One Fish Fits All? The Big-Fish-Little-Pond Effect and Individual Differences in Learning

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Abstract

The big-fish-little-pond effect (BFLPE) postulates that students who attend academically selective schools have lower academic self-concepts than equally able students in average- and low-ability schools. Researchers (e.g., Marsh, 1991) have suggested that by identifying individual differences between students that moderate the negative effects of the BFLPE, policies may be identified that maximize the benefits of attending academically selective schools. However, to date there has been limited success in this endeavour. Utilising the 2003 Program for International Student Assessment (PISA) database (Organization for Economic Co-operation and Development, 2005a, 2005b) the present study identified potential moderators of the BFLPE that encompassed individual differences in the way in which students approach learning. Although many of the constructs investigated had a moderating effect on the BFLPE, these interaction effects were small and as the sample was particularly large, it was concluded that the BFLPE generalised well across these individual student characteristics.

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Every December newspapers in New South Wales publish the results of the Higher School Certificate, placing special emphasis on which schools obtain the best results. Invariably, many academically selective high schools will be at the top of this list, but others will not be, leading some to question why. If selective high schools take only the best and brightest, then why do some students not achieve to their potential? Marsh and colleagues would argue that the big-fish-little-pond effect could be a contributing factor.

The BFLPE theoretical model posits that students who attend academically selective schools will have lower academic self-concepts, defined as one's knowledge and perceptions about one's academic ability (Bong & Skaalvik, 2003), than equally able students in non-selective schools. More specifically, the BFLPE model rests on two predictions. Firstly, it predicts that individual ability is positively related to academic self-concept ("I'm bright, so I feel good about my academic abilities"). Secondly, it predicts that the average ability of the class or school is negatively related to academic self-concept ("My classmates are really bright, so I don't feel that I'm very bright"). It is this negative effect that characterises the BFLPE.

Notwithstanding the fact that the development of a positive self-concept is regarded as an extremely important educational objective (e.g., OECD, 2003), BFLPE research has consistently found that this is an objective that has not always been achieved when students are segregated on the basis of their academic ability (e.g., Davis, 1966; Marsh & Hau, 2003; Marsh, Koller, & Baumert, 2001). For example, Craven, Marsh, and Print (2000) examined the academic self-concepts of students in special Gifted and Talented primary classes, compared to those of gifted students who attended streamed or mixed ability classes. The students in the special Gifted and Talented classes showed a greater decline over time in their academic self-concepts than the gifted students in the streamed or mixed ability groups. Interestingly, these authors also assessed student motivation and achievement. Results indicated that for three of six motivational orientations the Gifted and Talented students' scores were significantly more negative than those of the other two groups, and that there was no difference between the groups on achievement test scores. Unfortunately, these effects also appear to be long lasting. Marsh, Trautwein, Ludtke, Baumert, and Koller (2007) demonstrated that the BFLPE still persisted four years after students had graduated from high school.

It is a cause for concern that students in high ability schools should have lower academic self-concepts as low academic self-concept has been associated with a number of undesirable educational outcomes, such as poorer occupational or educational aspirations, lower grade-point-averages, and the selection of less demanding courses (Marsh, 1991; Marsh & Yeung, 1997b). Furthermore, evidence from research conducted on the Reciprocal Effects Model (e.g., Guay, Marsh, & Boivin, 2003; Marsh & Yeung, 1997a) suggests that academic self-concept and academic achievement are causally related, with higher academic self-concepts being associated with higher academic achievement and vice versa. If, as research has shown, high-ability students attending high-ability classes and schools have lower academic self-concepts then it follows that they may not be reaching their full academic potential. To overcome the BFLPE and so allow these students to achieve their best, it is necessary to firstly identify whether there are any factors that can attenuate the BFLPE. Once identified, these factors could be used to assist in developing educational policies aimed at maximising the benefits, and limiting the negative effects, of attending academically selective environments (e.g., Marsh, 1991).

Although previous research has begun this search for constructs that may moderate the BFLPE, success has been limited (e.g., Marsh & Hau, 2003; Marsh, 1984, 1987, 1991). The present investigation was designed to fill this gap in the literature by examining individual difference in learning constructs as potential moderators of the BFLPE. Although not previously examined as BFLPE moderators, individual difference in learning constructs are important in their own right in other educational domains, and so may provide some insight into reducing the negative effects of the BFLPE.

Individual Differences in Learning

There are many differences between students in the way they learn. For example, whereas some students handle academic tasks easily, others have difficulty. Individual differences in learning are evident in the way in which “students address and handle learning tasks in school and the extent to which they are able to achieve their learning goals by applying strategies, motivating themselves, and by controlling and regulating their own learning processes” (Marsh, Hau, Artelt, Baumert, & Peschar, 2006, p. 313).

Self-Regulated Learning Strategies

Most teachers and policy makers agree that to learn effectively students need to be self-regulated learners (Boekaerts, 1997). Self-regulated learners are "metacognitively, motivationally, and behaviourally active participants in their own learning" (Zimmerman, 1990, p. 4). Zimmerman theorised that students who are self-regulated learners use these metacognitive (e.g., setting goals), motivational (e.g., intrinsic task interest), and behavioural processes (e.g., structuring environments to provide better learning opportunities) to optimise their learning potential. Self-regulated students use strategies that promote effective learning, are motivated to learn, have a belief in their own self-efficacy, and are not troubled by competitive environments (Marsh et al., 2006). Zimmerman distinguished between self-regulation processes (e.g., intrinsic task interest) and self-regulated learning strategies whose intent is to maximise these processes. Learning strategies include rehearsing and memorising, goal setting and planning, and organising and transforming (for full details of these strategies, see Zimmerman & Martinez-Pons, 1990).

Students who are self-regulated learners may deal more positively with the school environment than those students who are not. Students who use self-regulated learning strategies may be more confident in their learning as they take a proactive approach to it. The result may be that students who use self-regulated learning strategies are buffered against the negative effects of the BFLPE compared to students who do not use such strategies.

Anxiety

Anxiety has been associated with reductions in grade point averages (Chapell et al., 2005), and has been shown to be negatively related to numeracy scores on standardised tests (Martin, 2003). Zeidner and Schleyer (1998) examined the effect of test anxiety on academic performance for gifted students. Two components of test anxiety were assessed: worry and emotionality. Their sample comprised gifted students in two types of educational programs, these being regular mixed-ability classes or special homogeneous classes. Results indicated that test anxiety moderated the effects of the type of educational program on academic performance. Compared to the gifted students in regular classes, test anxiety had a more aversive impact on the academic performance of students in the special homogeneous classes. Moreover, research by Meece, Wigfield, and Eccles (1990) found that the correlations between mathematics ability perception (a construct similar to mathematics self-concept) and mathematics anxiety were consistently negative, ranging from -.11 to -.41.

On the basis of previous research in related domains, it seems reasonable to suggest that if students are highly anxious about their academic performance then they may not achieve to their potential. As they are not performing to their best, anxious students may also feel more negative about their abilities. Students may be anxious before they attend high-ability schools, or attending a high-ability school may cause them to become anxious. Whatever the causal relation, more pronounced BFLPEs may be associated with higher anxiety levels. Research examining the relation between mathematics ability perception and mathematics anxiety has also displayed a negative relation and so would support this viewpoint (Meece et al., 1990). Hence, the BFLPE may be more pronounced for students with higher anxiety levels.

Intrinsic / Extrinsic Motivation

Many motivation theories characterise motivation as being either intrinsic or extrinsic. Intrinsic motivation has been defined as "the doing of an activity for its inherent satisfaction rather than for some separable consequence" (Ryan & Deci, 2000, p. 56). Intrinsically motivated individuals engage in an activity because of the inherent enjoyment they obtain from the activity itself. Students, who are intrinsically motivated to learn, learn because they find the material interesting and enjoyable. However, as Ryan and Deci indicate, individuals are not always intrinsically motivated. There are occasions when students have to learn material that they do not find interesting, but which they must master to obtain a desired outcome (e.g., obtain a school leaving certificate; take a subject that is necessary to finish a desired course). In this case, students are said to be extrinsically, or instrumentally motivated. Extrinsic motivation is viewed as participating in an activity "in order to obtain some reward or avoid some punishment external to the activity itself" (Lepper, 1988, p. 292).

Historically, intrinsic motivation has been associated with positive educational outcomes (e.g., Ginsburg & Bronstein, 1993; Gottfried, 1985, 1990) and extrinsic motivation with poorer outcomes (e.g., Hardre & Reeve, 2003). However, extrinsic motivation has not always been associated with poorer educational outcomes. For example, Otis, Grouzet, and Pelletier (2005) noted that identification, a level of extrinsic motivation, was more highly correlated with educational adjustment than was intrinsic motivation.

The BFLPE may not affect intrinsically motivated students. Students who enjoy learning for itself may feel more capable and may not find the accomplishments of others as threatening, or even relevant, to their self-views. Implications for extrinsically motivated students are less clear as the research is contradictory. Perhaps if extrinsically motivated students are able to receive the external rewards they need to keep them motivated, they also may not suffer the negative effects of the BFLPE. However, if they are unable to receive these rewards, extrinsically motivated students may suffer the BFLPE to a greater extent.

The Present Investigation

The purpose of the present investigation was to extend current BFLPE theory and research by investigating individual differences in learning as potential moderators of the BFLPE. In order to achieve this aim, the following research questions were formulated:

1. Do self-regulated learning strategies moderate the BFLPE?
2. Does motivation moderate the BFLPE?
3. Is the BFLPE moderated by mathematics anxiety?

Method

Participants

Fifteen year-old school students (*N* = 276,165) from 41 countries around the world participated in the 2003 Program of International Student Assessment (PISA) administered by the Organization for Economic Cooperation and Development (OECD; 2005a; 2005b). Each PISA administration has a different academic focus and in 2003 this focus was on mathematics. Students completed a questionnaire that included background information and an assessment of their academic performance in mathematics. The background questionnaire included items that assessed mathematics self-concept and individual differences in the way in which students approach their learning. However, not all students completed the mathematics self-concept items, and there were some schools whose sample sizes were particularly small (i.e. less than

10 students, so these schools were not representative of their entire school population). Hence, only those students who had completed the self-concept measures were included and schools with less than 10 students were removed from further analysis. This resulted in a total sample size of 265,180 students in 41 countries.

Measures

Mathematics Self-Concept

Mathematics self-concept was measured by five items that were scored on a 4-point Likert scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). These items included "I get good marks in mathematics" and "I learn mathematics quickly" (see OECD, 2005b). Four items were inverted for scoring. A high score on this scale was associated with a higher mathematics self-concept. Cronbach's alpha was .88 in the current sample, indicating high reliability. This scale was standardised across the entire sample ($M = 0$, $SD = 1$). Subsequently, the range of scores was -2.24 to 2.48.

Individual Differences in Learning

Six scales were used to measure individual differences in learning. These scales assessed three broad theoretical dimensions: self-regulated learning strategies, motivation to learn, and anxiety. All scales used in the present investigation were validated by the PISA administrators using structural equation modelling. Full details of the these scales, including number of items, an example item, reliability, the response scales, range of scores, and the meaning of a high score are presented in Table 1. All scales were standardised across the entire sample to have a mean of zero and a standard deviation of one.

Mathematics Ability

To avoid obtaining biased population estimates, five plausible values were provided in the PISA database to estimate a student's mathematics ability. Researchers are advised not to average these plausible values. Hence, analyses with each plausible value were conducted separately and then all resulting parameters from these analyses were averaged (see OECD, 2005a). This course of action also provided standard errors that reflected variance both within and between plausible values (see OECD, 2005a and Raudenbush, Bryk, & Congdon, 2005).

Procedure and Statistical Analysis

After removing cases with missing self-concept data and small schools, mathematics self-concept, the five plausible values for mathematics ability, and the individual differences in learning scales were standardised across the entire sample (M = 0, SD = 1). School-average mathematics ability was calculated for each plausible value by averaging each one separately within each school. To keep school-average mathematics ability and the plausible values for mathematics ability in the same metric, the school-average mathematics ability variable was not re-standardised. Interaction terms with school-average mathematics ability were created for each individual difference in learning construct, but these were not re-standardized.

The PISA data contains three levels of nested data: Students at the lowest level are taught within schools at the middle level, and there are numerous schools within countries at the top level. Single level models that ignore this type of nesting can result in serious statistical problems such as under-estimation of standard errors and violations of the assumption of independence. Hence, a multi-level statistical analysis approach was used to accommodate this multilevel structure (see Hox, 2002; Raudenbush & Bryk, 2002; Rowe, 2005).

For each individual learning construct five multilevel regression analyses (one for each plausible value for mathematics ability) were conducted and results aggregated. The outcome variable was mathematics self-concept for each of these analyses. Predictor variables included individual mathematics ability (as operationalised by the plausible values for mathematics ability), school-average mathematics ability, the individual differences in learning constructs, and the interactions of school-average mathematics ability with the relevant individual learning construct. The significance level was set at $p < .01$ due to the number of tests of statistical significance being conducted.

Results and Discussion

As seen in Table 2, a BFLPE was evident in these data. Individual ability was a significant positive predictor of mathematics self-concept (ranging from 0.25 for anxiety to 0.52 for memorisation) and school-average mathematics ability was significantly negatively associated with mathematics self-concept (ranging from -0.21 for intrinsic motivation to -0.37 for control strategies). This negative association is indicative of the BFLPE. Controlling for individual ability, students in high-ability schools had lower mathematics self-concepts than students in average- or low-ability schools.

Self-Regulated Learning Strategies

As indicated in Table 2, elaboration (0.37), memorisation (0.26), and control strategies (0.23) all had a statistically significant positive relation with mathematics self-concept. Whereas the interaction of elaboration with school-average mathematics ability was significantly positively associated with mathematics self-concept (0.02; see Figure 1), that of memorisation was significantly negatively related (-0.07; see Figure 2), and the interaction of control strategy use with school-average mathematics ability was not statistically significant (-0.02).

Slightly smaller BFLPEs were associated with students in high-ability schools who used the learning strategy elaboration to a greater degree, although as indicated in Figure 1, this difference is minimal. Compared to their counterparts in average- and low-ability schools, mathematics self-concept was lower for students in high-ability schools, but this reduction was less for students who used elaboration techniques to a greater extent. Perhaps students who use elaboration as a learning technique are less dependent on social comparison strategies thought to underlie the BFLPE, as they are more intent on understanding the material. Nonetheless, as seen in the graph of the interaction, this interaction effect was barely discernable.

Larger BFLPEs were associated with students who used memorisation to a greater extent (see Figure 2). Compared to their counterparts in average- and low-ability schools, mathematics self-concept was lower for students in high-ability schools, but this reduction was greater for students who used memorisation techniques to a greater extent. The use of memorisation strategies to learn material is associated with rehearsal techniques, and so students who use memorisation may tend to learn by rote. In high-ability schools, there may be schoolwork that cannot be addressed using rote learning. In these circumstances students who use memorisation techniques may find themselves out of their depth, and this may be reflected in lower self-concepts (the BFLPE).

Mathematics Anxiety

Mathematics anxiety was a statistically significant negative predictor of mathematics self-concept (-0.60; see Table 2). Lower mathematics self-concepts were associated with students who were highly anxious. The interaction between mathematics anxiety and school-average mathematics ability was significantly negative (-0.12). As seen in Figure 3, high mathematics anxiety was associated with the BFLPE, but low mathematics anxiety was not. Students with low anxiety levels had similar mathematics self-concepts irrespective of the ability level of the school they attended. Conversely, compared to those who had average or low anxiety levels, larger BFLPEs were associated with students in high-ability schools who were highly anxious about their mathematics studies. Students in high-ability schools with average anxiety levels showed a slight decline in their mathematics self-concepts compared to their counterparts in low-ability schools. However, in high-ability schools, students who were highly anxious about mathematics had considerably lower mathematics self-concepts than their counterparts in low-ability schools. The significant interaction effect of anxiety and school-average mathematics ability on mathematics self-concept suggests that being low in anxiety may be a protective factor against the negative effects of the BFLPE. Perhaps highly anxious students may not achieve to their potential, and this may make them feel negative about their abilities especially if they attend a high-ability school, resulting in lower academic self-concept – the BFLPE. The current data do not allow the causal relation between anxiety and the ability level of the school to be examined. Hence, it is not possible to ascertain whether students bring their anxieties with them to high–ability schools, or whether high-ability schools exacerbate anxiety levels. Nevertheless, these findings suggest that the association between anxiety and the BFLPE is an important avenue to pursue in future research.

Motivation

The main effects for both extrinsic and intrinsic motivation demonstrated that they were statistically significantly positively related to mathematics self-concept (extrinsic = 0.38; intrinsic = 0.63; see Table 2). Both extrinsically and intrinsically motivated students had higher mathematics self-concepts. As regards the interaction effects, whereas the intrinsic motivation X school-average mathematics ability interaction was not statistically significant (0.02), the extrinsic motivation X school-average mathematics ability interaction was (0.04). Slightly smaller BFLPEs were associated with students in high-ability schools who reported high levels of extrinsic motivation (see Figure 4). Nevertheless, as is evident in the graph of the interaction, this slightly smaller BFLPE for more extrinsically motivated students was negligible. Although these results suggest that students who are more highly extrinsically motivated may be buffered against the BFLPE, when the power engendered by the large sample size is considered, the interaction effect is trivial.

Summary and Conclusions

All individual difference in learning variables, with the exception of anxiety, were positively related to mathematics self-concept. Students who used elaboration, memorisation, and control strategies as techniques to improve their learning or who were motivated had higher mathematics self-concepts. These results are consistent with previous research that has demonstrated that these individual differences in learning variables are associated with beneficial educational outcomes (Boekaerts, 1997; Ginsburg & Bronstein, 1993; Gottfried, 1985, 1990; Marsh et al., 2006; Otis et al., 2005; Ryan & Deci, 2000). Conversely, that highly anxious students had lower mathematics self-concepts is consistent with research demonstrating a negative relation between anxiety and ability perception, a construct similar to self-concept (Meece at al., 1990).

The present investigation aimed to examine individual differences in student learning characteristics to ascertain if any of these could modify the BFLPE. Significant interaction effects were found for many of these constructs. Results demonstrated significant interaction effects for memorisation, elaboration, extrinsic motivation, and anxiety. However, there are caveats that apply to these results. Although interactions for anxiety and memorisation were acceptable, the statistically significant interactions of elaboration and extrinsic motivation with school-average mathematics ability were small and when examined graphically appeared to be trivial. Large samples such as the one utilised in the present investigation can produce much power and so small interaction effects that would not reach significance in more moderately sized samples, may be found to be significant. Hence, considering the power engendered by the large sample size, results for these moderators should be treated cautiously. As such, the current findings suggest that the BFLPE is reasonably consistent and generalises across these specific student characteristics. Nevertheless, the mathematics anxiety interaction was a reasonably large effect and so may provide information for alleviating the negative effects of the BFLPE.

One of the strengths of the present investigation is that, by examining six potential BFLPE moderators in a single study, it has addressed one of the main limitations of BFLPE research. Moreover, the use of such a large culturally diverse sample is also an important strength, as is the use of multilevel modelling. Nested data, such as the data in the present investigation in which students were nested within schools and schools nested within countries, can be accommodated by multilevel modelling. The use of this type of statistical methodology ensures that problems associated with using single level techniques to analyse multilevel data are avoided.

However, the current study also has potential limitations. As it was based on a single time wave of correlational data, no causality can be inferred. Hence, it is unknown whether the present results are caused by virtue of attending a high-ability school, or whether these were pre-existing student characteristics. Longitudinal causal modelling studies are required to disentangle these relations. Future research could also examine personality characteristics and levels of student stress and depression to ascertain their roles in the BFLPE.

That the BFLPE generalises across the specific student characteristics examined in the present investigation attests to both the strength and general validity of the effect. It appears that irrespective of a student's approach to learning, whether that be using various learning strategies, being extrinsically or intrinsically motivated, or being anxious about one's learning, the BFLPE continues to reap its destruction on academic self-concept. As positive academic self-concepts have such a vital role in producing beneficial academic outcomes, it is imperative that the BFLPE be explored further to find ways to alleviate its negative effects

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Table 1. *Summary of Key Features of the Individual Differences in Learning Indices*

Dimension	Index	No. of Items	Cronbach's α	Example Item	Response Scale	Range of Standardised Scores	Meaning of a High Score
Learning Strategies	Control Strategies	5	.74	"When I study for a mathematics test, I try to work out what are the most important parts to learn"	4-point Likert scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). All items inverted for scaling.	-3.57 – 2.64	A high score indicates a preference for this learning strategy.
	Memorisation	4	.59	"When I study for mathematics, I try to learn the answers to problems off by heart"	4-point Likert scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). All items inverted for scaling.	-3.62 – 3.22	A high score indicates a preference for this learning strategy.
	Elaboration	5	.76	"When learning mathematics, I try to relate the work to things I have learnt in other subjects"	4-point Likert scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). All items inverted for scaling.	-3.41 – 3.10	A high score indicates a preference for this learning strategy.

Table 1. *Summary of Key Features of the Individual Differences in Learning Indices (contd.)*

Dimension	Index	No. of Items	Cronbach's α	Example Item	Response Scale	Range of Standardised Scores	Meaning of a High Score
Motivation	Extrinsic	4	.88	"Making an effort in mathematics is worth it because it will help me in the work I want to do later on"	4-point Likert scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). All items inverted for scaling.	-2.54 – 1.67	A high score indicates higher levels of instrumental motivation.
	Intrinsic	4	.89	"I am interested in the things I learn in mathematics"	4-point Likert scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). All items inverted for scaling.	-1.94 – 2.30	A high score indicates higher levels of interest and enjoyment in math.
Anxiety	Math Anxiety	5	.81	"I get very nervous doing mathematics problems"	4-point Likert scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). All items inverted for scaling.	-2.70 – 2.72	A high score indicates a higher level of math anxiety.

Table 2. *Individual Differences in Learning Moderators of the BFLPE (Standard Error (SE) in Parentheses)*

		Fixed Effects					Random Effects		
	Moderator	Iabil	Savg	Mod	ModXSavg	Cons	Cntry	Sch	Ind
Learning Strategies	Elaboration	0.50* (0.03)	-0.31* (0.02)	0.37* (0.01)	0.02*[a] (0.01)	-0.02 (0.02)	0.02* (0.00)	0.03* (0.00)	0.69* (0.03)
	Memorisation	0.52* (0.03)	-0.35* (0.03)	0.26* (0.02)	-0.07* (0.02)	-0.03 (0.03)	0.03* (0.01)	0.03* (0.00)	0.74* (0.04)
	Control Strategies	0.51* (0.03)	-0.37* (0.02)	0.23* (0.01)	-0.02 (0.01)	-0.03 (0.03)	0.03* (0.01)	0.033* (0.00)	0.75* (0.04)
Motivation	Extrinsic	0.44* (0.02)	-0.29* (0.02)	0.38* (0.01)	0.04* (0.01)	-0.01 (0.03)	0.02* (0.00)	0.02* (0.00)	0.68* (0.03)
	Intrinsic	0.36* (0.02)	-0.21* (0.02)	0.63* (0.01)	0.02 (0.01)	-0.02 (0.03)	0.03* (0.01)	0.02* (0.00)	0.48* (0.02)
Anxiety	Math Anxiety	0.25* (0.01)	-.022* (0.02)	-0.60* (0.01)	-0.12* (0.01)	-0.07 (0.03)	0.04* (0.01)	0.02* (0.00)	0.51* (0.02)

Note. Standard Error (SE) in Parentheses; IAbil = Individual Ability; Mod = Moderator Variable; Savg = School-average Ability; ModXSavg = Moderator by School-average Ability; Cntry = Country; Sch = School; Ind = Individual Student; Cons = Constant. * = $p < .01$; [a] = is significant, but appears not to be due to rounding.

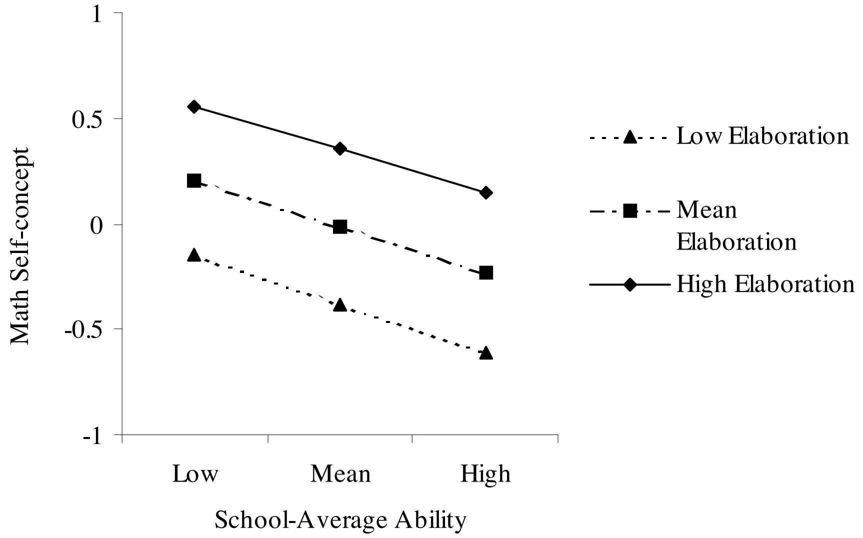

Figure 1. Elaboration by School-Average Ability Interaction

Note. Based on predicted values. High school-average ability = 1 standard deviation above the mean for school-average math ability, and low school-average ability = 1 standard deviation below the mean. Similarly, high elaboration = 1 standard deviation above the mean for elaboration, and low elaboration = 1 standard deviation below the mean. Individual ability is held constant.

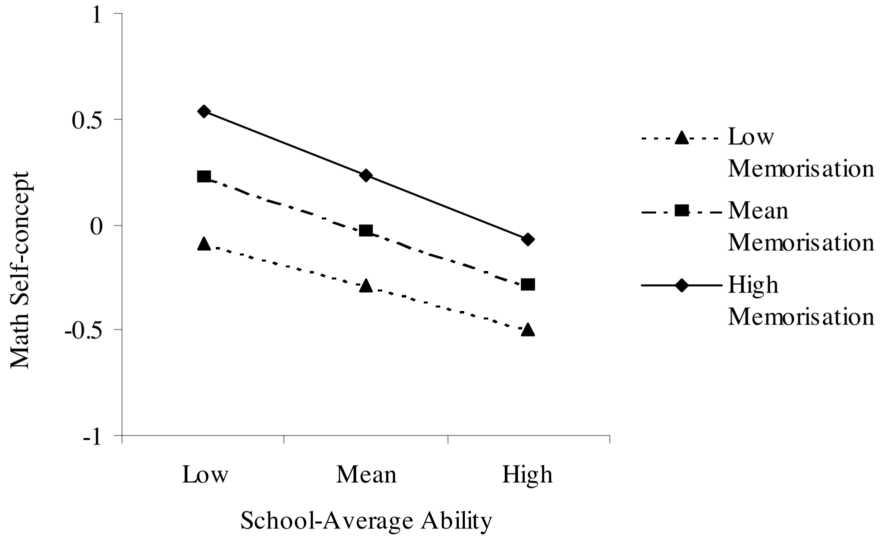

Figure 2. Memorisation by School-Average Ability Interaction

Note. Based on predicted values. High school-average ability = 1 standard deviation above the mean for school-average math ability, and low school-average ability = 1 standard deviation below the mean. Similarly, high memorisation = 1 standard deviation above the mean for memorisation, and low memorisation = 1 standard deviation below the mean. Individual ability is held constant.

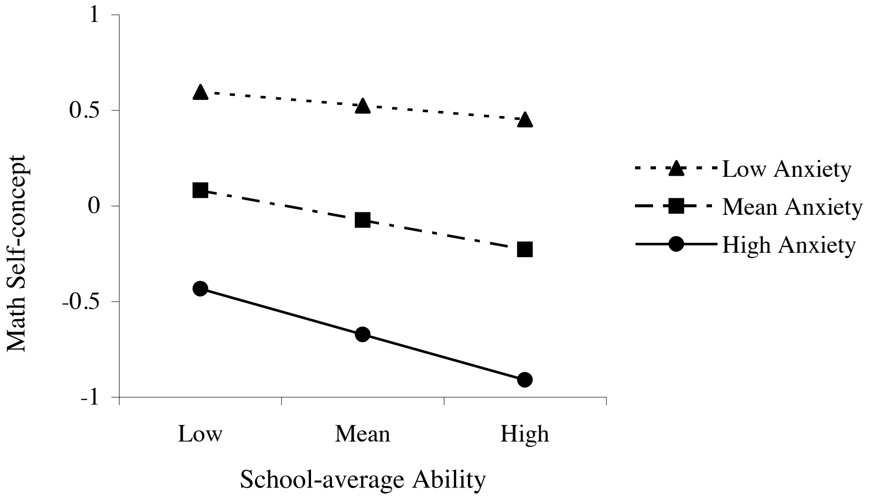

Figure 3. Math Anxiety by School-Average Ability Interaction

Note. Based on predicted values. High school-average ability = 1 standard deviation above the mean for school-average math ability and low school-average ability = 1 standard deviation below the mean. Similarly, high math anxiety = 1 standard deviation above the mean for math anxiety, and low math anxiety = 1 standard deviation below the mean. Individual ability is held constant.

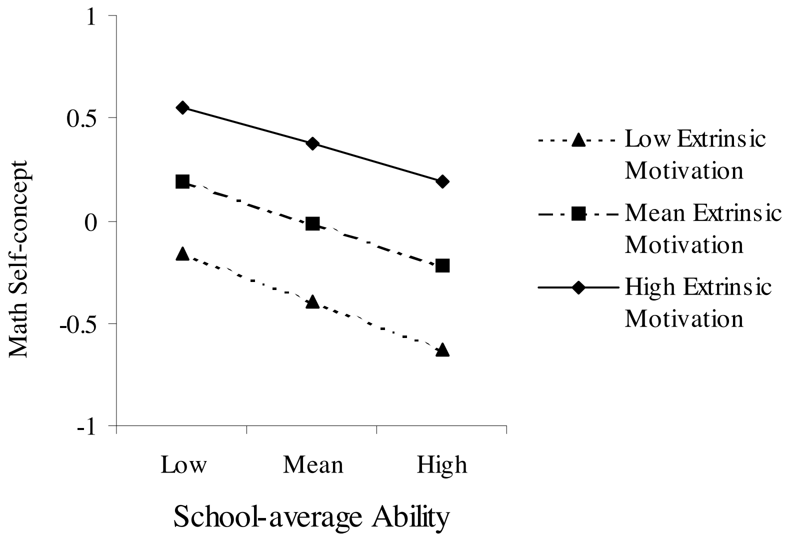

Figure 4. Extrinsic Motivation by School-Average Ability Interaction

Note. Based on predicted values. High school-average ability = 1 standard deviation above the mean for school average math ability, and low school-average ability = 1 standard deviation below the mean. Similarly, high extrinsic motivation = 1 standard deviation above the mean for extrinsic motivation, and low instrumental motivation = 1 standard deviation below the mean. Individual ability is held constant.