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ABSTRACT

This study explores the relationship between mathematics and English achievement and mathematics and verbal self-concept and investigates whether these relationships are invariant with respect to student ability and gender. Data from 16,033 10th grade students who completed both the base and the first follow-up student questionnaire of the National Education Longitudinal Study (NELS) of 1988 were used in this study. Findings indicate that math and verbal self-concepts are substantially less correlated than math and English achievement; individual level math (English) achievement has a positive, direct effect on math (verbal) self-concept but a negative, direct effect on verbal (math) self-concept; and school level math (English) achievement has a negative effect on math (verbal) self-concept but not on verbal (math) self-concept. These findings were found to be invariant across males and females as well as gifted and non-gifted students; however, statistically significant gender differences and giftedness differences were found in the correlations between math and verbal self-concepts. Higher correlations were found to exist between math self-concept and verbal self-concept for males than for females and for gifted than for non-gifted students. Contains 76 references. (Author/JRH)

Influences of Internal and External Frames of Reference on Math and Verbal Self-concepts for Gifted and Non-gifted Tenth Grade Students

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Abstract

In this article, we applied structural equation modeling to (1) estimate and test Marsh's (1986, 1990b) model that explained the relationship between mathematics and English achievement and mathematics and verbal self-concept; and to (2) estimate whether the model is invariant with respect to student ability and gender. Based on the statistical analyses, we concluded that math and verbal self-concepts are substantially less correlated than math and English achievement; individual level math (English) achievement has a positive, direct effect on math (verbal) self-concept but a negative, direct effect on verbal (math) self-concept; and school level math (English) achievement has a negative effect on math (verbal) self-concept but not on verbal (math) self-concept. These conclusions are invariant across males and females as well as gifted and non-gifted students. However, there are statistically significant gender differences and giftedness differences in the correlations between math and verbal self-concepts. Higher correlations exist between math self-concept and verbal self-concept for males than for females and for gifted than for non-gifted students.

Background and Objectives

Self-concept is an important variable in education and in educational evaluation and research. Harter (1986) proposed that self-concept influences both affect and motivation. A positive self-concept has been posited as a desirable goal in personality and child development, in clinical treatment, and in education (Marsh & Shavelson, 1985).

Although William James (1892) devoted a chapter to the self in his early textbook, *Psychology: The Briefer Course,* prior to the 1980's, self-concept research still suffered from the lack of well-tested theoretical models, substandard measurement, and inconsistent findings from the large number of studies that had been done. Some of these problems have been remedied in the past decade, during which research has focused on the dimensionality of the self-concept construct.

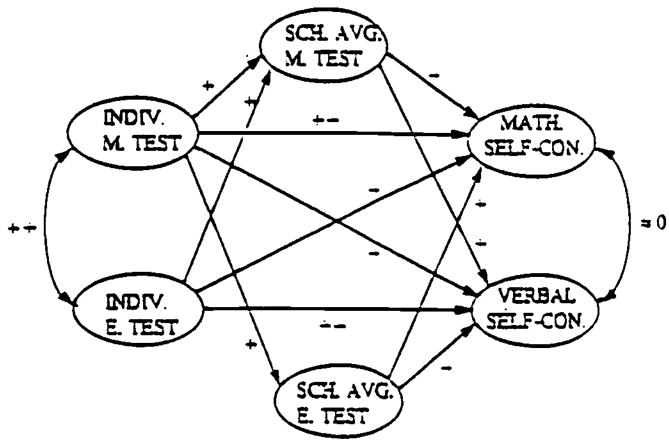
Shavelson, Hubner, and Stanton (1976) broadly defined self-concept as a person's self-perceptions of him/herself. In the Shavelson et al. multifaceted, hierarchically ordered model, general self-concept appears at the apex and is divided at the next level into general academic and general nonacademic self-concept. Studies have found general academic self-concept to be only moderately correlated with achievement (Byrne, 1984; Hansford & Hattie, 1982; Marsh & Shavelson, 1985). However, when Marsh and Shavelson (1985) used the Self Description Questionnaire (SDQ, Marsh, 1988; Marsh & O'Neill, 1984) to test the Shavelson et al. (1976) original model, two academic factors were found—verbal academic and math academic self-concepts—instead of only a general academic self-concept.

To describe the separation of math and verbal self-concept and their relations to math and English achievement, Marsh developed the internal/external (I/E) frame of reference model (Marsh, 1986; Marsh, Byrne, & Shavelson, 1988; Marsh, Smith, & Barnes, 1985). According to the I/E model, verbal and math self-concepts are formed in relation to both external and internal comparisons. Students compare their self-perceptions of their math and verbal abilities with their perceptions of other students' abilities, and use this external, relativistic impression as one basis of their academic self-concept in each of the two areas. Students also compare their self-perceived math ability with their self-perceived verbal ability and use this internal, relativistic impression as a second basis of their academic self-concept in each of two areas. In the I/E model, the direct effects of math achievement on math self-concept and of verbal achievement on verbal self-concept are positive, but the direct effects of verbal achievement on math self-concept and of math achievement on verbal self-concept are negative. These effects illustrate clear distinctions between academic self-concepts and academic achievement, and show that self-concepts are much better differentiated than are corresponding areas of academic achievement. These effects also demonstrate that academic self-concepts are more complex than merely a subjective reflection of normatively defined academic achievement and that academic self-concepts are affected by processes different from those affecting the corresponding achievement.

Chapman and Volkman (1939), Festinger (1954), Goethals (1986), Kelley (1952), Rosenberg (1965), Sherif and Sherif (1969), Thibaut and Kelley (1959), and many others have asserted that group membership influences the values and standards of performance that people use in their self-evaluations. Marsh and Parker (1984) replicated Soares and Soares (1969) and Trowbridge's (1970, 1972) studies that reported a paradoxically negative correlation between school average socioeconomic status and self-concept. Marsh and Parker (1984) found that the earlier studies had seriously underestimated the negative effect on academic self-concept of attending a high-ability school. Based on these findings, they formulated their frame of reference model to describe the "Big Fish Little Pond Effect" (BFLPE), which is posited to be specific to academic self-concept. The BFLPE hypothesis states that, in addition to the student's own ability level, academic self-concept is influenced substantially by the ability levels of other students in the same school. BFLPE occurs when equally able students have lower academic self-concepts from comparing themselves to more able students, and higher academic self-concepts from comparing themselves with less able students (Marsh, 1984a, 1984b, 1987; Marsh & Parker, 1984). According to BFLPE, the negative effects of school-average achievement on academic self-concept are shown in corresponding content areas.

In Marsh's most recent model (1990b), an internal/external (I/E) frame of reference and the BFLPE were combined into a single analytic framework (see Figure 1). This research has shown that mathematics and verbal self-concepts are uncorrelated despite a substantial correlation between math and English test scores, strongly related to individual achievement scores in corresponding content areas, and negatively affected by school-average achievement scores in corresponding content areas (Byrne, 1984; Marsh, 1986, 1990a, 1990b, 1992, 1993, 1994b; Marsh, Byrne, & Shavelson, 1988; Marsh & Shavelson, 1985; Shavelson & Marsh, 1986).

Figure 1. The Combined Effects of the BFLPE and the I/E Model (Marsh, 1990b)



Note. Coefficients labeled as "++", "+", "-", and "0" are predicted to be high positive, low positive, low negative, and approximately zero, respectively.

Research conducted on self-concept has also been concerned with whether the relationship between self-concept and achievement is invariant across different student groups (e.g., Bracken, 1980; Byrne, 1986; Byrne, Shavelson, & Marsh, 1992; Hattie, 1992; Hoge & Renzulli, 1991, 1993). Two types of comparison agreement have shown variable relationships between academic self-concept and achievement. One is the comparison between gifted/talented and average students (e.g., Bracken, 1980; Brounstein, Holahan, & Dreyden, 1991; Cornell, Delcourt, Goldberg, & Bland, 1992; Hoge & McSheffrey, 1991; Hoge & Renzulli, 1991, 1993; Marsh, Chessor, Craven, & Roche, 1995), which often involves comparisons of students in different instructional programs (Cox, Daniel & Boston, 1985; Feldhusen, 1989; Kulik & Kulik, 1982, 1984, 1987; Reis, 1989). The studies have indicated generally higher academic self-concepts for gifted students, but otherwise the results of the investigations have been highly variable (Hoge & Renzulli, 1993). The second comparison is related to issues of gender, about which many studies have been conducted (Byrne, 1988; Eccles, 1987; Ethington &

Wolfe, 1986; Fleming & Whalen, 1990; Hattie, 1992; Marsh, 1985, 1989a, 1989b, 1993, 1994a; Meece, Parsons, Kaczala, Goff, & Futterman, 1982; Pallas & Alexander, 1983). Hattie (1992) reported differences favoring males for general, physical, and math self-concept, and favoring females for verbal self-concept. Consensus, however, has not been reached among contemporary scholars regarding the components of self-concept and their relationships with respect to gender and ability levels.

Early support for Marsh's I/E model was based entirely on Self Description Questionnaire responses by Australian students. Later, Marsh tested the I/E model with responses by Canadian students (Marsh, Byrne, & Shavelson, 1988) and United States students (Marsh, 1990b) and found similar results. However, research conducted in Norway (Skaalvik & Rankin, 1990) found no strong support for the I/E model. Considering the problem of the potential threat to external validity, our study empirically retests the internal/external (I/E) frame of reference model using Marsh's SDQ indicators with a nationally representative sample.

Until about 1980, data analysis in the social sciences was based largely on analysis of variance and multiple regression methods originally designed for experimental studies and prediction (Marsh, 1990a). These methods did not adequately serve the need to examine relationships among multiple variables that are fallible indicators of the underlying sources of variation. Most comparison research has examined group differences in mean levels of self-concept without testing the implicit assumption that the processes which determine self-concept constructs are the same for different groups (Hattie, 1992; Marsh, 1989b). Recognizing the importance of this perspective, Hattie

(1992) emphasized that "the differences in means may not be as critical in the development of self-concept as changes in factor structure" (pp. 177-178), and Byrne and Shavelson (1987) have claimed that "testing for mean differences across gender is problematic: testing for differences in structure would appear to be a more logical strategy" (p.382). The application of structural equation modeling, which deals with multiple latent variables in the structure simultaneously, has grown rapidly in this past decade (Byrne, 1995). Recent advances in the application of structural equation modeling (e.g., Byrne, Shavelson, & Muthen, 1989; Eye & Clogg, 1994; Hoyle, 1995; Jöreskog and Sörbom,1993; Marsh & Grayson, 1990) allow researchers to compare the psychometric properties of the same measures across multiple groups, to compare latent means for the different groups, and to test the appropriateness of interpretations of these data.

Based on self-concept theory and recent structural equation techniques, the present study uses Jöreskog and Sörbom's **LISREL** (LInear Structural RELations) to (1) estimate and test Marsh's academic self-concept model (1986,1990b) that attempts to explain the relationship between mathematics and English achievement and mathematics and verbal self-concepts and (2) investigate whether the structure of academic self-concept is invariant across specific groups, namely, gifted and non-gifted students and males and females.

We posed the following research questions:

1. Are math and verbal self-concepts substantially less correlated than math and English achievement for the U.S. 10th grade population? Are these relationships

invariant across males and females? Are they invariant across gifted and non-gifted students?

2. Does individual math (English) achievement have a strong, positive, direct effect on math (verbal) self-concept but a weaker, negative, direct effect on verbal (math) self-concept for the U.S. 10th grade population? Are these effects invariant across males and females? Are they invariant across gifted and non-gifted students?

3. Does school-average math (English) achievement have a negative effect on math (verbal) self-concept but not on verbal (math) self-concept for the U.S. 10th grade population? Are these effects invariant across males and females? Are they invariant across gifted and non-gifted students?

Method

Subjects. Data from 16,033 10th grade students who completed both the base year and the first follow-up student questionnaire of the National Education Longitudinal Study of 1988 (NELS: 88) were used in this study. The base year for NELS:88 was 1988, and the first follow-up was in 1990. The National Opinion Research Center (NORC) conducted all data collection activities for the first follow-up. The final response rates of NELS:88 first follow-up showed a cooperation rate of over 98 percent from school districts and schools, 94 percent participation from students, and 91 percent participation from dropouts (NCES, 1992). To compensate for unequal probabilities of selection and adjust for effects of nonresponse, the NELS:88 responses were weighted to take into account the disproportionate sample of specified subgroups in the NELS:88

design (NCES, 1992). By using the panel weights, the results of this study may generalize to the population of 1990 10th graders who were in 8th grade on 1988. This sample was 49.2% male and 50.8% female; 19.8% were gifted and 76.2% were non-gifted; and 71.7% were white, 11.6% were Hispanic, 9.3% were black, 6.3% were Asian, 0.9% were American Indian.

Instruments. The model under study includes six latent variables that are measured by 20 observed indicator variables. All these indicators which come from the NELS:88 first follow-up survey when the respondents were 10th graders, are described below.

Verbal self-concept was measured by four items (VSC1, VSC2, VSC3, and VSC4) drawn from the SDQ II (Marsh,1990c). Reliability (alpha) calculated for the four-item subscale score was found to be .85 for the target sample of this study. These four items were based on requirements established by NCES, and chosen by Marsh. Marsh reported that this subscale has the same reliability as the original full SDQ II subscale (Marsh, 1994b).

Mathematical self-concept was also measured by four items (MSC1, MSC2, MSC3, and MSC4) drawn from the SDQ II (Marsh, 1990c). Apha reliability was calculated as .88 for the target sample of this study. These four items were also based on requirements established by NCES, and chosen by Marsh (1994b). Again March reported that this subscale has the same reliability as the original full SDQ II subscale.

Individual English achievement was assessed by two levels of proficiency in an Educational Testing Service (ETS) developed reading test. Both level scores were used in this study as observed indicators and were named "Individual English 1" (IE1), and "Individual English 2" (IE2). The internal consistency (coefficient alpha) was .82 for the reading test (NCES, 1992).

Individual math achievement was measured by the Educational Testing Service (ETS) developed Mathematics Test, which has four levels of proficiency. Four level scores were used in this study as observed indicators and were named "Individual math 1" (IM1), "Individual math 2" (IM2), "Individual math 3" (IM3), and "Individual math 4" (IM4). The internal consistency (average coefficient alpha) was 0.79 for the mathematics test (NCES, 1992).

School-average English values for the two assessed proficiency levels were aggregated as the mean of each school on the responses of those who completed the NELS:88 first follow-up reading test. *School-average English* scores were matched to the first follow-up data, so that all students from the same school were assigned the same *School-average English* values. Each student has two level assigned *school-average English* indicators (SE1 and SE2) corresponding to individual English reading measurement.

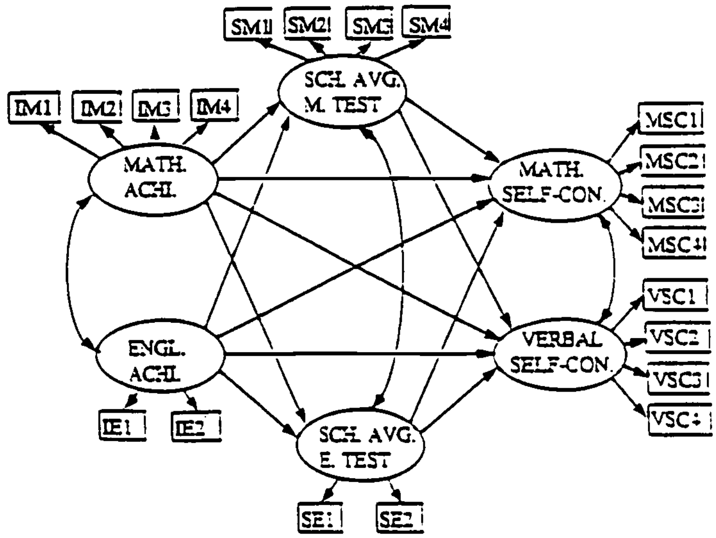
School-average mathematics values for the four assessed proficiency levels were also aggregated as the mean of each school on the responses of those who completed the NELS:88 first follow-up mathematics test. *School-average mathematics* scores were matched to the first follow-up data, so that all students from the same school were assigned the same *School-average mathematics* values. Each student has four level assigned *school-average mathematics* indicators (SM1, SM2, SM3, and SM4) corresponding to individual mathematics measurement.

Two survey questions in the student questionnaire, *sex* and *enrollment in classes for gifted students*, were selected as the grouping variables for the present study. Gifted and non-gifted students were distinguished by whether or not they had been enrolled in classes for gifted students when they were in eighth grade. (In NELS:88, the "giftedness question" had been asked on the base year survey only.) The definition of giftedness used here is based solely on involvement of students in gifted programs, which may be problematic in that different definitions of giftedness were used in the various school districts. It should be noted, however, that these definitions are being used across the country and in that sense the results will have external validity.

Analysis. Data in the empirical model were analyzed by means of structural equation modeling involving six latent variables (i.e., math self-concept, verbal self-concept, individual math achievement, individual English achievement, school-average math achievement, school-average English achievement). Jöreskog and Sörbom's LISREL 8.12 was used to develop each equation in the model using multiple indicators of latent variables and structural relations among the latent variables. Figure 2 represents the initial structural model of hypothesized relationships among the latent variables of this study.

In Figure 2, latent variables are represented by ellipses. The hypothesized causal directions of the relationships among the latent variables are denoted by one-headed arrows. These arrows point from independent variables (exogenous) to dependent

Figure 2. The Initial Hypothesized Model



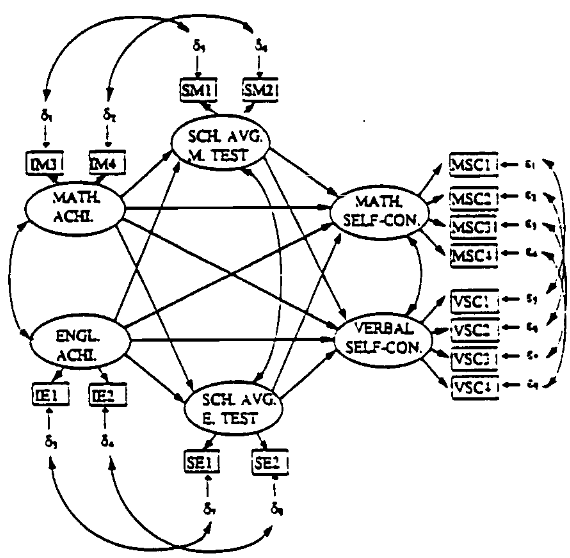
variables (endogenous). In this study, individual mathematics achievement and individual English achievement are exogenous latent variables, whereas school-average mathematics, school-average English, mathematical self-concept, and verbal self-concept are the endogenous latent variables. Each latent variable is presumed to be an underlying cause of a set of measured indicators (i.e., the boxes). An arrow pointing from a latent variable to a measured variable indicates an assumption that individuals' positions on the latent variable are indicated by their responses to the measured variables. Curved double-headed arrows indicate correlation but not causation among the latent variables. This model is a recursive model that does not involve any reciprocal relationships or indirect loops.

As Bollen (1989) has pointed out, an initially hypothesized model often does not adequately fit the data, so model respecifing becomes necessary. A maximum likelihood chi-square estimate for the goodness of fit of the initial hypothesized model of 36,958 with 155 degrees of freedom, a goodness-of-fit index (GFI) (Jöreskog and Sörbom, 1986, 1989, 1993) of 0.78, and an adjusted GFI (AGFI) (Jöreskog and Sörbom, 1986, 1989, 1993) of 0.70 were generated by LISREL program. These statistics indicate that there is unsatisfactory fit between the matrices implied by the initial hypothesized model (expected) and the matrices generated from the actual data (observed) (Bollen & Long, 1993; Carmines & McIver, 1981). The initial model should be respecified in order to improve the fit between the model and the data.

Sequential testings were respecified from the initial model. First, because school-average achievement tests scores were aggregated from the individual achievement scores, the uniqueness of the individual and school-average scores are likely to be correlated. Second, because the wording of verbal self-concept items is parallel to the wording of math self-concept items, the uniqueness associated with each pair of items having the same wording are likely to be correlated. Thus, correlated uniqueness among certain pairs of indicators were incorporated into the first respecification of the initial model.

School-average achievement scores are the aggregate mean of the individual level tests. From the measurement model perspective, this causes correlated errors; from the point of view of the structural model, this leads to a collinearity between the paired latent variables; neither is desirable. One remedy is to "unpair" the measurement model, by dropping certain observed indicators so that a pair of latent variables does not share the same observed indicators. For example, it may be better to drop IM1 and IM2 from IM and SM3 and SM4 from SM. The new IM now will consist of only IM3 and IM4 while the new SM will include only SM1 and SM2. The reason for choosing the remaining IM3 and IM4 for IM and SM1 and SM2 for SM is empirically based on the pattern of zero-order correlation coefficients among these indicators, by maximizing the within-factor correlations while minimizing the across-factor correlations (see APPENDIX A). Ideally, the same unpairing procedure should apply to IE and SE as well. But because both IE and SE had only two initial indicators, any reduction in the observed indicators would cause the measurement model to become underidentified. Therefore, IE and SE have remained unchanged. Figure 3 presents the final hypothesized model of this study.

Figure 3 The Final Hypothesized Model



The final hypothesized model posits four correlated uniqueness relating pairs of self-concept items that share the same wording (i.e., MSC1 with VSC1, MSC2 with VSC2, MSC3 with VSC3, and MSC4 with VSC4), and four correlated uniqueness relating individual and school-average math, English scores based on the same test (i.e., IM3 with SM1, IM4 with SM2, IE1 with SE1, and IE2 with SE2). This respecified model was evaluated against criteria for model identifiability and showed a satisfactory model fit. Table 1 lists the model goodness of fit indices, under Maximum Likelihood estimation (ML) for the final hypothesized model obtained by LISREL.

Table 1
Goodness of fit indices of the final hypothesized model

$\chi2$	df	GFI	AGFI	NFI	NNFI	CFI	IFI	RFI
3,977	81	.97	.94	.97	.96	.97	.97	.96

Except for the $\chi2$, which was greatly inflated by the huge sample size and should not be the sole basis for determining model fit (Bentler, 1990; Bollen & Long, 1993; Hu & Bentler, 1995), the model goodness of fit is satisfactory for this hypothesized model. This model was used in this study to address the research questions.

Results

The most important parameter estimators (correlations or path coefficients) for the respecified model and Marsh's study (1990b) are summarized in Table 2.

Table 2
Important Parameter (correlation or path coefficients) Estimates

	IM IE	MSC VSC	IM MSC	IM VSC	IE VSC	IE MSC	SM MSC	SM VSC	SE VSC	SE MSC
NELS	.72	.13	.70	.09	.32	-.32	-.20	.02	-.09	.08
Marsh	.88	-.02	.66	-.35	.69	-.43	-.22	.17	-.22	.13

Note. All parameter estimators are presented in standardized form to facilitate interpretations. The first row of this table lists the parameter estimators provided by the present study. The second row of this table lists the parameter estimators provided by Marsh's (1990b) study for comparison. The first element in the table is a correlation coefficient of IM and IE, the second is a correlation coefficient of MSC and VSC; all the rest are direct path coefficients (see Figure 3).

In Table 2, the values of most pairs of estimated parameters for the present study and for Marsh's study have same sign, except MSC to VSC and IM to VSC. Also, the values of most pairs of estimated parameters have approximately equal magnitudes, except IE to VSC. Therefore, it can be concluded that the current data have very much the same pattern of academic self-concept structure as Marsh's model.

To evaluate the equality of the parameters between males and females, and between gifted and non-gifted, a series of testings for parameter equivalence across groups, which permits one parameter to vary while the rest are held equal over groups, was performed. The results for gender are summarized in Table 3 and those for giftedness in Table 4.

Table 3
Parameter comparisons for gender differences

	IM IE	MSC VSC	IM MSC	IM VSC	IE VSC	IE MSC	SM MSC	SM VSC	SE VSC	SE MSC
Males	.73	.20	.69	.11	.27	-.28	-.18	-.01	-.09	.08
Females	.74	.10	.70	.13	.31	-.32	-.21	.02	-.05	.06

Note. All parameter estimators are presented in standardized form to facilitate interpretations. The first and second rows show the results from a series of sequential runs where each run allows one parameter to vary while the rest are held equal over gender. The first element in the table is a correlation coefficient of IM and IE, the second is a correlation coefficient of MSC and VSC; all the rest are direct path coefficients.

The only significant difference of a parameter estimate in Table 3 is the correlation between MSC and VSC. That parameter was estimated .20 for males but .10 for females. This finding is discussed in detail later.

Table 4
Parameter comparisons for gifted and non-gifted

	IM IE	MSC VSC	IM MSC	IM VSC	IE VSC	IE MSC	SM MSC	SM VSC	SE VSC	SE MSC
Gifted	.79	.18	.65	.01	.34	-.30	-.14	-.01	-.11	.09
Non-g.	.68	.08	.65	.04	.30	-.31	-.17	.05	-.09	.04

Note. All parameter estimators are presented in standardized form to facilitate interpretations. The first and second rows show the results from a series of sequential runs where each run allows one parameter to vary while the rest are held equal over gender. The first element in the table is a correlation coefficient of IM and IE, the second is a correlation coefficient of MSC and VSC; all the rest are direct path coefficients.

Table 4 shows two significant differences in parameter estimates between gifted and non-gifted students. One is the correlation coefficient of IM and IE, another is the correlation coefficient of MSC and VSC. These findings are discussed later.

The first research question concerned the relationship of math and English achievement to math and verbal self-concepts. LISREL found the correlation coefficient between math self-concept and verbal self-concept was .13 for the overall sample (see Table 2). In contrast to this weak correlation, the correlation coefficient between individual math and English achievement ($r = .72$) is strong and substantial. A z test of the difference of Fisher's transformations, which has the null hypothesis H_0: $\rho_1 = \rho_2$, was performed. The result shows $z = 46.25$ ($p < .0001$). Cohen's (1988) effect size index (q)

of the difference between two correlation coefficients was also calculated for this comparison which resulted in $q = .77$. Cohen (1988) has proposed that effect size of .1 is considered small, .3 is medium, and .5 is considered large. The effect size of the difference between achievement and self-concepts is large. Such results indicate that math and verbal self-concepts are substantially less correlated than math and English achievement for the United States 10th grade population. Therefore, Marsh's findings that math and verbal self-concepts are substantially less correlated (-.02 in his study) than math and English achievement (.88 in his study) is confirmed for the 10th graders in the U.S. for 1990. After the subjects were divided by gender, the correlation between math and verbal self-concept was still substantially lower than that of math and English achievement for either group. The correlation coefficients were .73 vs. .20 for males and .74 vs. .10 for females (see Table 3). The z statistic of Fisher's transformations was 51.34 ($p < .0001$) for males and 60.11 ($p < .0001$) for females. Corresponding effect sizes are 0.73 and 0.85 for males and females, respectively. Such results indicate that the finding that math and verbal self-concepts are substantially less correlated than the math and English achievement is indeed invariant across males and females.

When the subjects were divided into a gifted and a non-gifted group, math and verbal self-concept scores for either group were still less correlated than math and English achievement scores. The results, shown in Table 4, were $r = .79$ vs. $r = .18$ for the gifted; $r = .68$ vs. $r = .08$ for non-gifted. The z statistic of Fisher's transformations was 62.87 ($p < .0001$) for gifted and 53.61 ($p < .0001$) for non-gifted. The corresponding effect sizes were 0.89 and 0.76 for gifted and non-gifted, respectively. These results indicate that the finding that math and verbal self-concepts are substantially less correlated than the math and English achievement is indeed invariant across giftedness.

The second research question concerned the relationship between individual achievement and self-concept constructs. Analysis of the effects of individual achievement showed that math achievement had a direct effect on math self-concept with a path coefficient of .70, whereas the path coefficient for individual English achievement on verbal self-concept was .32 (see Table 2). The relationship for math is thus stronger than that for English. In contrast, the direct effect of math achievement on verbal self-concept showed $r = .09$ while that of English on math self-concept had an $r = -.32$. These results provide some evidence to support Marsh's I/E model (Marsh, 1986, 1990b). The pattern of effects reported above for individual achievement on self-concept did not change when analyses were performed by gender. A Chi-square test of the differences among the respective correlations showed that none of the intergroup differences was statistically significant ($p > .01$). The estimated parameters are listed in Table 3 with the respective $\chi 2$ change being .2 for IM on MSC, 1.62 for IM on VSC, 4.51 for IE on VSC, and 5.85 for IE on MSC, all with one degree of freedom. A probability criterion of .01 was used to compensate for the large sample-inflated $\chi 2$ statistics. It can be concluded, therefore, that the individual level direct effects among math and English achievement and math and verbal self-concepts are invariant across males and females. With regard to the comparison of gifted and non-gifted students, again no significant differences ($p > .01$) were found for the direct effect of any of the parameters of IM, IE on MSC and VSC. For the four pairs of relevant parameters in estimated values (Table 4), the respective $\chi 2$

changes are, according to the order of appearance, .00 for IM on MSC, 3.17 for IM on VSC, 3.06 for IE on VSC, and .09 for IE on MSC. Thus, the conclusion from our data is that the pattern of influence from individual academic achievement on math and verbal self-concept is the same across gifted and non-gifted.

The third research question is related to school level achievement and its effect on self-concept. The results (in Table 2) show that school-average math scores are negatively related to math self-concept (-.20) but have no link to verbal self-concept (.02). School-average English scores also shows a small negative relationship with verbal self-concept (-.09), but a small positive one with math self-concept (.08). These findings are consistent with those reported by Marsh (1990b), and they therefore lend support to his "Big Fish Little Pond" theory. The pattern of effects reported above for school-average achievement on self-concept did not change when analyses were performed by gender. The respective parameters in estimated values in each group are listed in Table 3 with $\chi2$ change values of 2.63 for SM on MSC, 3.54 for SM on VSC, 5.84 for SE on VSC, and 2.04 for SE on MSC when $df = 1$. None of these $\chi2$ change values was significant at the .01 level. So, for either males or females, the effect of school-average scores on math and verbal self-concept constructs is consistent with the general observation that a school-average score affects either one of the academic self-concepts and has the opposite effect on the other academic self-concept. When gifted with the non-gifted students were compared, the negative effect of school-average math scores on math self-concept and that of school-average English scores on verbal self-concept did not change. While school-average math scores had an effect of -.14 on the gifted group, it showed -.17 on the non-gifted group. Although school-average English scores for the gifted was linked to verbal self-concept of (-.11), that for the non-gifted students was -.09 with a corresponding $\chi 2$ change as 2.38 and 1.68 (*df* = 1). None of these was significant ($p > .01$). When comparing the effect of SM on VSC and that of SE on MSC, however, the results show a slight difference. As Table 4 shows, the effect of SM on VSC was .05 for the non-gifted, but -.01 for the gifted; The $\chi 2$ = 6.10 (*df* = 1) was not significant ($p > .01$). The effect of SE on MSC was .04 for non-gifted, .09 for gifted; chi-square equal to 7.51 (df = 1) was marginal ($p = .01$). Considering the fact that the values of these parameters are near zero, one can conclude that school-average math scores do not affect verbal self-concept and school-average English scores do not affect math self-concept. These results fit both the gifted and non-gifted groups.

Our data also showed no statistically significant gender difference for the correlations between math and English achievement scores ($r = .73$ for males and $r = .74$ for females), but there was a statistically significant giftedness difference for the correlation between math and English achievement scores ($r = .79$ for gifted and $r = .68$ for non-gifted, $\chi 2$ = 133.06, *df* = 1, $p < .01$). There was a stronger correlation between math self-concept and verbal self-concept for U.S. 10th grade males ($r = .20$) than for the females ($r = .10$) ($\chi 2$ = 38.01, *df* = 1, $p < .01$); and a stronger correlation between math self-concept and verbal self-concept for gifted ($r = .18$) than for non-gifted students ($r = .08$) ($\chi 2$ = 16.65, *df* = 1, $p < .01$).

Conclusions and Discussion

The results of the current research support Marsh's I/E model in which math and verbal self-concepts are formed in relation to external and internal comparison processes. The joint operation of these two processes, which depends on the relative weight given to each, is consistent with the near-zero correlation between math and verbal self-concepts. Our data also support Marsh's BFLPE, which occurs when students have (1) lower academic self-concepts when they compare themselves to more able students and (2) higher academic self-concepts when they compare themselves to less able students. The replication is further strengthened because our data were derived from a more recent, large, and nationally representative sample, thus demonstrating the generality of the finding. No previous research has investigated whether the relationship found between achievement and self-concept in math and English, respectively, is invariant across gender and giftedness. Thus, these results extend those reported in the literature rather than support or refute them.

In most self-concept/achievement studies, researchers specifically try to test for differences in means. No such attempt was made here. Instead, we tested for differences in structure, which seems to be a more logical strategy than testing for mean differences. LISREL tests for differences in structure across multiple groups resulted in two interesting findings: (1) the correlation between math and English achievement is not significantly different for males and females, but the correlation between math and verbal self-concepts for the two groups do differ, and (2) the correlations between math and English achievement and between math and verbal self-concepts are both significantly greater for gifted than for non-gifted students. A most likely reason for the first finding is that as females mature their voices become more tentative and conflicted than males; they move "from self-confidence to self-consciousness" (Hancock, 1989). The possible interpretation of the second finding is that gifted student have more self-confidence. To confirm such speculations, testing the interactions of giftedness and gender will be needed.

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Appendix A

The correlation matrix of observed variables

	IM1	IM2	IM3	IM4	IE1	IE2
IM1	1.000					
IM2	0.653	1.000				
IM3	0.498	0.894	1.000			
IM4	0.314	0.581	0.771	1.000		
IE1	0.513	0.440	0.367	0.250	1.000	
IE2	0.476	0.663	0.678	0.589	0.538	1.000
SM1	0.455	0.393	0.339	0.251	0.272	0.313
SM2	0.344	0.544	0.510	0.381	0.256	0.407
SM3	0.295	0.511	0.551	0.456	0.224	0.410
SM4	0.224	0.394	0.475	0.538	0.176	0.370
SE1	0.286	0.301	0.267	0.206	0.470	0.344
SE2	0.288	0.421	0.425	0.372	0.300	0.525
MSC1	0.168	0.260	0.303	0.324	0.032	0.106
MSC2	0.182	0.296	0.337	0.361	0.037	0.131
MSC3	0.173	0.268	0.304	0.328	0.055	0.150
MSC4	0.139	0.214	0.250	0.264	0.095	0.131
VSC1	0.145	0.218	0.213	0.190	0.153	0.276
VSC2	0.118	0.191	0.192	0.157	0.124	0.262
VSC3	0.135	0.233	0.243	0.233	0.142	0.293
VSC4	0.174	0.205	0.202	0.178	0.210	0.272

CORRELATION MATRIX

	SM1	SM2	SM3	SM4	SE1	SE2
SM1	1.000					
SM2	0.745	1.000				
SM3	0.639	0.934	1.000			
SM4	0.487	0.724	0.858	1.000		
SE1	0.608	0.559	0.494	0.392	1.000	
SE2	0.623	0.781	0.783	0.703	0.660	1.000
MSC1	0.068	0.095	0.116	0.137	0.013	0.053
MSC2	0.067	0.107	0.128	0.153	0.018	0.055
MSC3	0.074	0.088	0.101	0.122	0.031	0.071
MSC4	0.078	0.090	0.103	0.107	0.076	0.076
VSC1	0.062	0.109	0.098	0.085	0.071	0.108
VSC2	0.041	0.094	0.088	0.070	0.051	0.098
VSC3	0.046	0.106	0.105	0.094	0.070	0.121
VSC4	0.074	0.094	0.095	0.082	0.104	0.113

CORRELATION MATRIX

	MSC1	MSC2	MSC3	MSC4	VSC1	VSC2
MSC1	1.000					
MSC2	0.780	1.000				
MSC3	0.775	0.761	1.000			
MSC4	0.539	0.502	0.562	1.000		
VSC1	0.067	0.131	0.114	0.064	1.000	
VSC2	0.078	0.081	0.082	0.024	0.665	1.000
VSC3	0.088	0.164	0.182	0.084	0.651	0.696
VSC4	0.000	0.047	0.067	0.162	0.536	0.493

CORRELATION MATRIX

	VSC3	VSC4
VSC3	1.000	
VSC4	0.546	1.000

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