). The normative nature of self-concept beliefs is reflected in typical self-concept items such as '*In maths, I am one of the best students in my class*' (Marsh, 1999). In contrast, self-efficacy items solicit goal-referenced evaluation (e.g., concrete performance standards) and do not ask students to compare their ability to that of others (Bong & Skaalvik, 2003; Pajares, 1996).

### *Time orientation*

Bong & Skaalvik (2003) further argue that academic self-concept refers to *past oriented* perceptions of the self whereas self-efficacy indicates relatively *future-oriented* perceptions. Since self-concept items lack task and context specific information, respondents are forced to make aggregated judgments of their competence in a given area. These aggregated judgments are solely based on *past experiences* and accomplishments within a given academic subject or domain (e.g., 'I've always been hopeless at maths'). In contrast, self-efficacy items such as 'I'm confident I will be able to solve the following

algebraic problems' do not draw exclusively on past mastery experiences; they also focus students' attention on their *future expectancies* for successfully performing specific academic tasks (Wigfield & Eccles, 2000).

## *2.2 Summary of empirical research*

Available research links both academic self-efficacy and academic self-concept to a number of desired student outcomes such as persistence (Lent, Brown, & Larkin, 1986; Skinner, Wellborn, & Connell, 1990), intrinsic motivation (Bandura, 1997; Skaalvik, 1997), the adoption of task and achievement goals (Bong, 2001; Skaalvik & Skaalvik, 2005), low anxiety levels (Skaalvik & Rankin, 1996; Zeidner & Schleyer, 1999) and academic achievement (Pintrich & Schunk, 1996; Marsh & Yeung, 1997). Hence, Bong and Skaalvik (2003) conclude that academic self-concept and academic self-efficacy seem to have comparable effects on students' motivation, emotion and achievement.

Likewise, a number of studies indicate that academic self-efficacy and academic self-concept also play a similar mediating role for the effects of background variables such as gender, prior knowledge and general cognitive skills on outcome variables such as (math) anxiety, interest and academic performance. For instance, Pajares and Kranzler (1995) argue that math self-efficacy at least partially mediates the effect of general cognitive ability and high school math level on mathematics anxiety and mathematics performance. In contrast, Bandalos et al. (1995) found that students' math self-concept and not their math (e.g., statistics) self-efficacy beliefs mediate the effect of prior math experience on math anxiety. The above described research results illustrate that, in order to gain more insight in the actual mediating and explanatory qualities of both judgements of self-perceived competence, more research that simultaneously investigates academic self-efficacy and academic self-concept is needed. However, such studies are rare (e.g., Bandalos et al., 1995; Choi, 2005; Lent et al., 1997; Pajares & Miller, 1994). Hence the current study testing if academic (e.g. math) self-efficacy and self-concept are empirically distinct constructs, their mutual relationship, the antecedents, the mediating role and the predictive power of both self-constructs.

### **3. Method**

#### *3.1. Participants, procedure and research instruments*

The research reported in this article is based on a secondary analysis of the Belgian data from the 2003 PISA-survey (Programme for International Student Assessment). PISA is a large scale, three-yearly international study carried out under the supervision of the OECD, that assesses knowledge and skills of 15-year-old students in all OECD countries (Organisation for Economic Co-operation and Development). All PISA-survey cycles assess student literacy in three cognitive domains: reading, mathematics, and science. However, within each cycle, the survey focuses on one cognitive domain. The 2003 survey focused on mathematical literacy. Students participating in the 2003 survey completed a mathematical test and a student questionnaire. The Belgian PISA-sample, which is fully representative of the fifteen-year-old Belgian secondary student population, comprises 8796 students enrolled in 277 schools (see the 2003 Pisa-data-analysis manual; OECD, 2005)..

#### *3.2. Measures*

Appendix A gives an overview of (1) the PISA items measuring students' math self-efficacy (MSE), math self-concept (MSC), math anxiety and math interest, (2) the Likert-scales these items were rated on, and (3) the internal consistency of the scales these items constitute.

Next to the above mentioned variables, the current study also takes the following variables into consideration: gender, prior math grade (marks out of a hundred), difficulty level of secondary studies, and math score (see the 2003 Pisa-data-analysis manual; OECD, 2005). The variable difficulty level of secondary studies refers to the particular focus of the secondary studies: academic, technical, or (pre-) vocational qualifications.

#### *3.3 Data-analysis*

Confirmatory factor analyses (Amos 6 with Maximum Likelihood Estimation) were carried out to investigate if MSE and MSC do indeed represent two empirically distinct constructs.

To research the mutual relationship between MSE and MSC, their antecedents, their mediating role and their predictive qualities, several path analyses (Amos 6 with Maximum Likelihood Estimation), testing the fit of three alternative models, were performed. All models consider the relationships identified in previous empirical studies, between the exogenous variables (e.g., gender) and endogenous variables (e.g., math performance) this study comprises. For instance, both MSE and MSC are assumed to directly predict math anxiety and math performance. If the fit of a model was unsatisfactory, the model was respecified until good fit was obtained. Respecification involved removing insignificant paths and introducing new paths as suggested by the modification indices. The latter was only carried out if the causal relationships suggested by the modification indices were theoretically viable (Byrne, 2001).

#### **4. Results and discussion**

##### *4.1. Math self-efficacy and math self-concept: conceptually and empirically distinct constructs?*

Confirmatory factor analyses were performed to investigate if the PISA-items constructed to measure students' MSC (limited to its cognitive dimension) and MSE, do actually represent two empirically distinct constructs. Results for the one factor model (all items are deemed to measure self-perceived math competence) indicate a very poor fit:  $\chi^2_{65} = 178375, p = 0.000, GFI = 0.694, RMSEA = 0.166, CFI = 0.652$ ). In contrast, the fit of the two-factor model is satisfactory:  $\chi^2_{62} = 21243, p = 0.000, GFI = 0.967, RMSEA = 0.059, CFI = 0.959$  (covariance between two pairs of error terms was allowed). Moreover, in the two-factor model, all factor loadings were consistently higher than 0.50, no cross loadings were observed, and the internal consistency of both scales is good ( $\alpha = 0.82$  and  $0.89$  for MSE and MSC respectively). These results indicate that academic (e.g., mathematical) self-concept and academic self-efficacy, measured at their natural level of specificity, represent distinct judgements of self-perceived competence even when studied within the same domain.

#### 4.2. *The nature of the relationship between MSE and MSC*

To investigate the (causal) relationship between MSE and MSC, initially, the fit of two competing models was compared. In the first model it was assumed that MSE beliefs, at least partially, determine MSC beliefs. In the second model this unidirectional relationship was inverted: students' MSC was assumed to affect their self-efficacy beliefs. Results indicate that both models reflect a good fit (cf. table 1). Figures B1 and B2 in appendix B depict both models and report standardized path coefficients along with the percentage of variance explained in the dependent variables.

<Insert table 1 about here>

Since both models fit the data well, the question about whether MSE influences MSC or vice versa, remains undecided. To try to resolve the issue, the fit of a third model was tested that incorporated all causal relationships suggested by models 1 and 2, and in which MSE and MSC were assumed to influence each other reciprocally. Figure 1 depicts this model which also reflects good fit (cf. table 1). Note (1) that this third model is, with exception of the path  $MSE \rightarrow MSC$ , identical to the model in which MSC is assumed to directly influence MSE, and (2) that the paths unique to the model in which MSE directly influences MSC, become (almost) insignificant (e.g.,  $MSE \rightarrow MSC$  and prior math grade  $\rightarrow MSE$ ). Thus, our results indicate that students' MSC strongly impacts their MSE beliefs and not vice versa (see also Bandalos et al, 1995). However, a model comparison test did indicate that the model in which MSC and MSE influence each other reciprocally has a slightly but significantly better fit than the model in which MSC unidirectionally influences MSE ( $\chi^2 = 61.99, p = 0.000$ ). A possible explanation for this reciprocal effect of MSE on MSC might be that when students assess whether they are capable of performing a particular academic task, the result of this assessment has an immediate but small impact on their academic math self-concept. This effect is probably short-lived as their academic self-concept will ultimately be much more affected by their actual performance (e.g., Marsh et al., 2005).

<Insert figure 1 about here>

#### 4.3 The predictive power of MSE and MSC

The predictive power of MSE for math performance, as suggested by the final model (e.g. the third model), is relatively weak in comparison to a number of comparable studies (e.g., Pajares & Miller, 1994). This result is rather surprising given that in the current study, academic self-efficacy and academic performance correlate as strongly as in other self-efficacy studies (cf. table 2 which reports the zero correlations between the variables part of this study). This finding can most likely be explained by the fact that in this study, the effect of MSE on students' math score was controlled for the difficulty level of their secondary studies, a variable which on its own explains 42.8% of the variance in math performance and is likely to be indicative of prior math knowledge, cognitive ability and general learning skills. However, the current study also supports Pajares and Graham's (1999) assertion that, even when controlled for variables known to strongly influence math performance, MSE still makes a modest but independent contribution to the prediction of math scores.

< Insert table 2 about here>

In contrast to the findings of a number of self-concept-researchers (e.g., Marsh & Yeung, 1997), the current model indicates that students' MSC, when controlled for the other variables part of the model, has no *direct* predictive power for math performance. Yet, the model also demonstrates that the total effect of MSC on math achievement is at least as strong as the total effect of MSE. However, the impact of MSC on math performance is indirect and mediated through MSE and math anxiety (cf. tables C1, C2 and C3 in appendix C which respectively present the total, the direct and the indirect standardized effects suggested by the model)

In line with earlier self-concept research (e.g., Meece, Wiegfield & Eccles, 1990) our results indicate that MSC strongly affects math anxiety and math interest. In contrast to the findings of several self-

efficacy researchers (e.g. Pajares, 1996; Zimmerman, 1995) we find that MSE beliefs, when controlled for MSC, have no or hardly any effect on math anxiety and math interest.

#### *4.4 Antecedents of MSC and MSE*

The final model indicates that students' MSC is primarily influenced by their prior math grade, while their self-efficacy beliefs are strongly affected by the difficulty level of the secondary studies they pursue. These results lend support to the assertion of a number of other researchers (e.g., Marsh, 1993; Bong and Skaalvik, 2003) that academic self-concept beliefs are primarily based on social comparative information (e.g., 'How will I do compared to my peers?') while self-efficacy beliefs are more goal-referenced (e.g., "Can I solve these particular mathematical problems").

In line with other studies (e.g., Marsh & Yeung, 1998; Pajares & Miller, 1994), our results demonstrate that gender directly affects both students' MSC and MSE with about equal strength. Female students feel less self-efficacious and report lower math self-concept beliefs than male students. This result is all the more surprising the since prior grades of male and female students do not differ significantly and since the difficulty level of the studies girls attend, is somewhat higher than that of boys. Possible explanations for these gender differences are that female students tend to make less favourable social comparisons about their intellectual ability (Goethals et al., 1991) than boys and/or are more likely to attribute academic success to external causes such as luck (Leppin. et al., 1987)

#### *4.5 The mediating role of MSC and MSE*

The model further demonstrates that the mediating role of MSE and MSC mirror their predictive qualities. MSE beliefs almost exclusively mediate the effects of background variables (e.g., gender and difficulty level of their studies) on *math performance* while MSC beliefs are strong mediators for the effects of background variables (e.g., gender and prior math grade) on *affective and motivational variables*. Note, for instance, that gender and prior math grade only have a negative effect on math anxiety and math interest on condition these variables also negatively affect students' self-concept.

These results, at least partially, contradict the findings of earlier self-efficacy research (e.g., Bandura, 1997; Pajares & Miller, 1994) which indicates that self-efficacy beliefs mediate the effects of background variables on both performance and motivational/affective outcomes (e.g., math anxiety).

## **5. Conclusion**

This study indicates that academic self-efficacy and academic self-concept, measured at their natural specificity level, represent conceptually and empirically different constructs, even when studied within the same domain. The current study further suggests that students' academic self-concept strongly influences their academic self-efficacy beliefs and not vice versa. In our view, this finding is consistent with Bong and Skaalvik's assertion (2003) that academic self-concept represents a more past-oriented, aggregated and relatively stable judgment about one's self-perceived ability in a particular academic domain while academic self-efficacy represents a context-specific and relatively future-oriented judgment about one's confidence for successfully performing an upcoming subject-specific academic task.

Finally, the current study suggests that when both judgments of self-perceived competence are controlled for each other, academic self-concept is a better predictor (and mediator) for affective-motivational variables, while academic self-efficacy is the better direct predictor (and mediator) for academic achievement. However, the cross-sectional nature of this study, entails that the evidence for the causal relationships (e.g. between academic self-efficacy and academic self-concept) inferred by the final model, is limited. Longitudinal research could shed more light on the nature of these relationships.

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Table 1: Fit indices for the three competing models

	$\chi^2_{(df)}$	$p$	RMSEA	GFI	CFI
MSE $\rightarrow$ MSC	1526 ( $df=10$ )	.000	.042	.996	.993
MSC $\rightarrow$ MSE	1016 ( $df=11$ )	.000	.033	.997	.996
MSC $\leftrightarrow$ MSE	954 ( $df=10$ )	.000	.033	.997	.996

Table 2 – Means, Standard deviations, and Zero-Order Correlations for the variables in this study.

	1	2	3	4	5	6	7	8
1. Math score	-							
2. Math interest	.14**	-						
3. Math anxiety	.24**	-.33**	-					
4. Math self-efficacy	.43**	.32**	.24**	-				
5. Math self-concept	.22**	.62**	.65**	.37**	-			
6. Prior math grade	.15**	.33*	.42**	.18**	.57**	-		
7. Difficulty level secondary studies	.65**	-.10**	-.00	.34**	.00	.06**	-	
8. Gender	.04**	.10*	.16**	.18**	.18**	.00	.10**	-
	<i>M</i>	529	-.16	.09	-.04	-.03	65.3	
	<i>SD</i>	17	.97	.95	.97	.97	17.5	

\*\*  $p < .01$

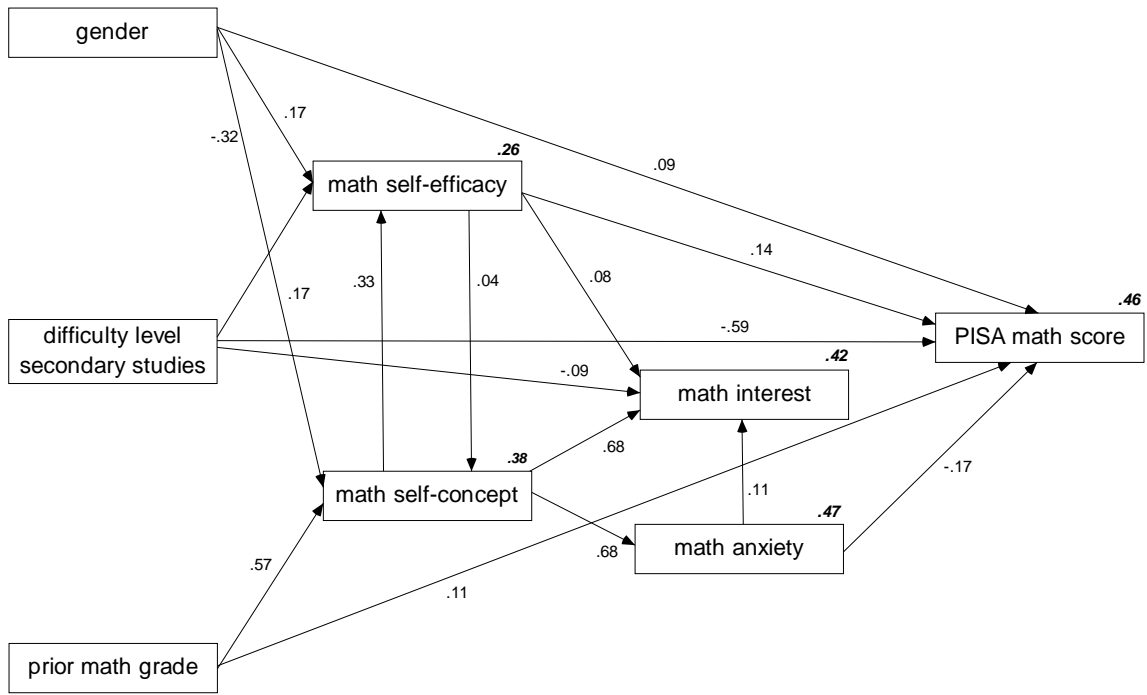


Figure 1: The model in which math self-concept and math self-efficacy are assumed to influence each other reciprocally

## Appendix A

### Math Self-efficacy ( $n = 8, \alpha = 81.6$ )

The PISA math self-efficacy scale was developed according to Bandura's (1997) guidelines regarding the specificity of self-efficacy beliefs assessment and their correspondence with criterial tasks.

*How confident do you feel about having to do the following Mathematics tasks?*

1. Using a train timetable to work out how long it would take to get from one place to another
2. Calculating how much cheaper a TV would be after a 30% discount.
3. Calculating how many square metres of tiles you need to cover a floor.
4. Understanding graphs presented in newspapers
5. Solving an equation like  $3x+5= 17$
6. Finding the actual distance between two places on a map with a 1:10,000 scale.
7. Solving an equation like  $2(x+3)=(x + 3)(x - 3)$
8. Calculating the petrol consumption rate of a car.

Items are rated on a 4 point Likert scale ranging from (1) "Very confident" to (4) "Not at all confident"

### Math self-concept ( $n = 5, \alpha = 88.6$ )

The PISA math self-concept items assess what Eccles and Wigfield (1995) identified as the ability component of subject-specific self-concept beliefs (as opposed to the affective/motivational component).

*Thinking about studying Mathematics: To what extent do you agree with the following statements?*

1. I am just not good at Mathematics
2. I get good marks in Mathematics
3. I learn Mathematics quickly.
4. I have always believed that Mathematics is one of my best subjects
5. In my Mathematics class, I understand even the most difficult work.

Items are rated on a 4 point Likert scale ranging from (1) "Strongly agree" to (4) "Strongly disagree"

### Math interest ( $n = 4, \alpha = 88.1$ )

The PISA math interest items measure what Wigfield et al. (1997) labelled as the enjoyment aspect of task interest (as opped to the usefulness/importance aspect).

Thinking about your views on Mathematics: To what extent do you agree with the following statements?

1. I enjoy reading about Mathematics
2. I look forward to my Mathematics lessons
3. I do Mathematics because I enjoy it
4. I am interested in the things I learn in Mathematics.

Items are rated on a 4 point Likert scale ranging from (1) "Strongly agree" to (4) "Strongly disagree"

Math anxiety ( $n = 5$ ,  $\alpha = 81.2$ )

The PISA math anxiety items focus on what Wigfield and Meece (1988) identified as the worry component of math anxiety (as opposed to the affective component).

'Thinking about studying Mathematics: To what extent do you agree with the following statements?'

1. I often worry that it will be difficult for me in Mathematics classes
2. I get very tense when I have to do Mathematics homework
3. I get very nervous doing Mathematics problems
4. I feel helpless when doing a Mathematics problem
5. I worry that I will get poor marks in Mathematics.

Items are rated on a 4 point Likert scale ranging from (1) "Strongly agree" to (4) "Strongly disagree"

**Appendix B**

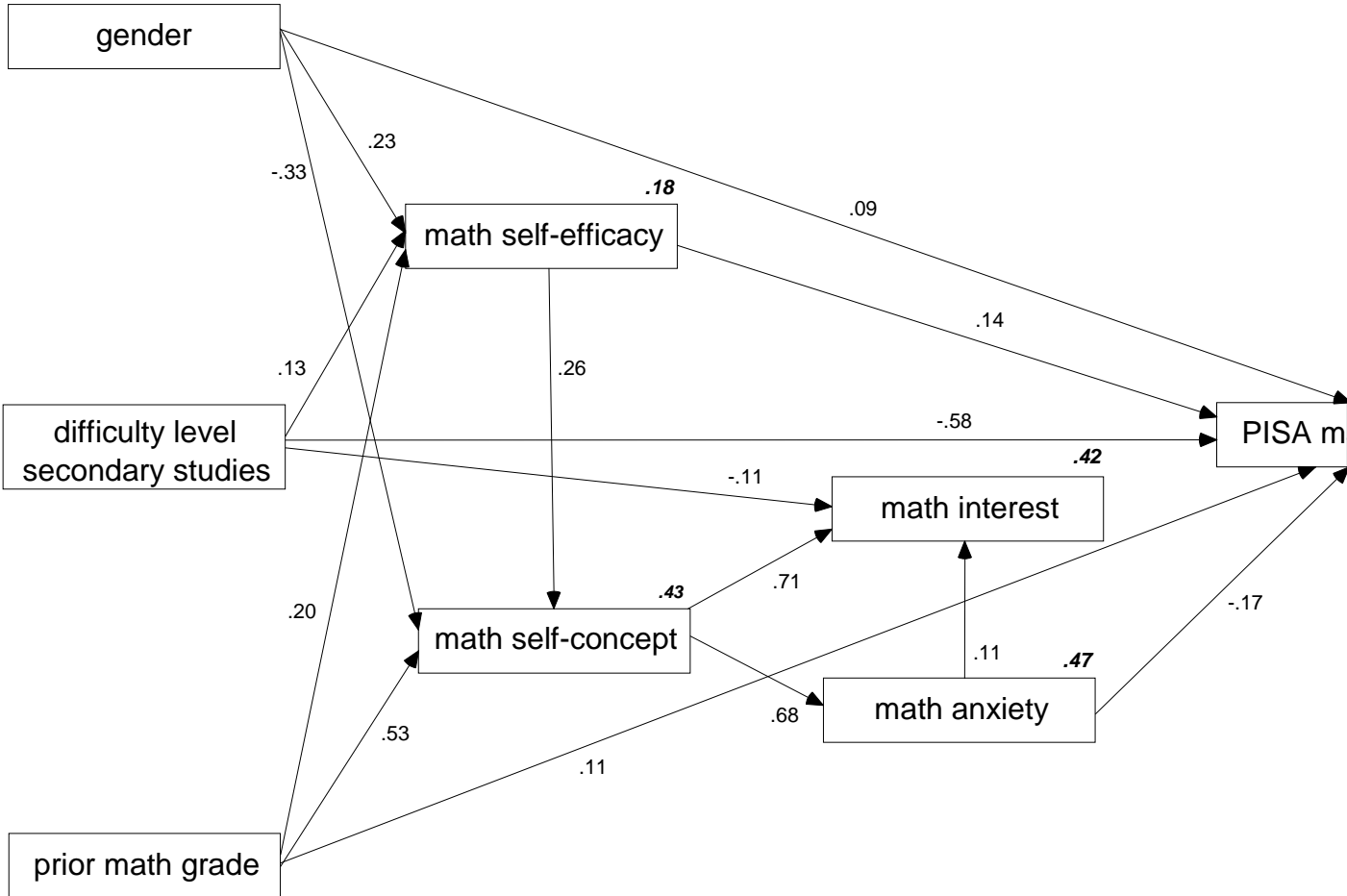


Figure B1: The model in which math self-efficacy is assumed to unidirectionally influence math self-concept

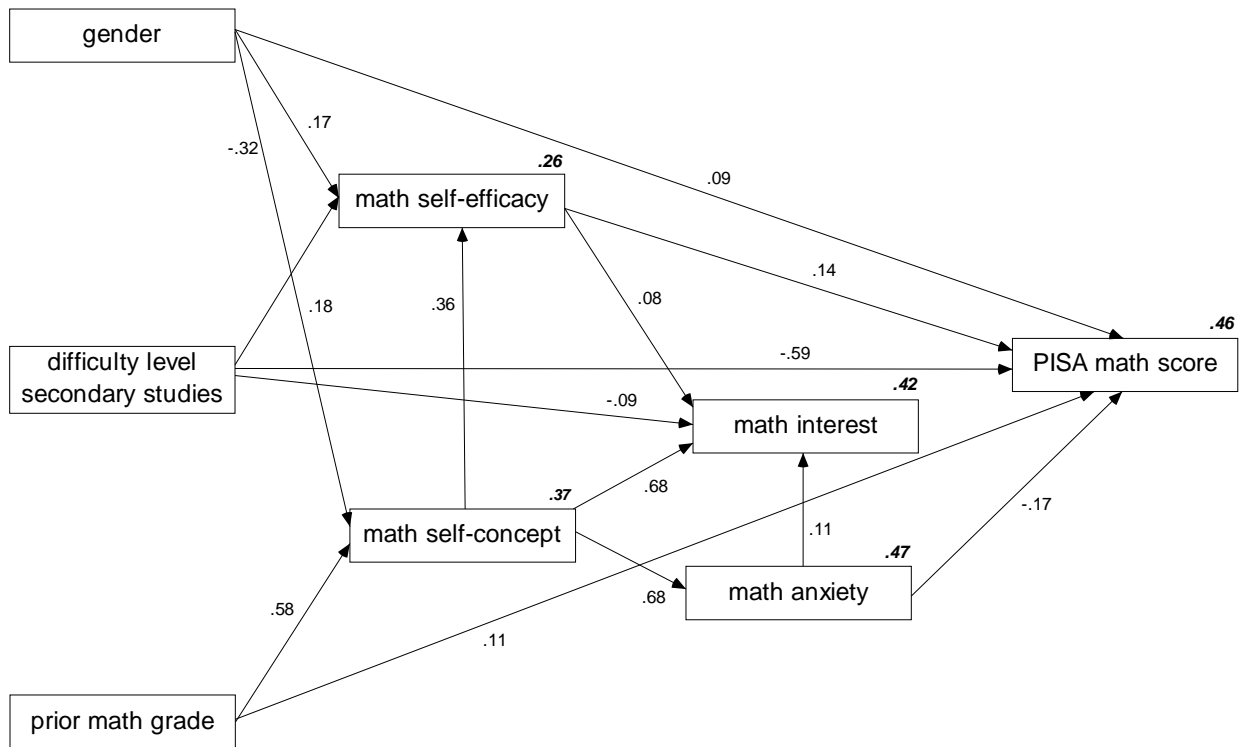


Figure B2: The model in which math self-concept is assumed to unidirectionally influence math self-efficacy

## Appendix C

Table C1 - Standardized total effects

Variables	Gender	Difficulty level S.S.	Prior math grade	Math self-concept	Mat self-efficacy	Math
Math self-concept	.181	-.011	.579	.012	.036	.
Math self-efficacy	.231	-.325	.191	.333	.012	.
Math anxiety	-.124	.008	-.396	-.691	-.024	.
Math interest	.128	-.120	.365	.637	.105	.
Math score	.145	-.631	.202	.162	.144	.

Table C2 - Standardized direct effects

Variables	Gender	Difficulty level S.S.	Prior math grade	Math self-concept	Mat self-efficacy	Math
Math self-concept	.173	.000	.573	.000	.035	.
Math self-efficacy	.171	-.321	.000	.330	.000	.
Math anxiety	.000	.000	.000	-.683	.000	.
Math interest	.000	-.086	.000	.679	.082	.
Math score	.092	-.585	.109	.000	.138	-.000

Table C3 - Standardized indirect effects

Variables	Gender	Difficulty level S.S.	Prior math grade	Math self-concept	Mat self-efficacy	Math
Math self-concept	.008	-.011	.007	.012	.000	.
Math self-efficacy	.060	-.004	.191	.004	.012	.
Math anxiety	-.124	.008	-.396	-.008	-.024	.
Math interest	.128	-.034	.365	-.042	.022	(
Math score	.053	-.046	.093	.162	.006	.

