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Big-Fish-Little-Pond Effect: Generalizability and Moderation— Two Sides of the Same Coin

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Research evidence for the big-fish-little-pond effect (BFLPE) has demonstrated that attending high-ability schools has a negative effect on academic self-concept. Utilizing multilevel modeling with the 2003 Program for International Student Assessment database, the present investigation evaluated the generalizability and robustness of the BFLPE across 16 individual student characteristics. The constructs examined covered two broad areas: academic self-regulation based on a theoretical framework proposed by Zimmerman and socioeconomic status. Statistically significant moderating effects emerged in both areas; however, in relation to the large sample (N = 265,180), many were considered small. It was concluded that the BFLPE was an extremely robust effect given that it was reasonably consistent across the specific constructs examined.

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Since Davis (1966) warned parents against sending their sons to the "better" colleges if there was a chance that the son would be at the bottom of the graduating class, there has been a plethora of research into what has become known as the big-fish-little-pond effect (BFLPE). This research has demonstrated that students who attend high-ability classes and schools have lower academic self-concepts than their equally able counterparts educated in low- and average-ability environments (e.g., Marsh, 1991, 2005; Marsh, Chessor, Craven, & Roche, 1995; Marsh & Hau, 2003; Marsh, Köller, & Baumert, 2001; Marsh, Seaton, et al., 2008). That students in high-ability classes and schools should have lower academic self-concepts than their counterparts in mixed- or low-ability classes and schools is a cause for concern. A positive self-concept been shown to be a critical factor in many areas of human functioning (e.g., Ha, Marsh, & Halse, 2004; Marsh & Perry, 2005; Rogers, 1951), and its promotion is regarded by education institutions worldwide as an important objective (e.g., Ministerial Council on Education, Employment, Training, and Youth Affairs, 1999; Organisation for Economic Cooperation and Development [OECD], 2003).

For any theory, both moderation and its counterpart, generalizability, are critically important for extending knowledge of that theory. In terms of the BFLPE, the identification of strong moderators would provide potentially valuable information to elucidate the processes underlying the BFLPE and to build interventions to lessen its negative consequences. Alternatively, generalizability implies that at least the direction and perhaps even the size of the BFLPE do not vary much across diverse student characteristics. Strong confirmation for generalizability would substantially strengthen support for the theoretical basis of the BFLPE. Clearly, the search for BFLPE moderators has important implications, not only for BFLPE theory, but also for ameliorating the educational experience of students who attend academically selective schools and classes. Although research has shown the BFLPE to be remarkably robust (see Marsh, Seaton, et al., 2008), little is known about constructs that may mediate, moderate, or counteract the effect. Moreover, previous tests of BFLPE moderators have had limited success (Marsh, 1984, 1987, 1991; Marsh & Hau, 2003; Marsh, Seaton, et al., 2008): Most have been idiosyncratic, largely focusing on one or a few characteristics. In the present investigation, we expand the range of BFLPE moderators to include a much larger selection of constructs, including academic self-regulation based on a theoretical framework proposed by Zimmerman (1994, 1998) and socioeconomic status (SES).

The Big-Fish-Little-Pond Effect

The theoretical model underlying the BFLPE posits that although individual ability is positively related to academic self-concept (defined as one's knowledge and perceptions about one's academic ability; Bong & Skaalvik, 2003), class- and school-average ability display a negative association, and it is this negative association that is characteristic of the effect. Although the BFLPE has its theoretical roots in adaptation-level theory (e.g., Helson, 1964), social psychology (e.g., Morse & Gergen, 1970), and the theory of relative deprivation (e.g., Davis, 1966), among others, it has been explained by social comparison theory (Festinger, 1954; see Marsh, Seaton et al., 2008, for a full account of the BFLPE's theoretical basis). A recent study by Huguet et al. (2009) demonstrated that the BFLPE is based on comparisons with classmates. These authors provided direct evidence that when students' comparisons with their class as a whole were controlled for, the BFLPE was eliminated. Huguet et al. concluded that the BFLPE "is rooted in how students compare with their class taken as a whole, a comparison which proved to be more invidious as class average ability increased" (p. 164).

In one of the early BFLPE studies, Marsh and Parker (1984) reported that students who attended high-ability/high-SES schools had lower academic self-concepts than their equally able counterparts in low-ability/low-SES schools. In the wake of this early research, the BFLPE has found widespread support in a myriad of studies demonstrating the extent of its effects at different levels of education (e.g., Craven, Marsh, & Print, 2000; Marsh et al., 1995) and on many educational outcomes (Marsh, 1987, 1991), its durability (Marsh, Trautwein, Lüdtke, Baumert, & Köller, 2007), its effect on admission into elite universities (Espenshade, Hale, & Chung, 2005), and its generalizability across countries and cultures (e.g., Marsh & Hau, 2003; Marsh et al., 2001; Mulkey, Catsambis, Steelman, & Crain, 2005; Seaton, Marsh, & Craven, 2009). Empirical research has demonstrated that the effect on academic self-concept of attending a high-ability class or school is negative: Students in high-ability classes and schools tend to have lower academic self-concepts than equally able students in lower-ability classes and schools, due to the BFLPE.

Although BFLPE studies are largely based on correlational analyses, so that causal interpretations should be offered tentatively, researchers should fully interrogate support for casual hypotheses in relation to a construct validity approach (see Marsh, 2007). This approach should be based on multiple indicators, multiple (mixed) methods, multiple experimental designs, and multiple time points, as well as testing the generalizability of the results across diverse settings and a wide variety of potential moderators and mediators. Fortunately, there is now a growing body of BFLPE research that utilizes such methods (see Marsh, 2007; Marsh, Seaton, et al., 2008). Quasi-experimental longitudinal studies based on matching designs as well as statistical controls show that academic self-concept declines over time when students shift from mixed-ability schools to academically selective schools (based on pre-post comparisons) and in relation to students matched on academic ability who continue to attend mixed-ability schools (e.g., Marsh et al., 1995). Extended longitudinal studies show that the BFLPE grows stronger the longer students attend a selective school and is maintained even 2 and 4 years after graduation from high school (Marsh et al., 2007). Recent research using a true experimental design has also provided evidence of the BFLPE (Zell & Alicke, in press). The authors of this work demonstrated that participants who were told that they had performed poorly in a high-ability group evaluated their performance significantly lower than participants of (bogus) equal ability who were told that they had performed well in a low-ability group. Also, there is good support for the convergent and discriminant validity of the BFLPE, as it is largely limited to academic components of self-concept and nearly unrelated to nonacademic components of self-concept and to self-esteem (see Marsh, Seaton, et al., 2008). Cross-national comparisons based on the OECD Program for International Student Assessment (PISA) data show that the BFLPE has good cross-national generalizability (Marsh & Hau, 2003; Seaton et al., 2009). Whereas the "third variable" problem is always a threat to contextual studies that do not involve random assignment, Marsh, Hau, and Craven (2004) argue that this is an unlikely counter-explanation of BFLPE results in that most potential "third variables" (resources, per-student expenditures, SES, teacher qualifications, etc.) are positively related to school-average achievement, so that controlling for them would increase the size of the BFLPE (i.e., the negative effect of school-average achievement).

The Present Investigation

Despite the wide range of BFLPE studies, there has not been a systematic attempt to test potential moderators of the BFLPE. More specifically, in their critique of BFLPE research, Dai and Rinn (2008) noted that BFLPE research has not focused on "possible situational or personal variables that might moderate the BFLPE" (p. 291) and suggested that BFLPE research should "facilitate identification of vulnerable groups of individuals who are susceptible to the BFLPE" (p. 303). The present study addressed these criticisms directly (see Marsh, Seaton et al., 2008, for a rebuttal of many of Dai and Rinn's other criticisms of BFLPE research) by testing, more extensively than any previous research, the question of moderators of the BFLPE. Our goal was to ascertain whether the BFLPE could be moderated by a varied range of constructs or whether the BFLPE generalized across these constructs. We began by mapping out a general theoretical framework for BFLPE moderation. We theorized that the BFLPE might be moderated by individual student characteristics that fall within two broad frameworks:

academic self-regulation, based on a theoretical framework proposed by Zimmerman (1994, 1998), and SES.

Socioeconomic Status

Some studies suggest that higher SES is associated with better academic performance (e.g., OECD, 2001; Pong & Ju, 2000), while others suggest that this association is weak at best (e.g., White, 1982). Additionally, the effect of individual SES on academic self-concept has tended to be positive (e.g., Bachman & O'Malley, 1986; Marsh, 1984). However, no studies of which we are aware have examined whether individual SES has a moderating effect on the BFLPE.

Research examining the relation between SES and academic achievement and between SES and academic self-concept suggests that SES may be a factor that can influence the BFLPE, although the exact nature of this effect is open to conjecture. Perhaps students from high SES backgrounds may feel more pressure to perform well at school and live up to their parents' expectations than those from low SES backgrounds and so the BFLPE may be greater for high SES students. Conversely, the negative BFLPE may be attenuated for high SES students compared to students from low SES backgrounds. High SES students are likely to have parents who are more highly educated. Parents with higher education levels may be more able to provide their children with coping strategies and models of persistence. Hence, high SES students may be more able to cope with the demands and pressures of high-ability classes and schools than students of low SES backgrounds. As such, compared to students from low SES backgrounds, higher SES students could suffer either more or less from the BFLPE. Hence, whether SES moderates the BFLPE remains to be elucidated by research and as such is an issue addressed in the present investigation.

Academic Self-Regulation

Students learn differently: Some handle academic tasks with ease; others have difficulty. To learn effectively, most teachers and policymakers agree that students need to be self-regulated learners (Boekaerts, 1997). Zimmerman (2008) defined *self-regulated learning* as "the degree to which students are metacognitively, motivationally, and behaviorally active participants in their own learning process" (p. 167). He proposed six psychological dimensions of academic self-regulation (see Zimmerman, 1994, 1998). The moderators examined in the present investigation fit within four of these psychological dimensions: motive, study methods, behavior, and social.

Motive

According to Zimmerman's framework (1994, 1998), the motive dimension addresses questions regarding students' motivations to study and learn.

It encompasses the self-regulatory processes of goal setting and self-efficacy. Two of the moderators we considered measured student motivation, and a third measured self-efficacy.

Intrinsic and extrinsic motivation. Motivation is characterized in different ways; one major distinction in the literature is between intrinsic and extrinsic motivation (see Ryan & Deci, 2000, for details in relation to this distinction). Individuals who are intrinsically motivated engage in an activity because of the inherent enjoyment they obtain from the activity itself. Extrinsically motivated individuals engage in an activity, not because they find it pleasurable in and of itself, but because the act of participating provides a desired return. Whereas intrinsic motivation has been associated with more positive educational outcomes (e.g., Ginsburg & Bronstein, 1993; Gottfried, 1985, 1990; Marsh, Hau, Artelt, Baumert, & Peschar, 2006), some studies have related extrinsic motivation to poorer outcomes (e.g., Hardre & Reeve, 2003). This was evidenced by Lepper, Corpus, and Iyengar (2005), who examined the association between intrinsic and extrinsic motivation and achievement in third- through eighth-grade students. They found that students who were intrinsically motivated performed better on standardized achievement tests but that those who were extrinsically motivated performed worse. Intrinsic motivation has also been associated with higher perceptions of academic competence. Across two studies, Gottfried (1985, 1990) offered evidence that students who were more intrinsically motivated perceived themselves to be more academically competent. Additionally, Valas and Sovik (1993; see also Marsh et al., 2006) demonstrated that students who had higher mathematics self-concepts were more intrinsically motivated, and Cokley, Bernard, Cunningham, and Motoike (2001) found that whereas intrinsic motivation was positively related to academic self-concept, there was no association between extrinsic motivation and academic self-concept.

As there appears to be a positive association between academic self-concept and intrinsic motivation, intrinsically motivated students may not suffer the declines in self-concept associated with the BFLPE. As they find academic tasks rewarding in and of themselves, intrinsically motivated students may not find the accomplishments of others as threatening, or even relevant, to their self-views. However, the relation between extrinsic motivation and the BFLPE is less clear. Perhaps if extrinsically motivated students are able to receive the rewards they need to keep themselves motivated, such as high grades or the praise of teachers and parents, they also may not suffer the negative effects of the BFLPE. However, external rewards might be more difficult to achieve in academically selective schools. This might result in externally motivated students having lower perceptions of their academic ability than they would otherwise have in mixed- and low-ability schools (the BFLPE).

Self-efficacy. Self-efficacy can be defined as a person's belief that he or she has the ability to succeed in a specific task. It is typically measured by having individuals evaluate their chances of succeeding at particular target tasks. Some researchers (e.g., Bong & Skaalvik, 2003) have noted similarities between academic self-efficacy and academic self-concept. However, Marsh (1993; see also Marsh, Trautwein, et al., 2008) has argued that these two constructs differ as regards the part played by social comparison and frame of reference effects. Self-concept measures directly imply frame of reference effects, whereas self-efficacy measures do not. In judging one's academic self-concept, individuals use the achievements of classmates as a frame of reference to evaluate their performances. In contrast, when judging one's efficacy at a particular task, individuals assess their capability to succeed relative to the particular tasks presented, thus minimizing the influence of frame of reference effects. Bong and Skaalvik (2003) emphasized this distinction when they noted "assessing one's capability in academic self-concept relies heavily on social comparison information" (p. 9) whereas "self-efficacy items solicit goal referenced evaluations and do not directly ask students to compare their abilities to those of others" (p. 9). Additionally, Marsh, Trautwein, et al. (2008) argued that the way in which self-efficacy is operationalized is important in distinguishing the two constructs. In the present investigation, the self-efficacy items measured the likelihood of being able to succeed in completing specific tasks, as opposed to the self-concept items that measured a student's perception of his or her mathematical ability (see appendix).

Studies have indicated that academic self-efficacy has a significant positive association with academic performance (e.g., Multon, Brown, & Lent, 1991) and mathematic self-concept (Marsh et al., 2006). If students feel able to succeed academically, and do, then attending a high-ability school or class with high-achieving classmates may have no effect on their self-concepts. As self-efficacy appears to be positively related to self-concept, students inherently high in self-efficacy may not be affected by the BFLPE.

Study Methods

The study methods dimension relates to how students study, and it encompasses the self-regulatory processes of task strategies, imagery, and self-instruction (Zimmerman, 1998). In the present investigation, task strategies were examined as moderators of the BFLPE. These encompassed cognitive (elaboration and memorization) and metacognitive learning strategies (control strategies).

Cognitive learning strategies (elaboration and memorization) and metacognitive learning strategies (control strategies). Students who use elaboration strategies think deeply about concepts and tend to integrate what they learn with other material. They are able to transfer concepts to different situations. Students who are effective learners also use control strategies (e.g., they decide what material is important to learn for a test and actively seek out information to shed light on a problem) to ensure that they can achieve the learning goals they set for themselves (see Marsh et al., 2006). Students who use memorization learning strategies tend to rehearse material and learn by rote (Aharony, 2006). Although this strategy is useful for learning basic and new material, it might not be conducive to a deep understanding of concepts. The use of elaboration and control strategies has generally been associated with positive educational outcomes (e.g., Marsh et al., 2006; Pintrich, Smith, Garcia, & Mckeachie, 1993) and mathematic self-concept (Marsh et al., 2006). However, whereas in some studies the use of memorization has been shown to be related to beneficial outcomes (e.g., Zimmerman & Martinez-Pons, 1986), it has been shown to be unrelated in others (e.g., Marsh et al., 2006; Pintrich et al., 1993; Zimmerman & Martinez-Pons, 1990; see Warr & Downing, 2000). All three strategies have been shown to be positively related to academic self-concept (Swalander & Taube, 2007).

Individual differences in the way students use these learning strategies may moderate the BFLPE, but as yet, these constructs have not been investigated in relation to the BFLPE. For example, students who use elaboration and control strategies may not suffer the BFLPE. It may be that students instinctively use elaboration and control strategies in their learning, or perhaps the school environment encourages students to use them. Students who use these strategies may be more confident in their learning, may deal more positively with the school environment, and may maintain a focus on task relevant activities and so may be buffered from the negative effects of the BFLPE. Conversely, students who use memorization as a learning strategy may suffer more from the BFLPE. Students may instinctively use memorization to learn. Or, as suggested by an anonymous reviewer, perhaps students use memorization strategies because they have a lowered self-concept due to attending a high-ability school and because they compare their achievements with other very high-achieving peers. Hau and Hui (1996) demonstrated that high-achieving students were less likely to use surface learning strategies such as memorization and more likely to use learning strategies involving understanding of material. So, perhaps students in high-ability schools who use memorization strategies do so because they feel less confident about their abilities.

Behavior

In Zimmerman's model (1998), the behavior dimension refers to "students' overall behavioural performance" (p. 75). According to this definition, two of our BFLPE moderators measured behavior: individual ability and anxiety.

Individual ability. The BFLPE moderator that has received the greatest attention has been individual ability. Theoretically, Marsh and colleagues (Marsh, 1987, 1990, 1991; Marsh & Craven, 2002; Marsh, Seaton, et al., 2008) argued that interactions between school-average ability and individual ability on academic self-concept are predicted to be small or nonsignificant because the frame of reference is established by school-average ability: All students in a high-ability school are predicted to have lower academic self-concepts than would the same students if they attended a low-ability school. Consistent with these predictions, studies investigating whether the BFLPE is similar at all ability levels have provided mostly small or nonsignificant results in which not even the direction of the interaction is consistent. For example, some researchers have noted that the BFLPE is more pronounced for students of lower ability in academically selective schools (Coleman & Fults, 1985); others have suggested that between-class ability grouping is associated with higher academic self-concepts for students of low-ability and lower academic self-concepts for students of high-ability (Reuman, 1989; see also Seaton et al., 2009), while still others have suggested that students of average ability suffer the most (Marsh & Rowe, 1996). Moreover, other studies have suggested that the BFLPE affects all levels of ability (Marsh et al., 1995; Marsh & Hau, 2003). Although results to date have been inconclusive—other than to suggest that the moderation effect is consistently small—individual differences in ability is an important BFLPE moderator that warrants further consideration.

Anxiety. Meece, Wigfield, and Eccles (1990) examined the relations between previous mathematics grades, mathematics ability perceptions, performance expectations, and value perceptions on mathematics anxiety. These authors noted that the correlations between their mathematics ability perception items and mathematics anxiety items were consistently negative, ranging from $-.11$ to $-.41$. As high anxiety levels have been related to lower perceptions of ability and as ability perceptions are integral to the BFLPE, it seems reasonable to suggest that larger BFLPEs may be associated with higher anxiety levels. Students may bring their anxieties with them to high-ability schools, or lower self-concepts, as a result of attending high-ability schools, may cause students to become anxious. Whatever the causal relation, more pronounced BFLPEs may be associated with students who have higher anxiety levels.

Social

Although Zimmerman (1998) noted that "socially self-regulated students are aware of how study partners, coaches, or instructors can help or hinder their learning" (p. 75), he defined this dimension only as an ability to seek help. We propose that, for the purposes of this study, this dimension be extended to include social relationships. This proposal is supported by the work of Cho and Jonassen (2009), who suggested that self-regulated learning models could be extended to include a human interaction dimension. Using exploratory factor analysis and confirmatory factor analysis, these authors developed the Online Self-Regulated Learning Inventory, which included such a dimension, encompassing enjoyment of, self-efficacy for, and concern for human interactions. McCaslin's work (1996) on co-regulation, in which she emphasizes the social roles of students, is also relevant here. She suggests that a student's basic task is "coordination of multiple social worlds, expectations, and goals" (p. 14) and views students as being more than just academic performers but rather as social beings who live in multiple social worlds (see also McCaslin & Good, 1996; McCaslin & Hickey, 2001). Moreover, one of the theoretical underpinnings of the BFLPE is that it is based on social comparison. In a recent study, Huguet et al. (2009) demonstrated that the BFLPE is based on social comparisons that students make with classmates. Hence, we consider that social relationships are critical to the social comparison basis of the BFLPE and as such are clearly important moderators to examine in relation to the BFLPE. For these reasons, we propose that four potential moderators—cooperative orientation, competitive orientation, student-teacher relations, and school belonging—fit into this social dimension as they capture relationships that students have with other students and teachers.

Competitive and cooperative orientations. As Marsh et al. (2006) noted, self-regulated learning entails being able to work by oneself but also with others, and both cooperative and competitive orientations are "compatible with effective self-regulated learning" (p. 321). However, research in this area appears to be inconsistent. Some studies have demonstrated that better academic performance ensues when students work together (cooperatively); others, that working individually (competitively) is superior (see Slavin, 1983). An OECD (2001) study demonstrated that both types of orientations are associated with good performance. Working cooperatively has been linked with positive cognitive (e.g., mastery of concepts and principles) and affective (e.g., positive self-attitudes) outcomes (see Johnson & Johnson, 1975). Conversely, Marsh et al. (2006) demonstrated that whereas a competitive orientation was positively associated with verbal and math achievement, a cooperative orientation was not. As regards self-concept in particular, Marsh and Peart (1988) compared a competitive and a cooperative fitness program. Compared to a control group, they demonstrated that whereas a cooperative program enhanced self-concept, a competitive program lowered self-concept.

As there are mixed findings in this area, implications for the BFLPE could be formulated in either direction. Organizational behavior research suggests that the fit between the person and the environment is related to positive employee attitudes and behaviors (see Greguras & Diefendorff, 2009). Applying this to the BFLPE, one might expect that if students had more of a competitive orientation, they may not be troubled by the competitive nature of high-ability classes or schools, as the fit would be right: Students who display a high competitive orientation may suffer less from the negative effects of the BFLPE. Alternatively, the BFLPE may be greater for these students as they are more likely to compare their achievements with those of fellow students. On the other hand, the fit between student and school may not be right for those students who endorse a cooperative orientation. These students may also suffer the BFLPE to a greater extent, as they may not be able to cope with the competitive nature of high-ability classes and schools. However, it is equally plausible that students who endorse a cooperative orientation may not need to rely on comparisons with others to assess their achievement and so the BFLPE may not affect these students.

Sense of belonging and student-teacher relationships. The relationships that students have with their peers and with their teachers may provide another avenue for BFLPE moderation. Two constructs can be considered within this context: sense of belonging to school (how connected a student feels to other students) and student-teacher relationships (how well students and teachers get along). Regarding school belonging, a greater sense of connection to one's school has been shown to be a protective factor in the general mental health of students (Ozer, 2005), and students who feel more connected appear to engage in fewer conduct problems than less connected students (Loukas, Suzuki, & Horton, 2006). Consistently, positive student-teacher relations have been shown to be an important factor in student success (e.g., Wentzel, 1999; Woolley, Kol, & Bowen, 2009). For example, positive student-teacher relations have been shown to facilitate achievement and reduce discipline problems (e.g., Crosnoe, Johnson, & Elder, 2004). Hence, it appears that strong social relationships with peers and teachers are related to better outcomes.

Perhaps students who report more positive feelings of belonging may suffer less from the BFLPE. For example, students in high-ability schools may feel more connected to their schools because they do not feel different from other students academically: They are attending a school with many other highly intelligent students, and this may promote a sense of belonging. Thus, students who feel more of a sense of belonging to their school may suffer the negative effects of the BFLPE to a lesser extent than those who do not feel so connected. Additionally, students may be buffered against the BFLPE if they have more positive relationships with teachers. It is quite likely that students in high-ability schools may have better relations with teachers as they may be more engaged in their schooling. As such, more positive student-teacher relationships may have a positive effect on self-concept and lessen the negative effects of the BFLPE. However, the issue of whether these social relationships moderate the BFLPE has yet to be elucidated by research and thus is addressed by the present investigation.

Summary

The present investigation proposed a variety of constructs that may moderate the BFLPE. As most of these constructs have never been considered in relation to BFLPE moderation, in our discussion of these constructs we have suggested ways in which moderation might occur. In many instances, a plausible case could be made for an opposite stance to the one(s) that we have outlined, as there was no clear evidence from previous research or theory to support one position or the other. Not only that, but we also accept that causality is an important issue: Do these constructs cause the BFLPE? Does being in a high-ability school cause these characteristics to appear within students? or Is the relation between these constructs and the BFLPE reciprocal? This is an issue to which we return in our discussion of the results.

Hypotheses and Research Questions Addressed by the Present Investigation

In order to assess whether the constructs we identified generalized across the BFLPE or moderated its adverse effects, the following hypotheses (with an a priori prediction of the effect) and research questions (a potentially important moderator where there was no basis for making an a priori prediction) were formulated on the basis of the preceding discussion:

1. Does level of SES moderate the BFLPE?
2. Intrinsic motivation will positively moderate the BFLPE: The Intrinsic Motivation × School-Average Ability interaction will be positively related to mathematics self-concept; students who are highly intrinsically motivated will suffer the BFLPE to a lesser extent than students who are less intrinsically motivated.
3. Is the BFLPE moderated by extrinsic motivation?
4. Self-efficacy will positively moderate the BFLPE: The Self-Efficacy × School-Average Ability interaction will be positively related to mathematics self-concept; students who are high in self-efficacy will suffer the BFLPE to a lesser extent than students who are not.
5. Elaboration will positively moderate the BFLPE: The Elaboration × School-Average Ability interaction will be positively related to mathematics self-concept; students who rely heavily on elaboration will suffer the BFLPE to a lesser extent than students who do not.
6. Memorization will negatively moderate the BFLPE: The Memorization × School-Average Ability interaction will be negatively related to mathematics self-concept; students who rely heavily on memorization will suffer the BFLPE to a greater extent than students who do not.
7. Control strategies will positively moderate the BFLPE: The Control Strategies × School-Average Ability interaction will be positively related to mathematics

self-concept; students who rely heavily on control strategies will suffer the BFLPE to a lesser extent than students who do not.

8. Is the BFLPE moderated by individual ability? Previous theory suggests that the BFLPE should not be moderated by individual ability, whereas previous research suggests that any such moderation is small or nonsignificant and not even consistent in direction.
9. Anxiety will negatively moderate the BFLPE: The Anxiety × School-Average Ability interaction will be negatively related to mathematics self-concept; students who are highly anxious will suffer the BFLPE to a greater extent than students who are less anxious.
10. Will a competitive orientation moderate the BFLPE?
11. Will a cooperative orientation moderate the BFLPE?
12. A sense of belonging to school will positively moderate the BFLPE: The Sense of Belonging to School × School-Average Ability interaction will be positively related to mathematics self-concept. Students who report a more positive sense of belonging to school will suffer the BFLPE to a lesser extent than students who report a less positive connection.
13. Student-teacher relations will positively moderate the BFLPE: The Student-Teacher Relations × School-Average Ability interaction will be positively related to mathematics self-concept. Students who report more positive student-teacher relations will suffer the BFLPE to a lesser extent than students who report less positive relationships.

In differentiating between hypotheses and research questions, we do not argue that constructs involved in explicit hypotheses are necessarily more important to consider.

Method

Participants

Participants were 15-year-old students from 41 countries (N = 276,165) who took part in the PISA study conducted in 2003 by the OECD. PISA is an internationally standardized assessment conducted by the OECD that takes place every 3 years and is administered to 15-year-old students in schools around the world. These assessments typically focus on mathematics, literacy, and science, but PISA also contains a vast amount of additional information about students' families, home backgrounds, and SES. Students also report their learning habits, how they feel about their achievements, and how they connect with other students and teachers within their school (OECD, 2005b). Hence, using this database, the present investigation examined 16 potential constructs that may moderate the BFLPE. These moderating constructs fall within the frameworks of SES and academic self-regulation. (For full details of the measurement of these constructs, see appendix.)

Fifteen-year-old students can be in different grades depending on many factors, such as the age at which they started school, whether they repeated a school year, or whether they were accelerated. Moreover, the grades that 15-year-old students attend are not equivalent across countries (see OECD, 2005a). Additionally, as the tests used by PISA were not curriculum specific, we considered that it was appropriate to include all students, irrespective of the grade they were in. Furthermore, following the suggestion of a reviewer, we conducted analyses in which we included grade level as a potential moderator of the BFLPE, but it was not statistically significant. However, not all students completed the math self-concept items, which are a central focus of the current study. Hence, those students who did not complete any of these items were removed from further analysis. For the remaining variables, there were almost no missing data (less than 1%). Additionally, multilevel modeling was used to analyze these data. As estimates based on small samples tend to be unreliable (particularly in that the OECD required that there were at least 20 students sampled in each school) and to enable multilevel modeling to be effective, previous studies using the PISA database have deleted schools with 10 or fewer students from further analyses (Marsh & Hau, 2003; see also Seaton et al., 2009). To maintain comparability, this course of action was followed in the present investigation. As a result, the current sample consisted of 265,180 students who attended 10,221 schools in 41 countries.

Measures

SES. SES measures included parental occupation, parental education, home educational resources, and cultural possessions within the home. Higher values signified higher levels of the construct. Full details of these constructs are provided in the appendix.

Academic self-regulation. Constructs that fell within four of Zimmerman's psychological dimensions (1998) in his proposed academic self-regulation framework were examined as potential BFLPE moderators. Within the motive dimension, these constructs were intrinsic and extrinsic motivation and self-efficacy. Within the study methods dimension were the cognitive and metacognitive learning strategies of elaboration, memorization, and control strategies. Individual ability and anxiety were measured within the behavior dimension, while the social dimension contained competitive and cooperative orientations, sense of belonging, and student-teacher relationships. For all these constructs, higher values signified higher levels of the construct under discussion. Full details of all constructs are presented in the appendix.

Many of these academic self-regulation constructs are represented in the Student Approaches to Learning (SAL) Instrument developed by the OECD for PISA. Marsh et al. (2006) evaluated SAL responses from nationally representative samples of approximately 4,000 15-year-olds from each of 25 countries (N = 107,899)—the 2000 PISA database. They used multiple-group confirmatory factor analyses to show that SAL's a priori structure was well defined and reasonably invariant across the 25 countries. The results supported posited relations among constructs derived from different theoretical perspectives and their cross-cultural generalizability. From this perspective, the use of the PISA data and the SAL constructs provides a strong basis for testing the generalizability of the BFLPE in relation to potential moderators, more so than any previous research into this critical question.

Mathematics self-concept. Mathematics self-concept was the outcome variable in all analyses. Five items were used to measure this construct (see OECD, 2005b). Items, scored on a 4-point Likert-type scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*), included "I get good marks in mathematics" and "I learn mathematics quickly." Four of the five items were inverted for scoring. Thus, a high score was associated with a higher mathematics self-concept. In the current sample, Cronbach's alpha was .88, indicating that the reliability of this scale was high. Additionally, using confirmatory factor analysis, the PISA administrators demonstrated that the items that formed this scale were psychometrically sound (see OECD, 2005b). The Mathematics Self-Concept scale was standardized across the entire sample to have a mean of 0 and a standard deviation of 1. Subsequently, the range of scores was –2.24 to 2.48.

Individual ability. The PISA database does not contain a single mathematics ability measure. Rather, it provides five plausible values to estimate a student's academic ability, which avoids biased population estimates being obtained. According to the PISA documentation, Wu and Adams (2002) describe plausible values as providing a "representation of the range of abilities a student might reasonably have. . . . Instead of directly estimating a student's ability θ, a probability distribution for a student's θ is estimated" (OECD, 2005a, p. 75). The PISA documentation advises researchers not to average these plausible values but to conduct analyses with each plausible value separately and then average all resulting parameters (see OECD, 2005a). This was the course of action followed in the current study. Additionally, standard errors were calculated to reflect variance both within and between plausible values (see OECD, 2005a; Raudenbush, Bryk, & Congdon, 2005).

Statistical Analysis and Procedure

First, the five plausible values for mathematics ability, mathematics self-concept, and all the potential moderators were standardized ($M = 1$, $SD = 0$) across the entire sample. A school-average mathematics ability variable was calculated for each plausible value by averaging each one separately within each school. This school-average mathematics ability variable was not restandardized, thus keeping all variables in the same metric as the individual test scores and in a metric that was consistent across all schools and countries. Cross-products with school-average ability were created for each potential moderator but were not restandardized (see Marsh & Hau, 2003; Marsh & Rowe, 1996; also see Aiken & West, 1991).

To prevent biased estimates of population parameters, the PISA documentation (OECD, 2005b) recommends the use of sample weights. This weighting was used in all analyses and ensured that countries had "weights according to their sample sizes so that the sum of weights in each country is equal to the number of students in the database" (OECD, 2005b, p. 325). The effect of this was to ensure that the weighted and unweighted sample sizes were similar. For full details of the weights used in PISA see OECD (2005a).

The PISA data have a hierarchical structure: Students are nested within schools, and schools are nested within countries. Using single-level statistical analyses to analyze data with a multilevel structure can result in serious statistical problems, such as violations of the assumption of independence and heterogeneity of regression. Hence, researchers suggest that multilevel modeling be used to analyze data with a multilevel structure (e.g., Hox, 2002; Raudenbush & Bryk, 2002; Rowe, 2005). A multilevel regression equation consists of fixed and random components. In the present investigation, for each moderator analysis the fixed components were individual ability (both linear and quadratic), the specific moderator, school-average ability, and the cross-product of the moderator and school-average ability. All models tested had a three-level structure: Individual students were at Level 1, schools were at Level 2, and country was at Level 3.

A separate set of five multilevel regression analyses (one for each plausible value for achievement) was conducted for each potential moderator of the BFLPE (4 SES moderators and 12 academic self-regulation moderators). Thus, for example, for intrinsic motivation, five multilevel modeling regression analyses were conducted, one for each achievement plausible value. Subsequently, based on these results, parameter estimates were averaged for each potential moderator and standard errors calculated to accommodate variance between and within plausible values (see OECD, 2005a; Raudenbush et al., 2005). In all analyses the outcome variable was mathematics self-concept, and predictor variables were individual mathematics ability (linear and quadratic), school-average mathematics ability, the potential moderator, and the interaction of school-average mathematics ability with the relevant moderator variable. Due to the large number of tests of statistical significance being conducted, the significance level was set at $p < .001$.

The current sample comprised over a quarter million students. Large samples such as this provide much power and can generate small significant effects that would not otherwise reach significance (Howell, 1997). As a result, we were cognizant of the fact that, in this sample, small interactions could be statistically significant but not practically important. Hence, effect sizes were utilized to decide whether statistically significant interaction effects were of substantive value.

Until recently there was no commonly defined measure of effect size for group-level constructs in multilevel studies. However, Tymms (2004; also see Trautwein, Gerlach, & Lüdtke, 2008) has suggested an effect size measure that is comparable with Cohen's *d* (1988), using the following formula:

$$\Delta = 2 \times B \times SD_{\text{predictor}} / \sigma_{\text{e}},$$

where B = the unstandardized regression coefficient in the multilevel model; $SD_{\text{predictor}}$ = the standard deviation of the predictor variable at the class level; and σ_{e} = the residual standard deviation at the student level.

Effect sizes for all moderators were calculated using this formula and evaluated according to Cohen's criteria (see Cohen, 1988). Although it is not possible to establish absolute guidelines as to what effects sizes are meaningful, effect sizes of .20 are considered small, .50 considered medium, and .80 large. From this perspective, our primary focus was on those effect sizes of at least close to .20, although we also thought it appropriate to describe smaller effect sizes that approached .10. We were less interested in tiny effect sizes (<.075)—even when they reached statistical significance due to the very large sample size considered in the present investigation—and believed that it was not practical to interpret them, as they are of no substantive value. Nevertheless, results for all significant interactions are presented so that readers can determine whether the size of the interaction effects warrant attention.

Results

The BFLPE

A BFLPE was evident in these data (see Table 1). Individual ability was significantly positively associated with mathematics self-concept (linear ability = .512; quadratic ability = .105), and school-average ability was a significant negative predictor of mathematics self-concept (−.319). Hence, students in schools whose ability levels were 1 standard deviation above average-ability schools had mathematics self-concepts that were .319 of a standard deviation lower than their equally able counterparts in average-ability schools. The corresponding effect size for school-average ability (the BFLPE) was −.520, clearly a sufficiently large effect to be of both theoretical and practical importance. The positive relation between mathematics ability and mathematics self-concept suggests that, when school-average mathematics ability is controlled, higher mathematics self-concepts are associated with higher mathematics ability. However, compared to average- and high-ability students, this relation between

Table 1
The Big-Fish-Little-Pond Effect (BFLPE) and Individual Ability as a Moderator of the BFLPE

	BFLPE (*SE*)	Ability as Moderator (*SE*)
Fixed effects[a]		
Constant	−.120 (.035)*	−.124 (.036)*
Linear ability	.512 (.019)*	.520 (.020)*
Quadratic ability	.105 (.005)*	.118 (.005)*
School-average ability	−.319 (.022)*	−.300 (.023)*
School-Average Ability × Linear Ability		−.048 (.008)*
School-Average Ability × Quadratic Ability		−.016 (.005)
Random effects[b]		
L3 country intercept	.050 (.014)*	.052 (.015)*
L3 linear ability	.014 (.003)*	.014 (.003)*
L3 quadratic ability	.001 (.000)*	.001 (.000)*
L3 school-average ability	.018 (.006)	.016 (.006)
L2 school intercept	.035 (.003)*	.032 (.005)*
L2 linear ability	.009 (.001)*	.007 (.003)
L2 quadratic ability	.000 (.000)	.000 (.000)
L1 student intercept	.777 (.035)*	.777 (.035)

Note. Dependent variable is math self-concept. L1 = Level 1; L2 = Level 2; L3 = Level 3.
[a]For fixed effects, regression coefficients are shown along with their standard errors.
[b]For random effects, (a) the variances of the intercepts for the three levels of the model and (b) the variances of the slopes of each variable in the model at the levels at which they were allowed to vary are shown, along with their standard errors.
$^{*}p < .001$.

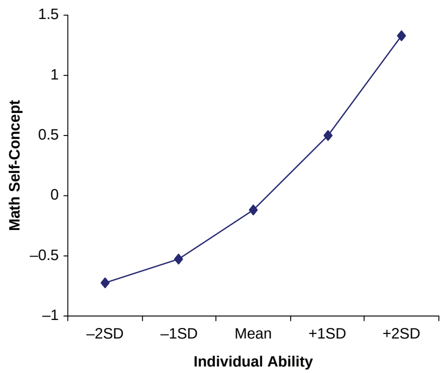

Figure 1. **Relation between individual ability and math self-concept, controlling for school-average ability.**
Note. Figure based on predicted values. −2SD = two standard deviations below the mean; −1SD = one standard deviation below the mean; +1SD = one standard deviation above the mean; +2SD = two standard deviations above the mean.

Table 2
Socioeconomic Status Moderators of the Big-Fish-Little-Pond Effect

	Highest in Occupation (*SE*)	Highest in Education (*SE*)	Home Educational Resources (*SE*)	Cultural Possessions (*SE*)
Fixed effects[a]				
Constant	−.126 (.035)*	−.122 (.035)*	−.124 (.035)*	−.124 (.035)*
Linear ability	.514 (.018)*	.507 (.018)*	.506 (.018)*	.509 (.019)*
Quadratic ability	.102 (.005)*	.103 (.005)*	.106 (.005)*	.105 (.005)*
School-average ability	−.317 (.021)*	−.329 (.021)*	−.328 (.021)*	−.322 (.021)*
Moderator	.004 (.007)	.036 (.006)*	.036 (.005)*	.018 (.005)*
School-Average Ability × Moderator	.012 (.004)	−.006 (.004)	.012 (.005)	−.015 (.004)*
Random effects[b]				
L3 country intercept	.050 (.014)*	.050 (.014)*	.050 (.014)*	.050 (.014)*
L3 linear ability	.013 (.003)*	.013 (.003)*	.013 (.003)*	.014 (.003)*
L3 quadratic ability	.001 (.000)*	.001 (.000)*	.001 (.000)*	.001 (.000)*
L3 school-average ability	.016 (.005)	.015 (.005)	.017 (.005)*	.016 (.005)
L3 moderator	.002 (.000)*	.001 (.000)*	.001 (.000)*	.001 (.000)*
L2 school intercept	.032 (.005)*	.035 (.003)*	.035 (.003)*	.035 (.003)*
L2 linear ability	.007 (.002)*	.009 (.001)*	.009 (.001)*	.009 (.001)*
L2 quadratic ability	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)
L2 moderator	.001 (.001)	.001 (.001)	.001 (.001)	.002 (.000)*
L1 individual intercept	.776 (.035)*	.773 (.035)*	.775 (.035)*	.774 (.035)*

Note. Dependent variable is math self-concept. L1 = Level 1; L2 = Level 2; L3 = Level 3.
[a]For fixed effects, regression coefficients are shown along with their standard errors.
[b]For random effects, (a) the variances of the intercepts for the three levels of the model and (b) the variances of the slopes of each variable in the model at the levels at which they were allowed to vary are shown, along with their standard errors.
*$p < .001$.

mathematics ability and mathematics self-concept is not as strong for low-ability students (see Figure 1).

Socioeconomic Status

Although the main effect of the highest parental occupation level on mathematics self-concept (.004) was not statistically significant, the remaining three SES variables each had a significantly positive but small association with mathematics self-concept (highest in education, .036; home education resources, .036; and cultural possessions, .018). These positive main effects indicate that, controlling for individual ability, higher mathematics self-concepts were weakly associated with students from higher SES backgrounds (see Table 2).

We were especially interested in whether the BFLPE was moderated by any of these SES variables. One interaction with school-average mathematics ability was statistically significant but small: cultural possessions (−.015). All other interactions were not statistically significant. However, the effect size for the School-Average Mathematics Ability × Cultural Possessions interaction was negligible at –.024 and so was deemed to be too small to be of practical importance for purposes of the present investigation. Hence, it was not considered further.

Academic Self-Regulation: Motive

Intrinsic and extrinsic motivation. Both extrinsic and intrinsic motivation were statistically significant positive predictors of mathematics self-concept (extrinsic = .375; intrinsic = .616; see Table 3). Students who were motivated extrinsically or intrinsically had higher mathematics self-concepts. Contrary to predictions, the Intrinsic Motivation × School-Average Mathematics Ability interaction was not statistically significant. Additionally, the interaction of extrinsic motivation and school-average mathematics ability was not statistically significant. These findings suggest that the BFLPE generalizes across all levels of both intrinsic and extrinsic motivation.

Self-efficacy. As evidenced in Table 3, mathematics self-efficacy was a significantly positive predictor of mathematics self-concept (.449). Students who were high in mathematics self-efficacy had higher mathematics self-concepts. However, the mathematics self-efficacy (−.037) interaction with school-average mathematics ability had a statistically significant negative association with mathematics self-concept. Nonetheless, the effect size (see Table 4) for the mathematics self-efficacy interaction with school-average ability was too small for any practical interpretation (−.067; <.075).

Study Methods: Cognitive and Metacognitive Learning Strategies

Results indicated that all three learning strategies had a statistically significant positive relation with mathematics self-concept (elaboration = .363, memorization = .254, and control strategies = .229; see Table 3). Students who availed themselves of these learning strategies had higher mathematics self-concepts. Regarding the interaction effects, only that of memorization (−.089; see Table 3) had a statistically significant negative association with mathematics self-concept, as was expected. However, contrary to predictions, the interactions of elaboration with school-average mathematics ability and that of control strategies with school-average mathematics ability were not statistically significant.

The effect size for the Memorization × School-Average Mathematics Ability interaction at −.157 (see Table 4) deserves interpretation. Figure 2 shows that larger BFLPEs were associated with students who used memorization to a greater extent. Students in high-ability schools who used the

Table 3
Academic Self-Regulation Moderators of the Big-Fish-Little-Pond Effect

	Motive (*SE*)		
	Extrinsic	Intrinsic	Self-Efficacy
Fixed effects[a]			
Constant	−.077 (.027)	−.049 (.028)	−.063 (.026)
Linear ability	.432 (.016)*	.349 (.015)*	.264 (.014)*
Quadratic ability	.085 (.005)*	.056 (.004)*	.070 (.004)*
School-average ability	−.240 (.017)*	−.165 (.017)*	−.311 (.018)*
Moderator	.375 (.009)*	.616 (.008)*	.449 (.015)*
School-Average Ability × Moderator	.026 (.009)	.009 (.007)	−.037 (.011)*
Random effects[b]			
L3 country intercept	.030 (.005)*	.033 (.007)*	.027 (.005)*
L3 linear ability	.010 (.002)*	.008 (.002)*	.008 (.001)*
L3 quadratic ability	.001 (.000)*	.001 (.000)*	.001 (.000)[c]
L3 school-average ability	.010 (.003)*	.010 (.002)*	.011 (.003)*
L3 moderator	.003 (.001)	.003 (.001)	.008 (.002)*
L2 school intercept	.023 (.002)*	.013 (.001)*	.026 (.002)*
L2 linear ability	.007 (.001)*	.004 (.001)*	.007 (.001)*
L2 quadratic ability	.000 (.000)	.001 (.000)*	.000 (.000)
L2 moderator	.008 (.001)*	.008 (.001)*	.015 (.001)*
L1 individual intercept	.650 (.027)*	.457 (.018)*	.636 (.030)*

(continued)

Table 3 (continued)

	Study Methods (*SE*)			Behavior (*SE*)
	Elaboration	Memorization	Control Strategies	Anxiety
Fixed effects[a]				
Constant	−.084 (.024)*	−.097 (.028)*	−.102 (.025)*	−.099 (.037)
Linear ability	.477 (.019)*	.496 (.018)*	.489 (.019)*	.241 (.013)*
Quadratic ability	.080 (.005)*	.107 (.005)*	.105 (.005)*	.048 (.004)*
School-average ability	−.253 (.019)*	−.307 (.024)*	−.319 (.022)*	−.198 (.016)*
Moderator	.363 (.008)*	.254 (.017)*	.229 (.014)*	−.592 (.008)*
School-Average Ability × Moderator	.013 (.006)	−.089 (.014)*	−.023 (.008)	−.097 (.013)*
Random effects[b]				
L3 country intercept	.023 (.003)*	.032 (.007)*	.025 (.004)*	.055 (.021)
L3 linear ability	.014 (.003)*	.013 (.002)*	.015 (.003)*	.007 (.002)*
L3 quadratic ability	.001 (.000)*	.001 (.000)*	.001 (.000)*	.001 (.001)
L3 school-average ability	.013 (.004)*	.021 (.006)*	.017 (.005)*	.009 (.003)
L3 moderator	.003 (.001)	.011 (.002)*	.007 (.001)*	.002 (.001)
L2 school intercept	.024 (.002)*	.028 (.003)*	.029 (.002)*	.018 (.002)*
L2 linear ability	.006 (.001)*	.007 (.001)*	.008 (.001)*	.007 (.001)*
L2 quadratic ability	.000 (.000)	.000 (.001)	.000 (.000)	.001 (.000)*
L2 moderator	.010 (.000)*	.013 (.001)*	.011 (.001)*	.014 (.002)*
L1 individual intercept	.660 (.038)*	.691 (.037)*	.713 (.035)*	.483 (.018)*

(continued)

Table 3 (continued)

	Social (*SE*)			
	Competitive Orientation	Cooperative Orientation	Sense of Belonging	Student-Teacher Relations
Fixed effects[a]				
Constant	–.084 (.025)*	–.105 (.028)*	−.125 (.034)*	−.101 (.034)
Linear ability	.460 (.018)*	.502 (.020)*	.509 (.019)*	.511 (.019)*
Quadratic ability	.087 (.004)*	.105 (.005)*	.105 (.005)*	.099 (.005)*
School-average ability	−.261 (.020)*	−.311 (.023)*	−.327 (.023)*	−.311 (.023)*
Moderator	.361 (.012)*	.130 (.018)*	.088 (.005)*	.138 (.004)*
School-Average Ability × Moderator	−. 012 (.009)	−.050 (.006)*	.025 (.004)*	.012 (.005)
Random effects[b]				
L3 country intercept	.025 (.005)*	.031 (.007)*	.045 (.013)*	.048 (.014)*
L3 linear ability	.013 (.003)*	.015 (.003)*	.015 (.003)*	.014 (.003)*
L3 quadratic ability	.001 (.000)*	.001 (.000)*	.001 (.000)*	.001 (.000)*
L3 school-average ability	.015 (.004)*	.018 (.005)*	.018 (.006)	.019 (.005)*
L3 moderator	.006 (.001)*	.013 (.005)	.001 (.000)*	.000 (.000)
L2 school intercept	.024 (.002)*	.032 (.003)*	.034 (.003)*	.032 (.002)*
L2 linear ability	.006 (.001)*	.008 (.001)*	.009 (.001)*	.008 (.001)*
L2 quadratic ability	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)
L2 moderator	.011 (.001)*	.012 (.001)*	.005 (.001)*	.009 (.001)*
L1 individual intercept	.659 (.033)*	.739 (.038)*	.760 (.036)*	.752 (.035)*

Note. Dependent variable is math self-concept. L1 = Level 1; L2 = Level 2; L3 = Level 3.
[a]For fixed effects, regression coefficients are shown along with their standard errors.
[b]For random effects, (a) the variances of the intercepts for the three levels of the model and (b) the variances of the slopes of each variable in the model at the levels at which they were allowed to vary are shown, along with their standard errors.
[c]Appears significant at $p < .001$ due to rounding.
*$p < .001$.

Table 4
Effect Sizes for Big-Fish-Little-Pond Effect Moderators

Moderator × School-Average Ability	Effect Size
Ability	
Linear ability	−.093
Quadratic ability	−.070
Socioeconomic status	
Highest in occupation	.020
Highest in education	−.011
Home educational resources	.022
Cultural possessions	−.024
Academic self-regulation	
Extrinsic motivation	.046
Intrinsic motivation	.019
Self-efficacy	−.067
Elaboration	.023
Memorization	−.157
Control strategies	−.039
Anxiety	−.192
Competitive orientation	−.021
Cooperative orientation	−.083
Sense of belonging	.041
Student-teacher relations	.021

memorization technique to a greater extent suffered a larger decline in mathematics self-concept than those who used the technique to a lesser extent. Although all students who used memorization had lower mathematics self-concepts if they attended high-ability schools than students of similar memorization usage who attended average- or low-ability schools, the drop in mathematics self-concept was more pronounced for students who used memorization to a greater extent. This is evidenced in the steeper slope for those who used memorization to a greater extent.

Behavior

Individual ability. As seen in Table 1, when examined as a BFLPE moderator, individual ability was significantly positively associated with mathematics self-concept (linear component = .520 and quadratic component = .118). The quadratic Individual Ability × School-Average Ability interaction was not statistically significant. However, the linear Individual Ability × School-Average Ability interaction was significantly negatively related to mathematics self-concept (−.048), with an effect size of −.093 (see Table 4). The negative effect of school-average ability was somewhat greater for more able students. The pattern of this interaction is shown in Figure 3. Students in high-ability

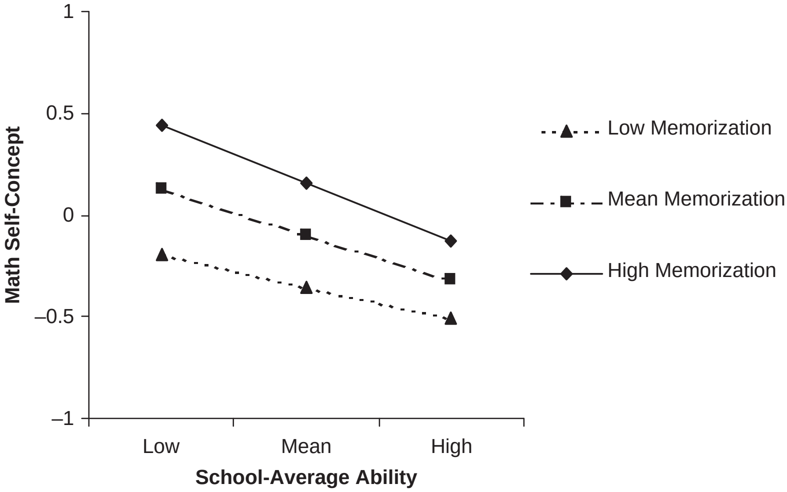

Figure 2. **Memorization × School-Average Ability.**
Note. Figure based on predicted values. High school-average ability = 1 standard deviation above the mean for school-average math ability; low school-average = 1 standard deviation below the mean. Similarly, high memorization = 1 standard deviation above the mean; low memorization = 1 standard deviation below the mean. Individual ability is held constant.

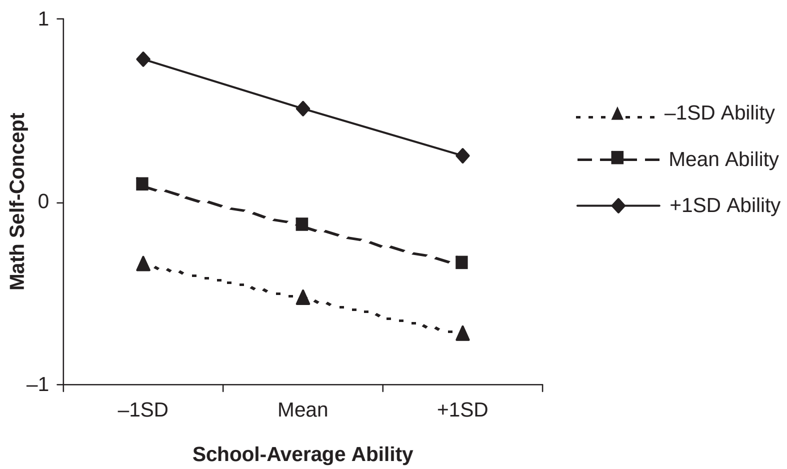

Figure 3. **Individual Ability × School-Average Ability.**
Note. Figure based on predicted values. High school-average ability = 1 standard deviation above the mean for school-average math ability; and low school-average = 1 standard deviation below the mean. Similarly, +1SD Ability = 1 standard deviation above the mean; −1SD Ability = 1 standard deviation below the mean.

schools had lower mathematics self-concepts than their equally able counterparts in average- and low-ability schools. However, larger BFLPEs were associated with high-ability students in high-ability schools. Although students of all ability levels had lower mathematics self-concepts if they attended high-ability schools than students of similar ability who attended average- or low-ability schools, the drop in mathematics self-concept was more pronounced for high-ability students. This is evidenced in the steeper slope for students whose ability was 1 standard deviation above the average ability level.

Anxiety. Mathematics anxiety had a large statistically significant negative association with mathematics self-concept (−.592; see Table 3). Students who were highly anxious had lower mathematics self-concepts. The mathematics anxiety interaction with school-average ability (−.097) had a statistically significant negative association with mathematics self-concept. The effect size associated with this interaction (−.192; see Table 4) was close to our .20 cutoff and so was deemed to be interpretable.

The pattern of results for the Mathematics Anxiety × School-Average Ability interaction (see Figure 4) indicated that in low-ability schools, students low in mathematics anxiety had higher mathematics self-concepts than students whose anxiety levels were average, who in turn had higher mathematics self-concepts than students high in anxiety. However, students who exhibited low mathematics anxiety had smaller BFLPEs. Their self-concepts were only slightly lower in average- and high-ability schools than in low-ability schools. Conversely, highly anxious students in high-ability schools had considerably lower mathematics self-concepts than highly anxious students in low-ability schools. Thus, as expected, a larger BFLPE was associated with highly anxious students compared to those who exhibited average or low anxiety levels.

Social

Competitive and cooperative orientations. Results indicated that both competitive and cooperative orientations had statistically significant positive relations with mathematics self-concept (.361 and .130, respectively), although this effect was stronger for those who espoused a competitive orientation. Students who reported a competitive or cooperative orientation had higher mathematics self-concepts. Having a competitive orientation did not moderate the BFLPE: Students in high-ability schools had lower mathematics self-concepts, irrespective of the extent to which they espoused a competitive orientation. Conversely, the Cooperative Orientation × School-Average Mathematics Ability interaction was statistically negatively associated with mathematics self-concept (−.050), with an effect size of –.083 (see Table 4). As this effect approached .10, we considered it to be worthy of description (see Figure 5). Compared to those who had a low cooperative orientation, larger BFLPEs were associated with students who had a high cooperative

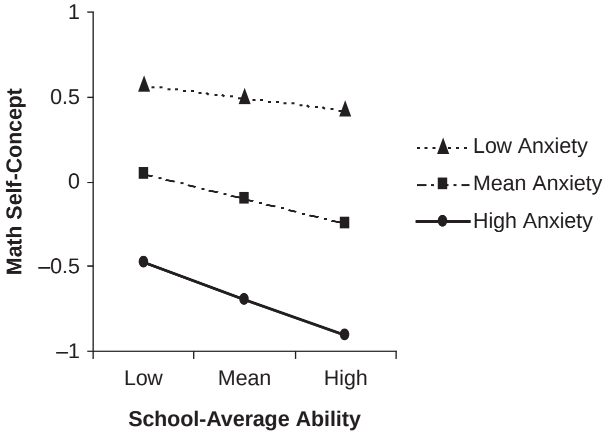

Figure 4. **Mathematics Anxiety × School-Average Ability.**
Note. Figure based on predicted values. High school-average ability = 1 standard deviation above the mean for school-average math ability; low school-average = 1 standard deviation below the mean. Similarly, high anxiety = 1 standard deviation above the mean; low anxiety = 1 standard deviation below the mean. Individual ability is held constant.

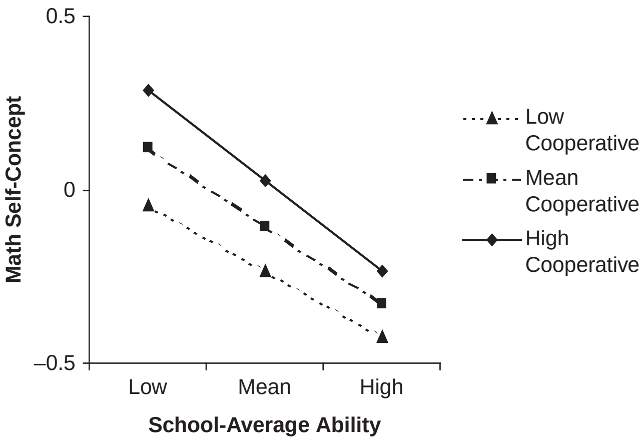

Figure 5. **Cooperative Orientation × School-Average Ability.**
Note. Figure based on predicted values. High school-average ability = 1 standard deviation above the mean for school-average math ability; low school-average = 1 standard deviation below the mean. Similarly, high cooperative = 1 standard deviation above the mean; low cooperative = 1 standard deviation below the mean. Individual ability is held constant.

orientation. Although all students who reported a cooperative orientation had lower mathematics self-concepts if they attended high-ability schools than students with similar levels of cooperative orientation who attended average- or low-ability schools, the drop in mathematics self-concept was more pronounced for students who reported a high cooperative orientation. This was evidenced in the steeper slope for these students.

Sense of belonging and student-teacher relationships. Results of the current study indicated that mathematics self-concept was positively associated with a greater sense of belonging to the school (.088) and a good relationship with teachers (.138; see Table 3). Contrary to predictions, the Student-Teacher Relations × School-Average Mathematics Ability interaction was not statistically significant. Irrespective of their perceptions of student-teacher relations in their schools, students in high-ability schools had lower mathematics self-concepts. However, as expected, a statistically significant positive interaction with school-average mathematics ability was demonstrated for a sense of belonging (.025; see Table 3). Nevertheless, when the effect size was calculated for this interaction, it was believed to be too small to be considered further (.041; see Table 4). Thus, it appears that the BFLPE is reasonably consistent across these two human interaction constructs.

Discussion

In the current study, within SES and academic self-regulation frameworks, particular individual student characteristics were assessed to determine if any could moderate the negative effects of the BFLPE. Although significant interaction effects were found for many of these potential BFLPE moderators, in light of the large sample size, some of them were considered too small to be practically important. For this reason we used effect sizes to determine which interactions were of substantive value. As a result, only four interaction effects were interpreted: The BFLPE was more pronounced for students who were more intelligent, who were highly anxious, who used memorization as a learning strategy, or who endorsed a cooperative orientation.

Socioeconomic Status

Results from the current study indicated that students from higher SES backgrounds had higher mathematics self-concepts. These findings are consistent with previous research that has linked higher SES levels with more positive educational outcomes and higher academic self-concept (e.g., Bachman & O'Malley, 1986; Marsh & Parker, 1984; OECD, 2001; Pong & Ju, 2000). However, the association between SES and mathematics self-concept in the current study was weak, suggesting that the contribution of SES to the prediction of mathematics self-concept, over and above that of individual ability, is minimal. When SES variables were tested as moderators of the BFLPE, only one of the SES interactions with school-average ability was statistically significant (cultural possessions) but not of any substantive importance given the large sample size. As such, these analyses provide evidence that the BFLPE generalizes well over different levels of SES. It appears that it does not matter whether students are from high- or low-income families; the BFLPE does not discriminate and affects students from all economic backgrounds. Previous research has demonstrated that the BFLPE is generalizable across economically developed and developing countries and collectivist and individualist cultures (Marsh & Hau, 2003; Seaton et al., 2009). The finding that it is also generalizable across levels of SES provides more evidence of the pan-human validity of the effect.

Academic Self-Regulation

Motive. In the present study, students felt more competent in mathematics if they were motivated to work in that subject, for either intrinsic or extrinsic reasons, or if they felt that they were able to succeed in mathematics. Consistent with previous research that has shown a positive association between academic self-concept and intrinsic motivation (Cokley et al., 2001; Gottfried, 1985, 1990; Valas & Sovik, 1993), students had higher mathematics self-concepts if they were intrinsically motivated. Previous research has also shown a positive relation between mathematics self-concept and academic self-efficacy (e.g., Marsh et al., 2006). This relation was also found in the current study. However, contrary to previous research (Cokley et al., 2001), students also had higher mathematics self-concepts if they were extrinsically motivated. In many schools there is an emphasis on external rewards, such as achievement certificates, best in subject awards, and trophies for dux of school. This emphasis may encourage students to be extrinsically motivated and so may explain this positive association between mathematics self-concept and extrinsic motivation.

As regards moderation, none of the motivation variables examined moderated the BFLPE. We had predicted that intrinsically motivated students would be less concerned with the accomplishments of others when forming their self-concepts and so would be buffered against the BFLPE. However, this was not the case: Being motivated intrinsically did not prevent students who attended high-ability schools from having lower self-concepts (the BFLPE). It appears that even although students find academic tasks intrinsically motivating, they may nevertheless use comparisons with others to form their self-concepts. And in high-ability schools, these comparisons may threaten their self-views, leading to the lower self-concepts associated with the BFLPE. Additionally, being motivated extrinsically did not buffer students against the BFLPE. Rewards are difficult to achieve in high-ability schools. So, it is possible that if extrinsically motivated students do not obtain the rewards that they need to keep themselves motivated, they may not feel they are achieving and so they may suffer declines in their self-concepts associated with the BFLPE.

Although the mathematics self-efficacy interaction with school-average ability was significant, the associated effect size was judged to be too small to be of any practical importance. Hence, we concluded that, contrary to predictions, the BFLPE generalized well across different levels of self-efficacy. Irrespective of one's level of self-efficacy, students who attended high-ability schools had lower mathematics self-concepts. It appears that feeling capable of succeeding does not buffer students against the negative effects of the BFLPE. Perhaps because students in high-ability schools are surrounded by so many intelligent students, they may feel that even although they are able to do the work, they are not as good as the others, thus contributing to the BFLPE.

Study methods. Consistent with previous research showing that students who use self-regulated learning strategies perform better academically (e.g., Pintrich et al., 1993; Zimmerman & Martinez-Pons, 1986), in the present investigation students had higher mathematics self-concepts if they said they used the learning strategies, elaboration, memorization, and control strategies. Perhaps students who use such strategies to a greater extent feel more in control of their learning and perform better and so consider themselves more able academically.

Results for BFLPE moderation indicated that the BFLPE was more pronounced for students who said they used a surface learning strategy, but the reported use of deep learning strategies did not moderate the BFLPE. The use of the surface learning strategy, memorization, was associated with higher mathematics self-concepts. However, if students who used this technique to a greater extent attended high-ability schools, they were more likely to have lower mathematics self-concepts than students in average- and low-ability schools who used memorization to a similar extent. Students who use memorization strategies use rehearsal techniques to learn material and so tend to learn by rote. Perhaps students in high-ability schools who learn by rote may not feel as confident about their abilities. In high-ability schools, school work may need to be addressed that cannot be solved using rote learning. In such circumstances students who use memorization techniques may often find themselves out of their depth, and this may be reflected in lower self-concepts (the BFLPE). Or, perhaps in high-ability schools, there are so many other high-achieving peers with whom to compare one's ability that students feel that their own abilities are inadequate and so resort to memorization techniques in order to try to perform well academically.

Irrespective of whether students reported using elaboration or control strategies to a greater or lesser extent, those in high-ability schools had lower mathematics self-concepts (the BFLPE). This finding was contrary to predictions. We had expected that students who reported using such strategies would have been deep learners, who would have been more confident in their learning, and who would have thus been buffered against the BFLPE. Although beyond the scope of the present investigation, it might be that students attending high-ability schools adapted different learning strategies to cope with the increased pressures of being in high-ability schools. In any case, the results of the present investigation provide no evidence that the use of surface or deep learning strategies protects against the BFLPE.

Behavior. In the present investigation, larger BFLPEs were associated with students of higher ability and with those who reported being more anxious. As regards ability, although higher-ability students had higher mathematics self-concepts if they attended high-ability schools, their self-concepts were lower than their high-ability counterparts in low- and average-ability schools. Although consistent with previous findings (Reuman, 1989; see also Seaton et al., 2009), research in this area has tended to produce conflicting results that are often small or nonsignificant. In the present case, considering the size of the sample, the linear interaction, although significant, was small, as was its associated effect size (<.10). Clearly, high ability does not provide protection from the BFLPE. For this reason, and because there appears to be no consistency in the direction or strength of the effect across studies, we concluded that, pending further research, the BFLPE generalizes across ability levels. Hence, consistent with previous research (e.g., Marsh et al., 1995; Marsh & Hau, 2003), this result suggests that the BFLPE affects all students, irrespective of their ability level. This finding is also consistent with BFLPE theory, which predicts that the BFLPE is largely invariant across ability levels (see Marsh, Seaton, et al., 2008, for a fuller discussion of this point).

Students who were highly anxious about their mathematics studies had lower mathematics self-concepts, a finding consistent with research demonstrating a negative relation between anxiety and ability perception, a construct similar to self-concept (Meece et al., 1990). As regards moderation, anxiety negatively moderated the BFLPE. Compared to those who exhibited average or low anxiety levels, larger BFLPEs were associated with highly anxious students. Thus, highly anxious students had lower mathematics self-concepts, but this association was stronger for those students who attended high-ability schools. This finding has intuitive appeal. Students who are highly anxious about their academic performance may not achieve to their potential. If they are not performing to their best, anxious students may feel negative about their abilities, and this may be compounded if they attend a high-ability school where they are surrounded by high-achieving peers. The result may be a lower academic self-concept—the BFLPE. Alternatively, being in a high-ability school may produce feelings of anxiety. Although it was not possible to test the causal relation between the two in the present investigation, these findings suggest that the association between anxiety and the BFLPE is an important avenue to pursue.

Social. All the social constructs examined had a positive association with mathematics self-concept. Consistent with previous research demonstrating that both types of orientations are associated with good performance (OECD, 2001), students who reported higher cooperative and competitive orientations had higher mathematics self-concepts. This was also the case for students who indicated a higher sense of belonging and more positive relations with teachers. These latter findings are consistent with previous research that has demonstrated that these constructs are related to better educational and mental health outcomes (Crosnoe et al., 2004; Ozer, 2005; Wentzel, 1999; Woolley et al., 2009).

As regards moderation, none of the social constructs examined protected students against the negative effects of the BFLPE, with one construct (cooperative orientation) being associated with larger BFLPEs. Students in high-ability schools with a cooperative orientation had lower mathematics self-concepts than students in average- and low-ability schools who endorsed a similar cooperative orientation. Although not a large interaction effect, this finding suggests that cooperatively oriented students may be more prone to the negative effects of the BFLPE. These students enjoy working and sharing ideas with others. They may simply prefer to work with others, but alternatively it may be that attending a high-ability school, where there is much competition, may foster yearnings to work more cooperatively in some students. Although the present investigation was unable to demonstrate causality, this is an important direction for future research. Moreover, the competitive spirit that may be fostered in high-ability schools may be especially distressing for students who prefer to work cooperatively. In this case, there may be no fit between the person and the environment, with the result that these students perceive themselves to be less competent.

Concerning the remaining social relationship constructs, irrespective of one's level of competitive orientation, sense of belonging to school, or relationship with teachers, students in high-ability schools had lower mathematics self-concepts (the BFLPE). It appears that although students may report a competitive orientation, those students who actually attend the competitive environment of a high-ability school feel less able. Moreover, we had argued that more positive relations with peers and teachers might reduce the BFLPE, but this did not occur. Perhaps these results are not so surprising. Recent research has shown that the BFLPE is based on comparisons with classmates (Huguet et al., 2009). People can have positive relationships with others, enjoy competing with them, and even feel connected to them but still compare to them and feel dejected about their abilities. This may be what is occurring in this instance. Additionally, if classmates are the most important people in the formation of the BFLPE, then this may explain why relationships with teachers had no influence on the BFLPE. Hence, it appears that it does not matter how positive students' social relationships are, attending a high-ability school still has a negative effect on how they view their abilities.

Implications for Practice, Strengths, Limitations, and Areas for Future Research

Taken together, these results have important implications for practice. For example, schools in which primarily high-ability students are enrolled should be conscious that anxiety might aggravate the BFLPE and endeavor to create environments where anxiety is reduced. Especially given that higher levels of anxiety have been linked with lower achievement (e.g., Chapell et al., 2005; Martin, 2003; Zeidner & Schleyer, 1998), these matters should be given priority. Moreover, perhaps interventions aimed at students who prefer to work cooperatively may allow them to cope with the competitive environment of a high-ability school. Additionally, the BFLPE may be counteracted by strategies that reduce reliance on memorization as a learning strategy. Educators and researchers should also focus on explicating why the BFLPE was not moderated by learning strategies such as elaboration and control strategies, intrinsic motivation, or self-efficacy. As these are significant constructs in producing beneficial academic outcomes, the reasons why they do not protect against the BFLPE may provide important information on which to base future interventions. Teachers and policymakers should also not assume that only students from a certain type of economic background or only low-ability students suffer the negative effects of the BFLPE. Our research shows that students of all backgrounds and ability are susceptible. Hence, any intervention strategies should focus on students from all types of economic backgrounds and of all ability levels. However, given that self-concept is central to the BFLPE, strategies that focus on enhancing students' self-concepts in specific subject domains (see O'Mara, Marsh, Craven, & Debus, 2006) and that serve to protect rather than undermine self-concept offer the most potent practical potential for counteracting the BFLPE.

A major strength of the present investigation lies in the breadth of its coverage of BFLPE moderators. Apparently, no previous research has examined so many diverse constructs (n = 16) as potential BFLPE moderators together in a single study. In doing so, the present investigation has addressed one of the main criticisms raised by Dai and Rinn (2008) and one of the limitations of the BFLPE literature. The use of multilevel modeling is another significant strength of the present investigation. Multilevel modeling can account for nested data, such as the data in the present investigation in which individuals were nested within schools and schools nested within countries. By accounting for this multilevel structure, problems such as violations of the assumption of independence and heterogeneity of regression can be avoided.

Despite the strengths of the present investigation, there are also important limitations. An obvious limitation is that the study was based on a single wave of data so that interpretation of effects should always be made cautiously. For example, in the case of anxiety, it is unknown from the current study whether students entered high-ability schools with existing high levels of anxiety or whether anxiety was increased due to attending a high-ability school. Such limitations could be overcome, at least in part, by longitudinal causal modeling studies in which students are assessed on these variables before they attend schools that differ substantially in terms of school-average ability. Countries such as Germany and Hong Kong would be ideally suited to this type of research. In these countries students are educated in reasonably heterogeneous primary schools and continue their education in highly academically segregated (homogeneous) high schools. Students could be assessed in their last year of primary school and then during the course of their high school education. In this way causality could be evaluated (see Gröbel & Schwarzer, 1982; Marsh, Kong, & Hau, 2000).

Moreover, other confounding variables not considered here (e.g., school expenditure levels, teacher characteristics, and other individual student characteristics) are likely to have an impact upon academic performance and school climate, and these likely vary greatly across the many schools included in this sample. However, it is worthwhile noting that the conditions typically considered conducive to effective learning, such as school resources, small class sizes, and better paid and more highly qualified teachers, are likely to be better in higher-ability schools than in lower-ability schools (Marsh & Hau, 2003). Controlling for such variables would thus be more likely to increase the size of the negative effect of school-average ability because we would be better able to disentangle the full BFLPE. As Marsh and Hau (2003) noted, "potential biases are likely to be conservative in relation to the negative BFLPE" (p. 374).

On a related point, no school policy or school practice variables were included in the present investigation. Although the BFLPE is concerned with the social comparison processes associated with school-average ability, rather than what actually occurs in the schools, there may be systematic policy or practice differences in higher-ability schools that lead to observed differences, and it is possible that these policies could vary greatly across different countries. We acknowledge that some policies, such as those that encourage competitiveness, are more likely to foster negative social comparisons and are usually more common in higher-ability schools, and so there could be some confounding of the effects (see Marsh & Craven, 2002; Marsh, Seaton, et al., 2008).

Areas for future research include studies to test the effectiveness of different learning strategies in high-ability schools and the causal relation between the two. Apart from reducing academic self-concept, attending a high-ability school may have a negative impact on how students learn. As suggested by an anonymous reviewer, an interesting avenue to explore is why constructs such as elaboration, intrinsic motivation, and self-efficacy are unable to overcome the comparison processes thought to lie at the heart of the BFLPE. Further avenues for future research could include further exploration of the psychological underpinnings of the BFLPE—in particular, the role that social comparison plays in the BFLPE. Although this was begun in recent studies by Seaton et al. (2008) and Huguet et al. (2009), there are still many questions regarding the relation between social comparison theory and the BFLPE that remain unanswered. Perhaps too, qualitative studies should be undertaken to elucidate the processes underlying the BFLPE. For example, interviews could be conducted with students in high-ability schools and with equally able students in average- and low-ability schools. These interviews could focus on social comparison processes and on how students think and feel about their academic abilities. In this way the processes underlying the BFLPE might be unpacked.

Conclusions

We have emphasized that generalizability and moderation are two sides of the same coin. In relation to the BFLPE, generalizability implies that the effect is robust and consistent across diverse individual student characteristics. Increasing support for the generalizability of the BFLPE provides support for the theoretical basis of the BFLPE. In the present investigation, the BFLPE generalized across SES and most of the constructs examined within four dimensions of an academic self-regulation framework, particularly across those constructs that are normally associated with beneficial educational outcomes. Irrespective of a student's SES, motivation, use of metacognitive and deep learning constructs as methods of self-regulation, ability, or whether they reported positive social relationships with peers and teachers, students in high-ability schools suffered the BFLPE. However, significant moderators of the BFLPE have important implications in terms of better understanding the BFLPE and how to ameliorate its negative consequences for students attending academically selective schools. With respect to the moderators studied here, when the BFLPE was moderated, it was in a negative direction. The BFLPE was worse for students who used surface learning as a method of self-regulation, who reported more anxious behavior, and who endorsed a cooperative social orientation. Overall, results from the present investigation provide support for the generalizability of the BFLPE and suggest that students are more similar than different in relation to the BFLPE. It appears that both sides of the BFLPE coin contain the same image: that of generalizability.

Appendix
Description of Constructs

Socioeconomic Status

Socioeconomic status was measured using information about parental occupation, parental education, and possessions within the home. The parental occupation measure was based on the higher occupational status: either the mother's or the father's. Higher scores represent higher levels of parental income. When standardized across the entire sample to have a mean of 0 and a standard deviation of 1, this index ranged from −1.82 to 2.49. The parental education measure was based on whichever educational level was higher, the mother's or father's. Higher scores represent higher levels of parental education. This index was standardized ($M = 0$, $SD = 1$) across the entire sample for subsequent analyses and ranged from −2.36 to 1.16. Details of the home educational resources scale and the cultural possessions scale are shown in Table A1. These details include number of items, an example item, reliability, the response scales, range of scores, and the meaning of a high score. Both scales were standardized across the entire sample ($M = 0$, $SD = 1$).

Academic Self-Regulation

Academic self-regulation was measured using 12 constructs that assessed four dimensions: motive, method, behavior, and social. Table A1 provides details of the constructs used, including number of items, a sample item, reliability, the response scales, range of scores, and the meaning of a high score. All scales were standardized across the entire sample ($M = 0$, $SD = 1$).

Table A1
Summary of Key Features of Constructs

Dimension: Scale	Items (n)	Cronbach's α	Sample Item	Response Scale	Standardized Scores (Range)	Meaning of a High Score
Socioeconomic status						
Home Educational Resources	5	.58	"In your home do you have books to help with your schoolwork?"	*Yes* or *no*. All items inverted for scaling.	−0.39, 0.74	A high score reflects higher SES levels.
Cultural Possessions	3	.67	"In your home do you have books of poetry?"	*Yes* or *no*. All items inverted for scaling.	−1.18, 1.44	A high score reflects higher SES levels.
Academic Self-Regulation						
Study methods						
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: 1 (strongly agree), 4 (*strongly disagree*). All items inverted for scaling.	−3.57, 2.64	A high score indicates a preference for this learning strategy.
Memorization	4	.59	"When I study for mathematics, I try to learn the answers to problems off by heart."	4-point Likert scale: 1 (*strongly agree*), 4 (*strongly disagree*). All items inverted for scaling.	−3.62, 3.22	A high score indicates a preference for this learning strategy.

(continued)

Table A1 **(continued)**

Dimension: Scale	Items (*n*)	Cronbach's α	Sample Item	Response Scale	Standardized Scores (Range)	Meaning of a High Score
Elaboration	5	.76	"When learning mathematics, I try to relate the work to things I have learnt in other subjects."	4-point Likert scale: 1 (*strongly agree*), 4 (*strongly disagree*). All items inverted for scaling.	−3.41, 3.10	A high score indicates a preference for this learning strategy.
Motive						
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: 1 (*strongly agree*), 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: 1 (*strongly agree*), 4 (*strongly disagree*). All items inverted for scaling.	−1.94, 2.30	A high score indicates higher levels of interest and enjoyment in math.
Math Self-Efficacy[a]	8	.82	"How confident do you feel about . . . solving an equation like $2(x+3) = (x+3)(x-3)$?"	4-point Likert scale: 1 (*very confident*), 4 (*not at all confident*). All items inverted for scaling.	−4.00, 2.64	A high score indicates confidence with mathematical tasks.
Behavior						
Math Anxiety	5	.81	"I get very nervous doing mathematics problems."	4-point Likert scale: 1 (*strongly agree*), 4 (*strongly disagree*). All items inverted for scaling.	−2.70, 2.72	A high score indicates a higher level of math anxiety.

(continued)

Table A1 **(continued)**

Dimension: Scale	Items (n)	Cronbach's α	Sample Item	Response Scale	Standardized Scores (Range)	Meaning of a High Score
Social						
Cooperative Orientation	5	.78	"In mathematics I enjoy working with other students in groups."	4-point Likert scale: 1 (*strongly agree*), 4 (*strongly disagree*). All items inverted for scaling.	−3.29, 2.73	A high score indicates a preference for a cooperative learning environment.
Competitive Orientation	5	.84	"I would like to be the best in my class in mathematics."	4-point Likert scale: 1 (*strongly agree*), 4 (*strongly disagree*). All items inverted for scaling.	−3.04, 2.39	A high score indicates a preference for a competitive learning environment.
Student-Teacher Relations	5	.79	"Students get along well with most teachers."	4-point Likert scale: 1 (*strongly agree*), 4 (*strongly disagree*). All items inverted for scaling.	−3.15, 2.72	A high score indicates more positive perceptions of student-teacher relations.
Sense of Belonging	6	.78	"I make friends easily."	4-point Likert scale: 1 (*strongly disagree*), 4 (*strongly agree*). Three items inverted for scaling.	−3.40, 2.27	A high score indicates that the student feels more connected to the school.

[a]In the 2000 Program for International Student Assessment database, the self-efficacy measure was akin to self-concept. However, in the 2003 database (used in the current study), the self-efficacy measure is quite different from self-concept, being based more on absolute standards as shown in the sample item. The moderator, individual ability, is described within the text.

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