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Big-Fish-Little-Pond Effect on Gifted Students' Academic Self-Concepts: What If the Big Fish has Adaptable Academic Self-Concepts?

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Abstract

According to the big-fish-little-pond effect (BFLPE), equally able students would have lower academic self-concepts in high-ability settings than those who attend low- or mixed-ability settings. This study was an investigation of the BFLPE on math and science academic self-concepts of gifted students. Participants included 50 fifth- and sixth-grade gifted students who participated in an after-school program for gifted students (EPTS) at a university campus for five terms. Students' academic self-concepts were measured using the Math and Science Academic Self-Concept Questionnaire both in the EPTS setting and in the school setting in three measurement points. Findings showed that gifted students' academic self-concepts declined significantly from time 1 measurement to time 3 measurement. However, the level of their academic self-concepts was still high in the EPTS and very high in school. The main effect of setting showed that the overall academic self-concept in school (*M* = 34,24; *SD* = 2,26) was significantly higher than the mean of academic self-concepts in the EPTS (*M* = 31,49; *SD* = 3,87). They used the EPTS and school as two different frames of reference and thus held adaptable academic self-concepts, relatively low in the EPTS and relatively high in school.

Keywords

Big-fish-little-pond effect

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Introduction

In a pioneering study, Marsh and Parker (1984) put forward the big-fish-little-pond effect hypothesis (BFLPE) to refer to the negative effect of selective schools on students' academic self-concepts. According to this hypothesis, high-ability students who attend high-ability classrooms or schools have lower academic self-concepts than their equally able peers who attend mixed-ability classrooms or schools. Academic-self concepts can be defined as people's beliefs, perceptions and emotions about their competence and achievement (Byrne & Shavelson, 1986; Marsh & Craven, 2006). People shape their academic self-concepts based on a comparison of their achievment to others (Festinger, 1954).

The BFLPE hypothesis is grounded on the social comparison theory. The social comparison theory proposes that people are inclined to evaluate themselves with comparisons to others. They develop self-concepts based on this self-evaluation (Festinger, 1954). Similarly, they compare their abilities and achievement in comparison to their immediate environment or their peers. According to this theory, academic self-concepts are formed on social or peer comparisons of self-perceived achievement or ability to a frame of reference (Marsh, 1984, 1987; Marsh & Parker, 1984). The same level of ability or achievement can lead to dissimilar academic self-concepts depending on frames of reference students use to evaluate their own ability (Huguet et al., 2009; Liem, Marsh, Martin, McInerey, & Yeung, 2012; Marsh, 1984, Marsh, Trautwein, Lüdtke, Baumert, & Köller, 2007; Marsh et al., 2008).

According to the BFLPE hypothesis, students construct their academic self-concepts based on a comparison of the achievement of their classmates (Marsh & Hau, 2003). They usually use the mean of the academic achievement in the classroom as the frame of reference. Therefore, if they have a higher achievement than the class mean, they will develop higher academic self-concepts, whereas they will have lower academic self-concepts if they are brought together with high achieving students in the same classroom. However, the frame of reference for comparisons can be internal or external. External references make students to compare themselves with their peers while students who use internal references compare their own performance across courses (Bruner & Haste, 2010; Dickhäuser, 2005).

This social comparison process using different frames of reference can result in contrast effects (negative social comparisons) and/or assimilation effects (positive social comparisons). A contrast effect occurs when school- or classroom-average-achievement leads to lower academic self-concepts. Conversely, an assimilation effect occurs if school- or classroom-average-achievement leads to higher academic self-concepts (Marsh, 1984). For example, students will have low academic self-concepts when they compare their ability to students with higher ability (contrast effect). Conversely, students are likely to have high academic self-concepts if they compare their ability to low-ability students (assimilation effect). Marsh (1987) further argued that the size of the contrast effect varies according to contextual differences. Large differences in school-average-achievement should lead to large contrast effects. Similarly, large differences in individual ability should result in large assimilation effects for individuals with higher ability.

Although the original BFLPE study (Marsh & Parker, 1984) was not in relation to effects of participation in gifted education programs on academic self-concepts, it implicitly referred to possible negative effects of grouping in gifted education. In the study, Marsh and Parker examined academic self-concepts of sixth-grade students from five schools in Australia. Three of these schools had a high socioeconomic status (SES), whereas two schools had low socioeconomic status in comparison to schools in their regions. The high SES students had a mean IQ of 109 and the low SES students' mean IQ was 96. Their findings showed that even though individual ability had a positive effect on academic self-concepts, after individual ability was statistically controlled, school-average ability had a negative effect on students' academic self-concepts, which they called a "BFLPE." They hypothetically concluded that students in the high-ability classrooms would have lower academic self-concepts if individual ability is controlled, because, students use classmates as a frame of reference to evaluate their own ability.

Since the pioneering work of Marsh and Parker (1984), the BFLPE hypothesis has been tested across different educational settings, ability levels, and countries and has been partially supported (e.g., Demirel, 2019; Huguet et al., 2009; Ireson & Hallam, 2009; Kavanagh, 2020; Liem et al., 2012; Marsh, Chessor, Craven, & Roche, 1995; Marsh, Kong, & Hau, 2000; Marsh & O'Mara, 2010; Marsh et al., 2007; Seaton, Marsh, & Craven, 2009; Seaton, Marsh, Parker, Craven, & Yeung, 2015; Zeidner & Schleyer, 1999; Zhou, 2018). A hypothetical implication of the BFLPE is that effects of gifted education programs can be detrimental rather than beneficial for gifted students because of a reciprocal relationship between academic achievement and academic self-concepts (e.g., Guay, Marsh, & Boivin, 2003; Valentine, DuBois, & Cooper, 2004) and because of negative effects of school-average ability on educational and occupational aspirations after high-school graduations (Marsh & O'Mara, 2010; Marsh et al., 2007; Nagengast & Marsh, 2012).

Big-Fish-Little-Pond Effect on Gifted Students' Academic Self-Concepts

One of the major goals of gifted education programs is to support academic achievement of gifted students through delivering enriched and accelerated education in different grouping settings, such as special schools, self-contained classrooms, and after-school programs. Benefits of these programs have been investigated and proved in a number of studies, including meta-analyses (Kulik & Kulik, 1992; Shields, 2002; Steenbergen-Hu & Moon, 2011; Steenbergen-Hu, Makel, & Olszewski-Kubilius, 2016; Tieso, 2005). However, the controversy about the effect of gifted education programs on students' academic self-concepts has gained much attention since the first BFLPE study on gifted education was published by Marsh et al. (1995). This research included two studies in Australia. Researchers compared academic self-concepts of two groups of high-ability students. The first group was recommended by their teachers as high-ability students for a full-time gifted and talented class. The comparison group was matched on grade, gender and achievement with gifted students. Students' academic self-concepts were measured using the Self-Description Questionnaire (Marsh et al., 1995) three times within a school-year. Their findings showed a steady decline in math, reading and school academic self-concepts of students who were in the full-day class, but those who were in the mix-ability classes did not have any declines. In the second study, gifted students were placed in a full-time class. Students in the comparison group were identified by their teachers based on students' achievement and IQ (at least 117). These students were enrolled in mix-ability classes in different schools. Results of this study also showed a decline in academic self-concepts in math, reading and school for students who were in the full-day class. Because, in both studies, group differences in academic self-concept changes did not interact with initial ability, Marsh et al. (1995) concluded that participation in high-ability classes led to declines in academic self-concepts for students of all ability.

The findings of the first BFLPE study on gifted students should be interpreted with cautions because the study had several limitations that weaken their generalizability, as stated by the authors, such as sample size, student identification and matching the experimental and comparison groups (Marsh et al., 1995). A limitation that was overlooked by the authors was that age heterogeneity was greater in the experimental group than the comparison group and that might have been a factor influencing the results. Students' age ranged from as young as 9 to as old as 12 in the experimental class, because the class was composed based on ability and age. On the other hand, students of the comparison group attended different mix-ability classes in different schools. Although age range and mean age of these classes were unknown, presumably, these classes were composed based on age just like most regular classes are composed all around the world because age is the major criteria for student placement in classrooms. We can only assume that each of these classes had students as young as 9-year old and as old as 12-year-old to make a perfect match with the experimental class. Because the composition of the high-ability group was quite heterogeneous in terms of ability and socioemotional development as a result of great variation in age, it is reasonable that one can expect significant variations (too highs and too lows) in academic self-concepts.

The second important limitation of the first BFLPE study on gifted students (Marsh et al., 1995) was the uncertainty of the frame of reference. In this study, students were asked to respond declarative sentences (e.g., I am good at mathematics). Whether students both in the experimental group and in the comparison group compared their ability to their classmates, to school-average-ability, or to other peers outside the school setting was unknown. This uncertainty complicates the results of the study because the BFLPE hypothesis was theorized based on social comparison theories (e.g., Marsh & Parker, 1984; Liem et al., 2012), but the comparison standard (frame of reference) students used in the study to evaluate their own achievement can only be assumed to be their classmates. Consider, for instance, the following classmates who have the same level of achievement. While one student might use the class-average-ability as a frame of reference, another student could consider the performance of the top student in the class, and the third student could make a decision based on the school-average achievement as a comparison standard. That is, even though they have the same level of achievement, their academic self-concepts would differ substantially because comparison standards students use are different. In response to such criticisms (e.g., uncertainty in frame of reference), alternative frames of reference were recently proposed by Marsh and colleagues (Huguet et al., 2009; Liem et al., 2012). However, the first BFLPE study on gifted students still remains controversial because of certain limitations as reviewed here and criticized by other researchers (e.g., Dai, 2004; Dai & Rinn, 2008; Dai, Rinn, & Tan, 2012).

Since the publication of the original study, the BFLPE has been tested in different educational settings, including cross-national studies that may be directly or indirectly related to gifted education. For example, Marsh et al. (2000) carried out research on a nationally representative sample of about 8,000 students in over 40 high schools in Hong Kong. They measured students' academic self-concepts starting at sixth grade through 9^{th} grade. Their results showed a negative effect of school-average achievement on students' academic self-concepts. Likewise, Zeidner and Schleyer (1999) investigated the BFLPE with Israeli gifted students participating in either mix-ability classes or self-contained special classes for gifted students. Their findings showed that gifted students in mix-ability classes had higher general academic self-concepts than did gifted students in special classes. Marsh and Hau (2003) tested the BFLPE in a cross-national study in 26 countries, with nationally representative samples of about 4000 students from each country. In the study, individual-student-achievement and school-average-achievement were found to be related to academic self-concepts. The effect of individual-student-achievement on academic self-concepts was significant while school-average-achievement had less but negative effect. Even if the study included any gifted students was not known, Marsh and Hau claimed that educating gifted students in academically selective settings causes a decrease, not an increase in their academic-self concepts.

Another line of research was carried out in Turkey, China and Ireland. For example, Demirel (2019) investigated the BFLPE on 4273 high school students. Contrary to the BFLPE hypothesis, she found that students who attended high-achieving schools held higher academic-self concepts than did students who attended schools that had low or average achievement. However, she also found that after controlling individual achievement level, school achievement level had a negative effect on students' academic self-concepts. Zhou (2018), compared 429 university students' academic self-concepts after they were accepted by a prestigious university in China. Students' academic self-concepts slightly declined eight weeks after they began the university. In Ireland, Kavanagh (2020), explored that academic self-concepts were positively influenced by individual achievements whereas negatively influenced by classroom-level-achievement in math and English in sixth-grade students.

The BFLPE hypothesis has been criticized strongly by opponents in the field of gifted education for a number of reasons. First, participation in gifted education programs has been found to increase academic achievement substantially (e.g., Kulik & Kulik, 1992; Shields, 2002; Steenbergen-Hu & Moon, 2011; Steenbergen-Hu et al., 2016; Tieso, 2005). Second, as reviewed before, most gifted students participating in gifted education programs have been found to have high levels of academic self-concepts. Third, academic self-concept is associated with academic achievement; that is, a high academic achievement should lead to a high academic self-concept. That is, gifted students do not necessarily experience the BFLPE when they participate gifted education programs. Dai and his colleagues made one of the strongest critics against the BFLPE (Dai, 2004; Dai & Rinn, 2008; Dai et al., 2012). They argued that the BFLPE should be reevaluated and re-conceptualized based on an analysis of who are most likely to have BFLPE (person), when is BFLPE likely to occur (time), and which settings promote BFLPE to happen (place). In their longitudinal study with gifted students participating in summer programs for gifted students, Dai and his colleagues found no prevalent patterns of decreases in academic self-concepts. Besides Dai's research, a scientific support for Dai's critics comes from an early research done by Coleman and Fults (1985) on self-concepts of gifted students who were placed in special classes. Their findings showed gifted students in the top half of their gifted classes to have little or no decline in their self-concepts. In another study, Preckel and Brüll (2010) compared effects of class-average ability and class type on math academic self-concept with 722 fifth-grade students in a full-time ability grouping at the top track of the German high school system. They found higher class-average-ability to be associated with lower academic self-concepts after controlling for the positive effect of individual ability (contrast effect). Class type had a positive counterbalancing effect (assimilation effect). Yet, these effects were similar in size in gifted classes. They concluded that there was not an evidence for the BFLPE.

The present study differs from previous studies both in terms of methodology and sample characteristics. A single frame of reference was used in previous studies, whereas two frames of reference were used in this study, one in school and another in gifted education program. Contrary to previous studies that included gifted students identified through the measurement of general intellectual giftedness, this study employed students who had special talents in domains (math and science) in which their academic self-concepts were studied. That is, the big-fish-little-pond effect was investigated on math and science academic self-concepts of students who were identified to be talented in math and science (person) and who attended an advanced math and science program in an after-school program for gifted students at a university campus (place) for five terms (time) while they were attending mixed-ability classes in regular schools (place). Students' academic self-concepts were measured in math and science as perceived by students both in their schools and in the gifted education program at three points. In the current study, we developed three hypotheses:

1. Gifted students participating in an after-school gifted education program while attending regular schools would show *adaptable academic self-concepts* because they could develop different academic self-concepts as a result of contrast and assimilation effects in different settings over time. That is, their academic self-concepts would differ in school and in the gifted education program and be significantly higher in school than in the gifted education program.
2. Their academic self-concepts decline in the gifted education program after they begin the program (contrast effect; Marsh, 1987).
3. Their academic self-concepts increase in school as a result of being admitted to and attending the gifted education program (assimilation or reflected glory effect; Marsh, 1987).

Method

Research Design and Procedures

A time-series research was designed to investigate any changes on gifted students' academic self-concepts as perceived by students in science and math in both their schools and the EPTS (Research and Practice Center for High-Ability Education at Anadolu University in the City of Eskisehir, Turkey). The ASCQ-MS (Math and Science Academic Self-Concept Questionnaire) was used to measure academic self-concepts. Two different forms of the ASCQ-MS were used, one for the school and one for the EPTS, to make sure that students used two different frames of reference to compare themselves to two different groups. The only difference between the two forms was in the instruction. In the school form, students were asked to evaluate themselves compared to their peers in their schools. In the EPTS form, students were asked to compare themselves to their classmates in the EPTS.

The ASCQ-MS was administered to students on three occasions (time 1, time 2, and time 3). Students began the EPTS programs in the first week of the 2015 Spring term one week after they were identified and got admissions. The ASCQ-MS for school was administered to all students in the first week of the program (school time 1). They were asked to evaluate themselves relative to their peers in their schools. In the second week, students completed the ASCQ-MS for the EPTS (gifted time 1). They were asked to evaluate themselves relative to their peers in the EPTS. While students were participating in the EPTS programs on the weekends and summers, they were at the same time attending their schools during the weekdays. After students took 24 hours of math and 24 hours of science instructions in the EPTS on eight weekends (end of Spring term), the ASCQ-MS for school and the EPTS were administered again (time 2) in the same order they were administered as pretests. After the time 2 assessment, students took 30 hours of instruction both in science and math in a two-week summer program in 2015, 30 hours of instruction in both courses in the following Fall term, 28 hours of instruction in both courses in the Spring term of 2016 and 30 hours of instruction in both courses in the 2016 summer program. At the end of the 2016 summer program, the ASCQ-MS for school and for the EPTS was administered to students as the last assessment (time 3). In total, students took 276 hours of math and science instruction during a seventeen-month period, from the 2015 Spring term to the end of 2016 Summer term.

Participants

The initial sample included 56 gifted students. Because six students did not participate in one of the three measurements, the final sample consisted of 50 students who were attending fifth (N= 23; female= 9, male= 14) and sixth grades (N= 27; female = 9, male = 18) in middle schools and who were, at the same time, participating in gifted education programs at the EPTS Center (Research and Practice Center for High-Ability Education) at Anadolu University in the City of Eskisehir, Turkey. Students came from different schools. Of the total sample, 30 students were enrolled in public schools and 20 in private schools. They were identified through the standard identification and admission processes of the EPTS in the beginning of the Spring term of the school year 2015.

The identification and admission of gifted students for the EPTS Center include the following standard steps: First, towards the end of each year, all public and private schools within the city are informed about the entry exams of the EPTS. Students attending the fifth grade, first year of middle school, are recommended by their teachers, school counselors or parents to apply for the entry exams (In 2015, both fifth and sixth graders applied to the Center). The number of applicants is about 700 each year, which is 6% of all the fifth graders within the city. Only 28 of applicants are admitted to the EPTS which is equal to 4% of all the applicants and 0,002% of all the fifth graders within the city. That is, the EPTS admission is very competitive as only 0,002% of all students within the city are identified to be talented in math and science and admitted to the program. The admission decision is made based on students' performance on the Test of Mathematical Talent (TMT) and Creative-Scientific Ability Test (C-SAT). All applicants take both tests in two sessions on the University Campus. Tests are group-administered. The TMT is a multiple-choice test measuring mathematical ability of fifth through eighth graders. Its internal consistency reliability was found to be 0,80. The correlation between the TMT scores and grade in mathematics course ranged from 0,50 to 0,69. Significant performance differences were found among grades, showing developmental evidence (Sak, 2007; Sak et al., 2008). The C-SAT is composed of open-ended problems and measures creativity in science for fifth through eighth grade students. The interscorer reliability of the C-SAT was reported to range from 0,87 to 0,96. Internal consistency ranged from 0,85 to 0,87 in two studies. Mathematically gifted students scored significantly higher than average students on the C-SAT. Correlations between the C-SAT scores and science and math courses ranged from 0,31 to 0,36. (e.g., Ayas & Sak, 2014; Bermejo, Ruiz-Melero, Esparza, Ferrando, & Pons, 2016; Sak & Ayas, 2013).

Setting

The EPTS offers enriched and accelerated programs in mathematics and the sciences for gifted students from the fifth grade to the eighth grade on the main campus of Anadolu University. The EPTS has a standard curriculum in science and math in grades 5 through 8 and its effectiveness on gifted students' academic development was reported in a number of studies (Sak, 2011, 2013, 2016). The courses are taught by the academic staff of the University on the weekend and summer programs in three semesters each year (Fall, Spring and Summer). In total, students take 168 hours of math and science instruction in self-contained classrooms each year.

Instruments

Besides the C-SAT and the TMT used in the identification, the ASCQ-MS (Math and Science Academic Self-Concept Questionnaire) was used to measure students' academic self-concepts in math and science. The ASCQ-MS was constructed in Turkish language, using item structures developed by Marsh to construct academic self-concept items for the Academic Self-Description Questionnaire (ASDQ) (Marsh, 1990). The ASDQ has been used in most studies conducted by Marsh and his colleagues to examine the big-fish-little-pond effect (e.g., Marsh et al., 1995).

First, using the item structure in the ASDQ math and science parts, 12 items were adapted by the authors of this study. Then, an agreement was made on whether the items reflected in Turkish the original items. Then, the items were reviewed by experts to examine its content appropriateness and language. The ASCQ-MS had two scales (math and science) and each scale included six items. The questionnaire had 12 items in total. Parallel wording was used in the six items for both math and science scales. Because we used parallel wording in the 12 items, we report the six items only used in math. The items in the science scale is also the same, except the subject name. The six items in the math scale were the followings: 1) I am good at mathematics compared to others at my age; 2) I learn mathematics quickly; 3) I always have achieved well in mathematics; 4) I get good grades in mathematics; 5) Mathematics is easy for me; and 6) I am poor in mathematics. A 6-point Likert-type scale was used to rate each item in the Questionnaire (1 = definitely false to 6 = definitely true). Before conducting the current study, the reliability of the ASCQ-MS was investigated with 95 fifth and sixth grade students attending mix-ability classes in public schools. The reliability coefficients were found to be 0,93, 0,89, and 0,95 for the three scores (science, math, and the total scale respectively). In the current study, the reliability was estimated for all measurement points (time, 1, 2, and 3) in science and math in school and the EPTS. The reliability coefficients ranged from 0,80 (school science time 1) to 0,97 (EPTS total time 1).

Data Analysis

Because initial ability is considered a significant covariate with academic-self-concepts in prior studies, a preliminary analysis was carried out to examine the relationship between initial ability and academic self-concepts through correlational analyses. Students' standardized scores derived from the Test of Mathematical Talent and the Creative Scientific Ability Test were used as initial ability indexes. The range of the scores was rather narrow, ranging from 118 to 151 with a mean of 128,5 and a standard deviation of 6,27. Their math and science academic self-concept scores were used as indexes of academic self-concepts. The analysis showed low coefficients between the initial ability index and all measures of academic self-concepts in two settings: EPTS math (0,05 to 0,095), EPTS science (0,02 to 0,07), school math (0,02 to 0,04) and school science (0,03 to 0,1). Even the smallest probability value was above 0,47. Thus, the assumptions of covariance analysis were not met which led researchers to conduct analyses of variance instead.

A three-factor repeated-measures ANOVA was conducted to analyze the big-fish-little-pond effect of setting, course and time on academic self-concepts. Factors of the ANOVA were measures of academic self-concepts for two courses (math vs science) in two settings (EPTS vs school) in three measurement points (time 1, time 2, time 3). Simple main-effect analyses were conducted to interpret interaction patterns. A significance level of $p > .05$ was considered as significant and all the analyses were conducted with the SPSS program.

Results

Descriptive statistics revealed that means of students' academic self-concepts were very high, ranging from 28,12 to 35,06 (see Table 1). Note that the minimum possible value for academic self-concept in a subject is 6 and the maximum value is 36. As Table 1 shows, students evaluated their academic self-concepts near the maximum level in time 1 and time 2 measurements in math and science both in the EPTS and in school. Moreover, the means were approximately 0,5 standard deviation higher in school math than in the EPTS math and 0,25 standard deviation higher in school science than in the EPTS science.

A case by case analysis was carried out to explore the proportion of gifted students who experienced the BFLPE in the two settings during a certain period (time). The analysis showed that 40% of the students had a decline equal to or larger than one standard deviation in EPTS math self-concept and 32% had either an increase or no change. The rest of the students (28%) had an unsubstantial decline in their EPTS math self-concept. In EPTS science self-concept, 44% of the students had a one-standard-deviation or higher decline and 22% had an increase or no change. The rest had a decline less than one standard deviation. The pattern of change in academic self-concepts was apparently less extreme in school. Only 12% of the students had a decline equal to or higher than one standard deviation in math academic self-concept in school, whereas 48% of the cases had no change and 8% had an increase equal to or larger than one standard deviation. The change in the rest was not substantial. Similarly, in school science, 68% of the cases had no change, 22% had a decline and 4% had an increase equal to or larger than one standard deviation. The change in the rest was unsubstantial.

Table 1. Means of Math and Science Academic Self-Concepts for Settings in Three Measurements Points

Setting	Course	Mean*	SD	Minimum	Maximum	95% CI
EPTS	Math 1	32.68	5.14	13	36	31.22-34.14
	Math 2	32.48	5.01	14	36	31.06-33.90
	Math 3	28.12	6.16	13	36	26.37-29.87
	Science 1	33.84	2.86	19	36	33.03-34.65
	Science 2	33.10	4.67	18	36	31.77-34.43
	Science 3	28.70	6.21	10	36	26.94-30.46
School	Math 1	34.44	4.20	9	36	33.25-35.63
	Math 2	35.06	1.85	29	36	34.54-35.58
	Math 3	33.98	3.59	15	36	32.96-34.99
	Science 1	34.30	2.24	28	36	33.66-34.94
	Science 2	34.54	2.82	20	36	33.74-35.34
	Science 3	33.12	4.16	17	36	31.94-34.30

* Mean ranges from 6 through 36.

The results of the three-factor repeated-measures ANOVA, including the source and significance of differences across the measures, are reported in Table 2. As seen in Table 2, four of the seven null hypotheses explored in the current analysis were significant. First, the main effect of setting (EPTS vs school) showed that the overall academic self-concept in school (M = 34,24; SD = 2,26) was significantly higher than the mean of academic self-concepts in the EPTS (M = 31,49; SD = 3,87), with a large effect size. As seen in Table 1, academic self-concepts in school are higher than in the EPTS in all measurement points.

Second, the main effect of time was significant. The average of the first measurement (M = 33,82; SD= 2,71) and the second measurement (M = 33,8; SD = 3,11) was significantly higher than the third measurement (M = 30,98; SD = 4,02; p < ,001), with a large effect size. That is, students' academic self-concepts declined from time 1 and time 2 measurement to time 3 measurement. This declined was observed both in the EPTS and in school as seen in Table 1.

Third, the interaction effect of course and setting was significant (p < ,001), with a large effect size. This finding indicated that academic self-concepts in math and science differed across settings. This interaction is shown in Figure 1. Descriptive statistics related to each measure was calculated for the EPTS math (M = 31,09; SD =4,40), EPTS science (M = 31,88; SD = 3,66), school math (M = 34,49; SD = 2,79), and school science (M = 33,99; SD = 2,47). The difference between school math academic self-concept and school science academic self-concept was not significant (p > ,05). Nevertheless, the difference between math academic self-concept and science academic self-concept in the EPTS was significant (p < ,05). Students had relatively higher academic self-concepts in science than in math in the EPTS. However, a similar difference was not observed between school math academic self-concept and school science academic self-concept.

Table 2. Summary of Three-way Repeated-Measures ANOVA

Source	SS	df	MS	F	P	Partial Eta Squared	Observed Power
Setting	1137.12	1	1137.12	51.99	*0.000*	0.515	1.000
Error (Setting)	1071.71	49	21.87				
Course	2.94	1	2.94	0.21	0.651	0.004	.073
Error (Course)	697.23	49	14.22				
Time	1064.12	2	532.06	31.37	*0.000*	0.390	1.000
Error (Time)	1662.21	98	16.96				
Setting * Course	62.73	1	62.73	12.36	*0.001*	0.201	.931
Error (Setting * Course)	248.77	49	5.07				
Setting * Time	447.46	2	223.73	14.32	*0.000*	0.226	.998
Error (Setting * Time)	1531.20	98	15.62				
Course * Time	11.17	2	5.58	1.019	0.365	0.020	.223
Error (Course * Time)	537.16	98	5.48				
Setting * Course * Time	0.563	2	0.282	0.093	0.911	0.002	.064
Error (Setting*Course*Time)	297.437	98	3.035				

Fourth, the interaction effect of setting and time was statistically significant, with a large effect size. This finding means that changes in academic self-concepts between the three measurement points were not consistent across the settings (i.e., school vs. EPTS); albeit the direction of the change was consistent for both courses as illustrated in Figure 2. Simple main-effect analyses were conducted to interpret the change pattern. To conduct these analyses, descriptive statistics related to each measure were calculated for EPTS time 1 (M = 33,26; SD = 3,6), EPTS time 2 (M = 32,79; SD = 4,71), EPTS time 3 (M = 28,41; SD = 5,87), school time 1 (M = 34,37; SD = 2,6), school time 2 (M = 34,8; SD = 2,09) and school time 3 (M = 33,5; SD = 3,48). Analyses showed that academic self-concepts in school were significantly higher than academic self-concepts in the EPTS for all measurement points (p < ,01) except for the difference between the EPTS science time 1 measurement and school science time 1 measurement (p > .05). Second, time changes across settings were explored. The decrease from time 1 to time 2 was not significant for the settings. However, the decrease from time 1 to time 3 was statistically significant for both school (p < ,05) and the EPTS (p < ,001). In addition, the decrease from time 2 to time 3 was significant for both school (p < ,001) and the EPTS (p < ,001). Finally, observed decreases across school and EPTS self-concepts were compared. The decrease from time 1 to time 2 was similar between school and the EPTS (p > ,05) whereas the decrease from time 1 to time 3 was larger for the EPTS (p < ,001).

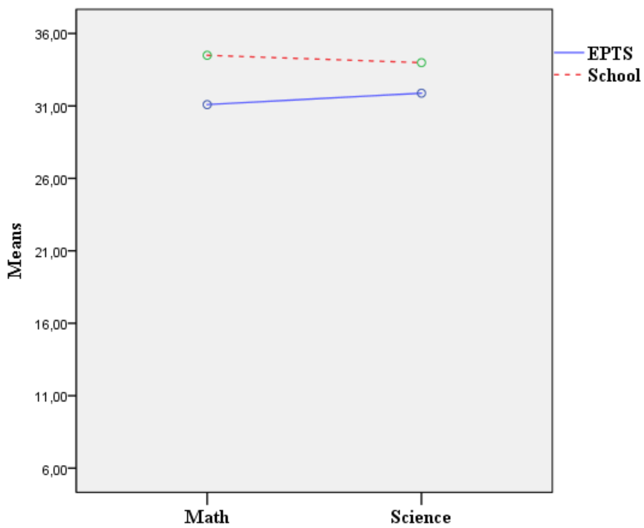

Figure 1. Interaction effect of course and setting for academic self-concepts

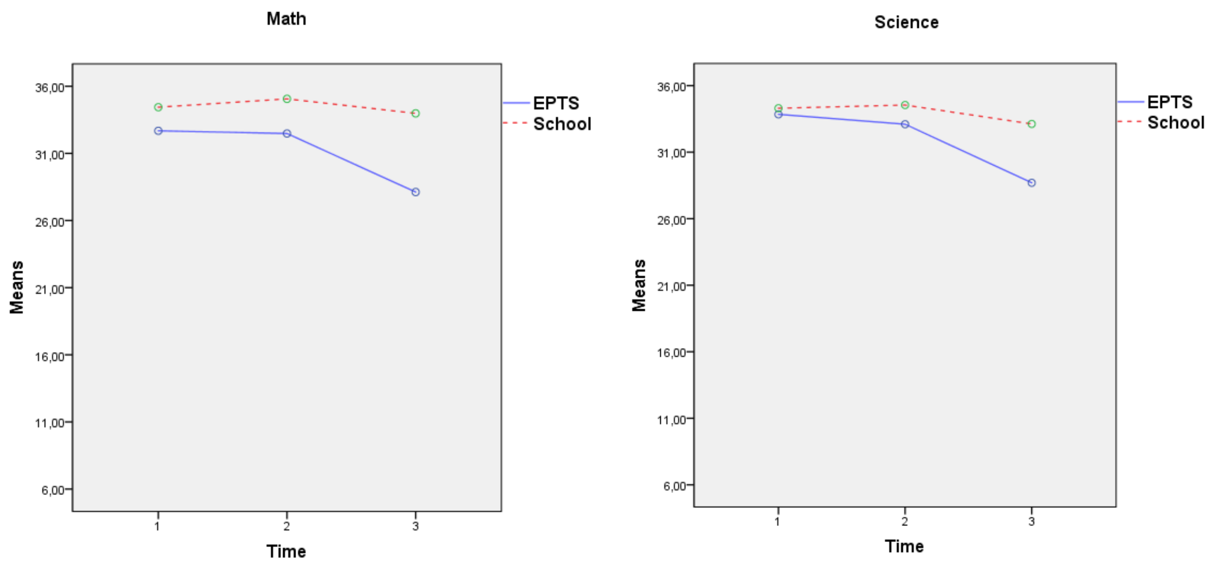

Figure 2. Interaction effect of setting and time by course

Three of the seven null hypotheses tested in the current study were found to be insignificant. The main effect for course was insignificant ($p > 0{,}05$). Overall means of math academic self-concept ($M = 32{,}79$; $SD = 3{,}36$) and science academic self-concept ($M = 32{,}93$; $SD = 2{,}74$) were similar. This similarity was found to be consistent across different measurement points (course * time; $p > 0{,}05$) and settings (settings * course * time; $p > 0{,}05$). These insignificant differences might be due to limited statistical power because of the modest sample size (N= 50) as seen in table 2.

Table 3. Means of Academic Self-Concepts by Gender

Variable	Gender	N	Mean	SD
	Male	32	31,15	4,42
EPTS Math	Female	18	31,00	4,49
	Total	50	31,09	4,40
	Male	32	31,47	3,78
EPTS Science	Female	18	32,61	3,40
	Total	50	31,88	3,66
	Male	32	34,24	3,20
School Math	Female	18	34,94	1,83
	Total	50	34,49	2,79
	Male	32	33,93	1,93
School Science	Female	18	34,09	3,29
	Total	50	33,99	2,47

After the effect of course, setting, time, and their interactions were analyzed, a five-factor mixed design ANOVA was conducted to see whether between-groups factors (i.e., grade and gender) demonstrated significant interactions with the within-groups factors. Very small F values with insignificant probabilities were observed throughout the interaction effects. The only significant finding was the interaction of setting, course and gender, which revealed a moderate effect size ($F_{1,46} = 4.357$; $p < .05$; eta squared = 0.121). To examine this effect further, descriptive statistics related to the variables were calculated and summarized in Table 3. Then, the interaction effect was illustrated in Figure 3.

Simple main-effect analyses revealed that none of the measures differed significantly between males and females, and probability values were very high ($p>.30$). Then, the difference between males and females for each self-concept was calculated. The gender difference between math and science self-concepts at the EPTS seemed marginally significant ($p=0.06$) whereas that of the school was not significant at all (p=0.504). This finding suggested that gender interacted with both the setting and the course type in influencing academic self-concept scores.

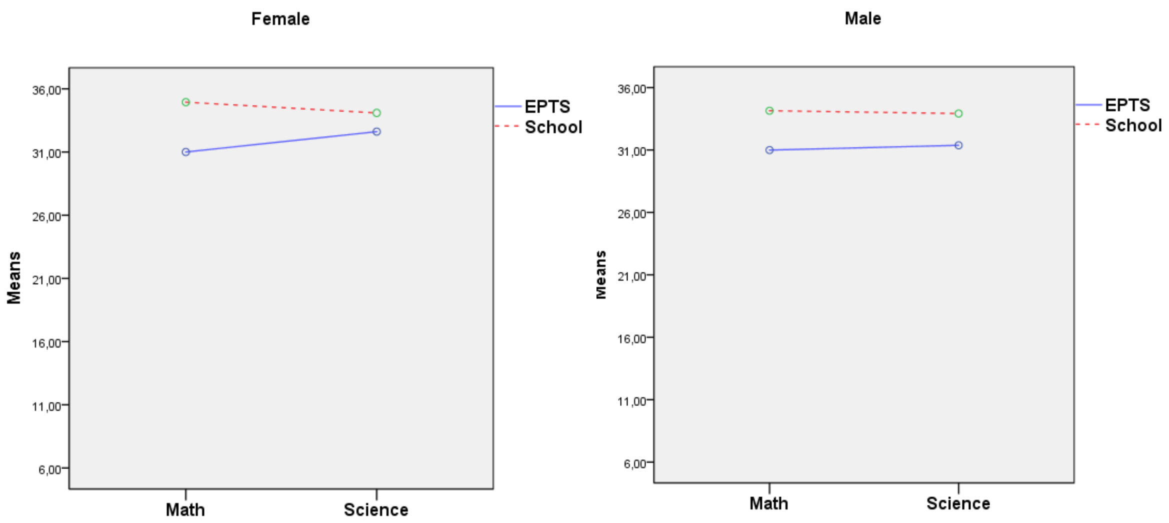

Figure 3. Interaction effect of setting and course by gender

Discussion

This study was designed to investigate the big-fish-little-pond effect (BFLPE) on math and science academic self-concepts of gifted students who participated in a competitive after school program for gifted students (EPTS) at a university campus for five terms. The study was the first of its kind in that two frames of reference were used to investigate the BFLPE on gifted students. Based on the BFLPE research derived from social comparison theories (Dai et al., 2012; Festinger, 1954; Marsh et al., 2000), it was hypothesized that gifted students would show *dual (adaptable) academic self-concepts*, excessively high in school and relatively low in the EPTS. The findings supported this hypothesis. The effects of setting (school vs EPTS) and time (time 1, time 2, time 3) and their interaction on academic self-concepts in both math and science were substantial. The study showed that students used school and the EPTS as two different frames of reference in that their academic self-concepts were found to be significantly higher in school than in the EPTS in all measurements points.

The second hypothesis was related to the direction of change in academic self-concepts. This hypothesis was partially supported. It was hypothesized that students would show an increase in their academic self-concepts in school over time as a result of being admitted and attending the EPTS (assimilation effect) but a decline in their academic self-concepts in the EPTS as a result of contrast effect. However, the results showed a decline in academic self-concepts in both the EPTS and school over time. The decline in the EPTS was steady whereas it was not the case in school. As hypothesized, students showed an increase in school math and school science academic self-concepts from time 1 to time 2 measurement and then a decline in both self-concepts. The increase was relatively small and insignificant in both subjects. Similarly, the decline was also small, but much larger than the increase. That is, the contrast effect was stronger than the assimilation effect. Note that because students evaluated their academic self-concepts to be excessively high, near the maximum level on the scale, in the first measurement (time 1), there was almost no possibility to make a much higher evaluation in time 2 measurement.

The pattern of initial increase and the subsequent decline in academic self-concepts in school can be explained by the counterbalancing processes as found in previous BFLPE research (Marsh, 1987, 1991; Marsh et al., 2000). That is, a contrast effect and an assimilation effect simultaneously play a role in changing students' academic self-concepts. In the current study, students' academic self-concepts in school were slightly elevated after they were admitted to and attended a prestigious program for gifted students for four months (assimilation effect). They were honored by being selected as gifted students. Marsh (1984) argued that an assimilation effect would occur if the selection is highly valued. Being a member in groups that are highly valued due to extraordinary qualities of group members can result in a positive assimilation effect. Such is the case in the identification of the EPTS. Nevertheless, this increase was not stable over time. In line with previous research (Marsh et al., 2000), after gifted students encountered equally able or higher-ability students in the EPTS for seventeen months, their academic self-concepts declined in both the EPTS and school (negative contrast effect).

However, the decrease might be caused totally by the phenomenon "regression to the mean" because a time-series research with three measurements was used in this study. This phenomenon happens when repeated measurements are made on the same subject because values are observed with random error. As a result, extreme scores are expected to be followed by less extreme scores closer to the subject's true mean (Barnett, van der Pols, & Dobson, 2005). As pointed out before, gifted students had extremely high scores on the academic self-concept questionnaire in the first measurement followed by less extreme scores on the third measurement.

In addition, the negative contrast effect was stronger than the assimilation effect in school which is what the BFLPE hypothesis essentially claims: Participation in selective educational settings can create an increase in academic self-concepts in the beginning through the reflected glory of accomplishments and then a decline as a result of negative contrasts. Felson and Reed (1986) underlined that an assimilation effect and a contrast effect might suppress each other in selective settings. Such an operation of the assimilation and contrast effect would be likely to happen in the EPTS because it is as prestigious as a competitive program. Therefore, these effects should be simultaneously taken into account in explaining the BFLPE in gifted education. These highly selective programs can have both positive and negative effects on academic self-concepts, depending on context, person, and time.

The steady decline in academic self-concepts in the EPTS is understandable as the EPTS have students with very high ability, and as a result, students might have experienced a negative contrast effect, as found in previous studies (e.g., Marsh et al., 1995; Marsh et al., 2000). Nevertheless, the decline in academic self-concepts in school is unexpected and needs further scrutiny. Because these students are, presumably, one of the best in their schools and honored by attending a prestigious gifted education program, they are expected to increase or at least to maintain the level of their academic self-concepts in school, but not necessarily in the EPTS. Such a hypothesis was not confirmed in this study. The most reasonable but probabilistic explanation is that students rated their academic self-concepts excessively high, near the maximum level on the scale in the first measurement. Presumably, they overrated their academic self-concepts in the first measurement as a result of the reflected glory of the identification for a highly prestigious program and/or as a result of being the best or one of the best students in their schools. After having accelerated and enriched education in math and science with other gifted students in the same educational setting, they came to realize that there were others who were better than them. This social comparison process might have led them to develop a more rational or a more realistic judgement of their own ability. Accordingly, their academic self-concepts might have declined from an excessive level to a more realistic level in both the EPTS and school. This conclusion also means that a change in academic self-concepts in a setting (e.g., EPTS) can bring about a change in academic self-concepts in another setting (e.g., school). Another probabilistic explanation of the decline in academic self-concepts of gifted students in school is related to a limitation of the study. Both the EPTS form and the school form of the academic self-concept questionnaire used in this study were administered in the special education program of the EPTS. This might create an interaction which is not accounted for in this study. Students might make different social comparisons if they are administered the same academic self-concept questionnaire in their schools.

Although gifted students' academic self-concepts declined after they started the EPTS, the level of their academic self-concepts was still high in the EPTS and very high in school. Dai et al. (2012) reported a similar pattern of change in academic self-concepts of gifted students participating in summer programs for gifted students. They found a few students to have increases or decreases in their academic self-concepts. Based on the findings (Dai, 2004; Dai & Rinn, 2008; Dai et al., 2012), Dai and his colleagues suggested an investigation of who are the most likely to have a BFLPE (person), and where they experience it (place) and when they perceive it (time). The investigation of these questions seemingly would provide a new frame for the BFLPE hypothesis. The results of the current study shed light on person, place and time questions. Although the current study showed a decline in gifted students' academic self-concepts after they participated in the EPTS, this decline cannot be equally generalizable to all gifted students in all settings in all time. Our analysis case by case showed that the direction of change from time 1 to time 2 and from time 2 to time 3 was not consistent for all students. For example, some students showed declines from time 1 to time 2 and then increases from time 2 to time 3. Some students had increases in the beginning and then decreases. Some of the students had an increase or decrease in the beginning and then no change over time. Additionally, our analysis showed that declines in academic self-concepts of some students were substantial whereas they were insignificant for other students. Some gifted students had a substantial increase in their academic self-concepts and others had a slight increase. The rest had no change in their academic self-concepts. That is, all gifted students do not experience a BFLPE as a result of participating in gifted education programs and those who experience a BFLPE might not experience it all the time.

In conclusion, gifted students, but not all, might have a decline in their academic self-concepts when they participate in gifted education programs, however, this decline should not be interpreted as totally detrimental to their academic achievement nor to their academic self-concepts. After participating in gifted education programs, some gifted students might become aware of their true capacity through peer comparisons. This is exactly what might have happened in academic self-concepts of gifted students who participated in the EPTS as their academic self-concepts in the EPTS seemingly differed from their perceptions in school. Based on the findings of this study, a further conclusion can be drawn that the big fish is aware of both the big pond and the little pond and swims accordingly. Their academic self-concepts do not necessarily decline in selective settings, rather they show an adaptable academic self-concept. That is, they are aware of the level of their ability and achievement and therefore they rationally adjust their academic self-concepts according to the setting. Finally, future research may explore the adaptability of gifted students' academic self-concepts in various competitive and challenging settings.

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