

# The Structure of Academic Self-Concept: The Marsh/Shavelson Model

Herbert W. Marsh

School of Education and Language Studies  
University of Western Sydney, Macarthur, New South Wales, Australia

New academic self-concept instruments were used to measure self-concepts in 13 (Grades 5-6) or 16 (Grades 7-10) school subjects and to test the structure of academic self-concept posited in the Marsh/Shavelson model. First-order factor analyses identified the scales each instrument was designed to measure, demonstrating that academic self-concept is remarkably subject-specific. As posited, two higher order factors were sufficient to explain relations among core academic subjects, but additional higher order factors were needed to explain other school subjects (e.g., physical education, art, and music). The hierarchy, however, was weak, and much of the variance in specific subject self-concepts was unexplained by the higher order factors. Researchers interested in self-concepts in particular subjects are advised to use self-concept scales specific to those subject areas in addition, perhaps, to other measures of academic self-concept.

Prior to the 1980s, reviewers of self-concept research noted a lack of theoretical models and appropriate measurement instruments. In an attempt to address this situation, Shavelson, Hubner, and Stanton (1976) reviewed existing theory, research, and instruments and developed a multifaceted, hierarchical model of self-concept. In their model a general facet at the apex of the self-concept hierarchy is divided into academic and nonacademic components of self-concept. Academic self-concept is then divided into self-concepts in particular subject areas (e.g., mathematics, English), and nonacademic self-concept is divided into social, emotional, and physical self-concepts. The academic portion of the Shavelson et al. model, which is the focus of this study, is shown in Panel A of Figure 1. The self-concept facets and the structure proposed by Shavelson et al. were heuristic and plausible, but they were not validated by research in their review. Commenting on this problem, Byrne (1984) noted that "many consider this inability to attain discriminant validity among the dimensions of SC [self-concept] to be one of the major complexities facing SC researchers today" (pp. 449-450). In contrast, more recent research based on better theoretical models and measurement instruments supports the multidimensionality of self-concept and many aspects of the Shavelson et al. model (e.g., Boersma & Chapman, 1979; Byrne, 1984; Dusek & Flaherty, 1981; Fleming & Courtney, 1984; Harter, 1982; Marsh, 1988, in press-a; Marsh, Byrne, & Shavelson, 1988; 1982; Soares & Soares, 1982).

The set of three Self Description Questionnaire (SDQ) instruments (Marsh, 1988, in press-b, in press-c) was developed to measure different areas of self-concept for preadolescents, early adolescents, and late adolescents. The facets of

self-concept in these instruments were derived from the Shavelson et al. (1976) model and provide a basis for testing the model. An important emphasis in this research has been on testing the multidimensionality of self-concept and, specifically, the factors that the SDQ instruments are designed to measure. To date, more than two dozen factor analyses of responses to SDQ instruments by diverse populations of subjects of different ages have identified the factors each instrument is designed to measure and are summarized in the respective test manuals. These factor analytic results provide strong support for the multidimensionality of self-concept, for the Shavelson et al. model with which the SDQ instruments were developed, and for the ability of the SDQ instruments to differentiate multiple dimensions of self-concept.

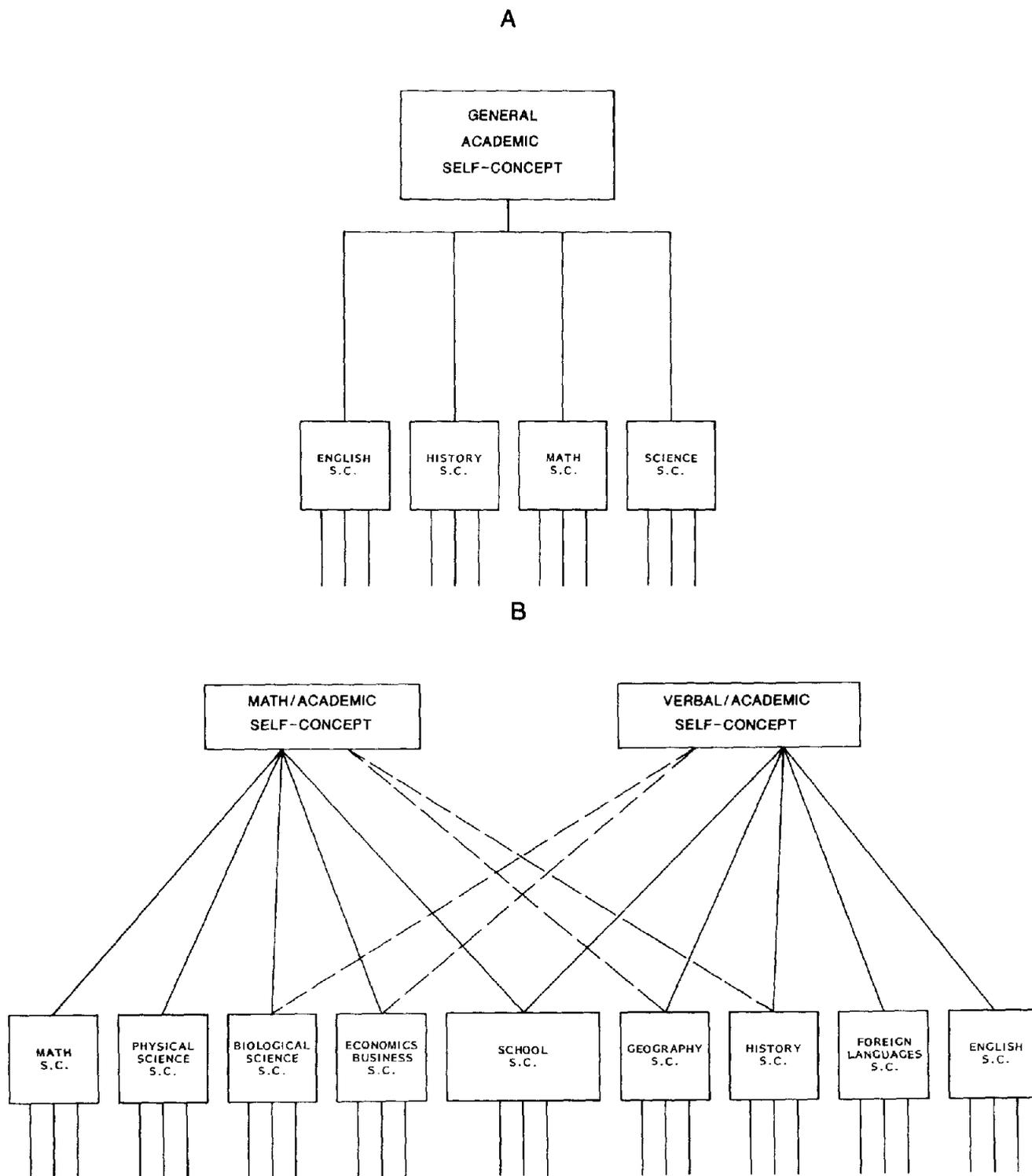
## The Marsh/Shavelson Model of Academic Self-Concept

Marsh and Hocevar (1985), Marsh and Shavelson (1985), and Shavelson and Marsh (1986) tested the first- and second-order structure of responses to the SDQ-I by students in Grades 2-5. First-order factor analyses at each grade level supported the factors that the instrument was designed to measure. A second-order model with just one higher order factor was unable to explain adequately relations among the first-order factors at any of the grade levels. A second-order model with two second-order factors—one defined by the nonacademic factors and one defined by the academic factors—did better but also was not adequate. The final hierarchical model posited two second-order, academic factors—Reading/Academic and Math/Academic self-concept—and a second-order nonacademic factor. This model fit the data significantly better than any of the other second-order models at each grade level. This final model was consistent with Shavelson et al.'s (1976) assumption that self-concept is hierarchically ordered, but the particular form of this higher order structure was more complicated than was previously proposed. This led to the Marsh/Shavelson revision (see Marsh

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Correspondence concerning this article should be addressed to Herbert W. Marsh, School of Education and Language Studies, University of Western Sydney, Macarthur, P.O. Box 555, Campbelltown, New South Wales 2560, Australia.



*Figure 1.* A: The academic portion of Shavelson, Hubner, and Stanton's (1976) original model. B: An elaboration of Marsh and Shavelson's (1985) revision that includes a wider variety of specific academic facets. (S.C. = self-concept. From "A Multifaceted Academic Self-Concept: Its Hierarchical Structure and Its Relation to Academic Achievement" by H. W. Marsh, B. M. Byrne, & R. J. Shavelson, 1988, *Journal of Educational Psychology*, 80, p. 378. Copyright 1988 by the American Psychological Association. Reprinted by permission.)

& Shavelson, 1985) of the Shavelson et al. model. The revision differs from the original Shavelson et al. model primarily in that there are two higher order academic factors—Math/Academic and Verbal/Academic—instead of just one. An elaborated version of the Marsh/Shavelson model is presented in Panel B of Figure 1.

In subsequent research (Marsh, 1987) the hierarchical structure of the SDQ-III, an instrument for late adolescents and young adults, was also tested. As in the SDQ-I research, a first-order model fit the data well, but simple hierarchical models positing one (general) or two (academic and nonacademic) higher order factors did not adequately fit the data. Of particular relevance to the present investigation is that the need for two second-order academic factors—Math/Academic and Verbal/Academic—was clearly supported. These results also indicate that the self-concept hierarchy is more complicated than originally anticipated by Shavelson et al. (1976).

Marsh, Byrne, and Shavelson (1988) tested the Marsh/Shavelson model by asking a large group of Canadian high school subjects to complete the Verbal, Math, and General School scales from three different self-concept instruments: the SDQ-III, the Self-Concept of Ability Scale (Brookover, 1962), and the Affective Perception Inventory (Soares & Soares, 1982). This research was important because it provided a strong test of the generality of results that were based on SDQ research in Australia to responses to other self-concept instruments by North Americans. Hierarchical confirmatory factor analysis was also used in this study. A first-order factor model provided good support for the nine a priori factors—Math, Verbal, and General School factors from each of the three self-concept instruments. The critical test was whether correlations among these nine first-order factors could be adequately explained by a single higher order factor, as posited in the original Shavelson et al. (1976) model, or whether two higher order factors, as posited in the Marsh/Shavelson revision, were required. The results showed conclusively that the Marsh/Shavelson model was superior. In fact, all three verbal self-concept scales were nearly uncorrelated with each of the three math self-concept scales. Similarly, in the hierarchical model based on the Marsh/Shavelson revision, the Verbal/Academic and Math/Academic higher order factors were not significantly correlated. These results provided strong support for the generality of earlier SDQ research and for the Marsh/Shavelson revision.

Marsh, Byrne, and Shavelson (1988) went on to critically evaluate the Marsh/Shavelson model. Support for the model was based primarily on the demonstration of problems with the original Shavelson et al. (1976) model. Although there was strong evidence that a single higher order academic component was inadequate, support for the adequacy of just two higher order academic factors was not strong. Part of the problem, Marsh, Byrne, and Shavelson argued, was that the revised model had not been presented in sufficient detail. To remedy this problem, they presented both models in their Figure 1, which is reprinted here. Panel A of Figure 1 shows the academic portion of the original Shavelson et al. model, and Panel B offers a more detailed development of the academic structure in the Marsh/Shavelson revision. The specific

academic facets in Panel B were selected to broadly reflect the core academic subjects in a typical academic curriculum, and the subject areas are roughly ordered from relatively pure measures of the Math/Academic component to relatively pure measures of the Verbal/Academic component. The evaluation of this model requires two important tests. First, are students able to differentiate their self-concepts in specific academic subjects so as to produce a well-defined structure of first-order factors reflecting each of the academic subjects in Panel B of Figure 1? Second, assuming that the first-order factor structure is well-defined, will the two higher order academic factors adequately explain the relations among the self-concepts in specific subjects?

### The Present Investigation

The purpose of this investigation was to test the structure of academic self-concept posited in the Marsh/Shavelson model (Figure 1, Panel B) and to test the limits of the model's generality. Whereas previous research has shown that a single higher order dimension of academic self-concept (Figure 1, Panel A) is inadequate, the Marsh/Shavelson model has not been tested with an array of subject-specific academic self-concepts as diverse as those shown in Figure 1, Panel B. As noted by Marsh, Byrne, and Shavelson (1988), academic self-concepts were more differentiated than anticipated in the original Shavelson et al. (1976) model, and a similar fate may befall the Marsh/Shavelson model when it is tested more fully. Although not specifically discussed by Marsh, Byrne, and Shavelson, the academic subject areas shown in Panel B of Figure 1 represent core academic subjects. If additional subjects (e.g., physical education, art, and music) were included, it is unlikely that just two higher order factors would be sufficient. Thus, the inclusion of an even more diverse variety of subjects than are shown in Figure 1, Panel B would test the limits of the Marsh/Shavelson model.

In order to test the Marsh/Shavelson model, I constructed two new academic self-concept instruments, the Academic Self Description Questionnaire (ASDQ) I and II, to assess a more diverse variety of academic self-concepts than has been previously considered. In consultation with school administrators at the school where the research was conducted, I determined the different school subjects taken by all subjects. Depending on grade level, students had taken either 12 or 15 different subjects. Corresponding six-items self-concept scales were constructed to assess academic self-concepts in each of the different subjects. For each scale, the wording of the six items was strictly parallel except for the particular subject area. For example, one of the six items was "I learn things quickly in [a specific subject area, e.g., mathematics]," and students responded to this item in relation to each of the 12 or 15 different subjects they had taken. In addition, a General School scale was constructed in which the term "most school subjects" was substituted for the specific academic subjects.

Separate analyses were done on the 13-scale (ASDQ-I) and the 16-scale (ASDQ-II) instruments. For both instruments, confirmatory factor analysis was used to test whether the 13 or 16 different scales could be identified, thus testing the first-order structure. Correlations among the first-order factors

were then used to test the hierarchical structure posited in the Marsh/Shavelson model. Initially, tests were conducted on relations among core academic factors such as those in Figure 1, Panel B. In subsequent analyses, the limits of the generality of the model were tested by including self-concepts in other subjects such as physical education, art, and music.

## Method

### *Sample and Procedure*

Students in this study were 234 boys in Grades 5 and 6 and 524 boys in Grades 7 through 10, who attended the same Catholic boys school in metropolitan Sydney Australia. The ASDQ-I and ASDQ-II instruments were based on the school subjects taken by each group of students (see description in the following paragraphs). Project staff met with the classroom teachers prior to collection of the data to describe how to administer the instruments. The ASDQ-I and ASDQ-II were administered by classroom teachers to all students in attendance on that day. Students were assured of the anonymity of their responses. Teachers read a standardized set of instructions to the students, who were then asked to complete sample items. (These instructions and sample items are the same as those on the SDQ-II instrument, Marsh, in press-b.) At the end of these standardized instructions, the following description was added: "Many of the sentences on the next pages are about school subjects (for example, Mathematics, Science, Art). Most of these are school subjects that you have studied this year. A few of the school subjects are ones that you have not studied this year but studied at some other time. For these school subjects try to remember how you felt when studying them."

The actual items were read aloud to the students, although they had copies of the questionnaires. Students were told the following: "I will be reading the sentences aloud to you. I am presenting the material this way instead of having you read them yourselves in order that everyone spends the same amount of time on each question." This procedure also ensured that all students completed the task at the same time, thus facilitating class control and reducing any effects of poor reading skills. (I describe this administration procedure in more detail in Marsh, 1988, in press-b.) After reading the items, the teachers gave the students a few minutes to check their responses. If students had questions about the meaning of any words or expressions, the teachers were instructed to "paraphrase the expression as best you can without changing the meaning, and ask the student to answer as best he can." Teachers reported that students had no difficulties in completing the instrument.

### *ASDQ-I and ASDQ-II Instruments*

The scales on the ASDQ instruments corresponded to school subjects actually taken by students at the two grade levels. On the ASDQ-I instrument (Grades 5-6), there were 12 subjects: Spelling, Reading, Handwriting, Social Studies, Computer Studies, Science, Mathematics, Physical Education, Art, Music, Religion and Health. For the purposes of this study, the first 7 were designated the core academic subjects, similar to those presented in Figure 1, Panel B. On the ASDQ-II instrument (Grades 7-10), there were 15 subjects: English Language, English Literature, Foreign Languages, History, Geography, Commerce, Computer Studies, Science, Mathematics, Physical Education, Health, Music, Art, Industrial Art, and Religion. For the purposes of this study, the first 9 were designated the core academic subjects.

A separate, six-item self-concept scale was constructed for each school subject. For all of the scales, the wording of the six items was strictly parallel except for the particular subject area. For both instruments the six items were the following: "Compared to others my age I am good at [a specific school subject]"; "I get good marks in [a specific school subject]"; "Work in [a specific school subject] classes is easy for me"; "I'm hopeless when it comes to [a specific school subject]" (reverse scored); "I learn things quickly in [a specific school subject]"; and "I have always done well in [a specific school subject]." In addition, a General School scale was constructed in which the term "most school subjects" was substituted for the specific academic subjects. In responding to each item, students selected one of six response categories: *false*; *mostly false*; *more false than true*; *more true than false*; *mostly true*; and *true*. Thus the ASDQ-I used in Grades 5-6 contained 13 scales on which self-concepts were inferred from responses to 78 items, and the ASDQ-II used in Grades 7-10 contained 16 scales on which self-concepts were inferred from responses to 96 items.

The design of the two new ASDQ instruments is based on previous research with the SDQ-I (Marsh, 1988) and the SDQ-II (Marsh, in press-b). The wording of the items is based on items from the SDQ-I and SDQ-II instruments. The six-point response scale is the same as the one used on the SDQ-II. The instructions given to students are nearly the same as those given for the SDQ-II. The use of items with parallel wording for different academic scales is also based on the SDQ-I (but only for the Reading, Math, and General School scales).

### *Statistical Analysis*

#### *Internal Consistency Estimates of Reliability*

In preliminary analyses, coefficient alpha estimates of reliability were determined for the scales from each instrument and item analyses were conducted to ensure that all of the items were working appropriately. For the ASDQ-I instrument (Grades 5-6), coefficient alpha estimates for the 13 scales varied from .881 to .941 (*Mdn* = .909). For the ASDQ-II instrument; (Grades 7-10), coefficient alpha estimates for the 16 scales varied from .885 to .949 (*Mdn* = .921).

#### *Exploratory Factor Analyses*

Preliminary exploratory factor analyses and subsequent confirmatory factor analyses were conducted on item-pair responses: The first two items in each six-item scale comprised the first item pair; the next two items comprised the second item pair; and the last two items comprised the third item pair. (The order of the items was randomized so that the wording of items in the first item pair varied depending on the scale.) The use of item pairs is typical in SDQ research, and I have presented the advantages of this approach elsewhere (Marsh, 1988; also see Marsh & O'Neill, 1984). The preliminary factor analyses were conducted on correlations among responses to the item pairs from each instrument with the commercially available SPSSx package (Statistical Package for the Social Sciences, 1986). For the responses to the ASDQ-I, a 13-factor solution identified all 13 self-concept scales that the instrument was designed to measure. For responses to the ASDQ-II, a 16-factor solution resulted in 16 reasonably well-defined factors. However, there was not a clear separation between the English Language and English Literature factors. Whereas there were two separate English factors, item pairs from both scales had substantial loadings on both factors. All of the remaining factors corresponded unambiguously to one of the scales the instrument was designed to measure. A 15-factor solution resulted in a well-defined solution in which responses to item pairs from the two English scales loaded on the same factor.

### *Confirmatory Factor Analysis*

The confirmatory factor analyses that constitute the major analyses were conducted with the commercially available LISREL V (Jöreskog & Sörbom, 1981) and LISREL VII (Jöreskog & Sörbom, 1988) statistical packages. The LISREL VII package is currently available for personal computers only, and some of the analyses were so large that the older, mainframe version of LISREL had to be used. Whereas the major focus of this study is the higher order structure of academic self-concepts, a critical initial step was to establish that the first-order solution is well-defined. The confirmatory factor analysis of ASDQ-I responses was conducted on the  $39 \times 39$  correlation matrix (i.e., 13 scales  $\times$  3 item pairs per scale), whereas the confirmatory factor analysis of ASDQ-II responses was conducted on a  $48 \times 48$  correlation matrix (i.e., 16 scales  $\times$  3 item pairs per scale). For both analyses, a very restrictive model was posited in which each measured variable was allowed to load on only the factor it was designed to measure; factor correlations were freely estimated; and the uniqueness terms for the item pairs were assumed to be uncorrelated. For both analyses, null models, models positing a single factor, and models positing uncorrelated factors were also fit to the data for comparison purposes.

### *Higher Order Factors*

Higher order factors are posited to explain correlations among first-order factors. Conceptually, this is similar to the process of doing a first-order factor analysis and then conducting a second, higher order factor analysis on the correlations among the first-order factors. Typically, first- and second-order factors are estimated in the same analysis (see Marsh & Hocevar, 1985; Marsh, Byrne, and Shavelson, 1988), but in this investigation the correlation matrix from the first-order solution was used as the basis for the higher order factor analysis. This approach substantially reduced the computer resources required to conduct the analysis, thus allowing the analyses to be conducted with the newer, personal computer version of LISREL VII. This approach also guaranteed that the first-order structure was the same across all analyses, precluding the necessity of reestimating the first-order structure for each higher order model.

### *Goodness of Fit*

Evaluation of a model generally consists of checking that (a) the solution is evaluated for technical difficulties such as out-of-range parameter estimates (e.g., negative estimates); (b) parameter estimates are evaluated in relation to a priori, theoretical predictions; and (c) tests of statistical significance and various indices of fit are used to evaluate the ability of the a priori model to fit the observed data. Marsh, Balla, and McDonald (1988); and Marsh and Balla (1990) evaluated the most widely used indices of fit and found that only the Tucker-Lewis index (TLI) was unbiased, was relatively independent of sample size, and penalized model complexity so that the addition of more parameters did not necessarily improve the fit of the model. The TLI is roughly analogous to the proportion of covariance explained by a model, and values greater than .9 are typically interpreted to mean that the fit is adequate.

When the a priori model does not fit adequately, the fit can be improved by estimating additional parameters. The selection of additional parameters can be justified on the basis of theory or empirical criteria. In LISREL VII (Jöreskog & Sörbom, 1988) modification indices are presented that provide an estimate of the change in the chi-square value that would result from freeing each fixed parameter. These a posteriori models must be interpreted cautiously. Because it will typically be possible to free enough parameters to achieve an acceptable fit, goodness-of-fit indices may not be useful in evaluating the

final a posteriori solution. If, however, the substantive interpretation of the final a posteriori solution supports the a priori predictions and is similar to the substantive interpretation of the original a priori solution, then the interpretation may be warranted.

I have also previously raised issues specific to the evaluation of higher order factors (Marsh, 1987; Marsh & Hocevar, 1985). The goodness of fit of a higher order model is evaluated in part by its ability to adequately explain covariation among the first-order factors. If, however, the first-order factors are relatively uncorrelated, then any higher order structure will be able to provide an adequate fit because there is little covariation to fit. The first-order factors are not, however, well represented by such a higher order structure in that most of the variance in each first-order factor is unexplained by the higher order factors. The first-order factor variance is represented as residual variance, that is, variance that is specific to that factor and not explained by the higher order factors. I (Marsh, 1987) recommended the following two additional steps in the evaluation of higher order factors.

1. The fit of a first-order model in which the first-order factors are constrained to be uncorrelated should be compared to the fit of the corresponding first-order model in which the correlations are freely estimated. If the difference in fit is not substantial, then the hierarchy may be so weak as not to warrant further investigation.

2. The size of residual variances in the first-order factors should be considered in evaluating the hierarchical model. Because the first-order factors are corrected for unreliability, any residual variance represents variance specific to the first-order factor that cannot be explained by the higher order factors. If the residual variance is substantial, then that first-order factor is not well represented by the higher order factors.

## Results

### *First-Order Factor Structure*

Fitting the first-order factor structure is an important first step in evaluating a higher order structure. If the first-order structure is not well-defined, then it may make no sense to proceed to evaluating a second-order structure. If the first-order structure with correlated factors does not fit the data substantially better than a first-order structure with uncorrelated factors, then the hierarchy may be so weak that further analyses are unjustified. A careful consideration of the first-order structure is also important in this investigation because this is the first time that the ASDQ-I and ASDQ-II instruments have been used, so it is important to test their ability to differentiate among the factors which they are designed to measure. Also, no previous research has attempted to identify nearly so many different components of academic self-concept. Thus it is substantively important to evaluate the ability of students to differentiate among so many different components of academic self-concept.

### *Evaluation of the First-Order Models*

Based on the design of the ASDQ instruments, the a priori models posited 13 (ASDQ-I) and 16 (ASDQ-II) factors in which (a) each measured variable (i.e., responses to an item pair) was associated only with the factor it was designed to measure, and all other factor loadings were fixed at zero; (b) correlations among the factors were freely estimated; and (c)

uniquenesses associated with the different measured variables were uncorrelated. The solutions based on the a priori models were proper in that neither had any out-of-range parameter estimates. Factor loadings for the measured variables were all large and statistically significant, varying from .743 to .974 (*Mdn* = .886) for the ASDQ-I and from .668 to .967 (*Mdn* = .889) for the ASDQ-II. For both instruments at least one of the three factor loadings for each factor was .90 or greater. Uniquenesses associated with each of the measured variables varied from 0.052 to 0.448 (*Mdn* = .218) for the ASDQ-I and from .066 to .527 (*Mdn* = .211) for the ASDQ-II. These parameter estimates demonstrate that each of the 13 ASDQ-I factors and 16 ASDQ-II factors is well-defined.

Goodness-of-fit indices (Table 1) for the a priori ASDQ-I model (TLI = .912) and the a priori ASDQ-II model (TLI = .939) were good. Alternative models in which one (General Academic) factor was fit and in which the correlations among the 13 factors in the a priori model were fixed at zero were,

not surprisingly, unable to fit the data nearly as well. The fit of the one-factor model was particularly poor (TLIs = .310 and .286 for the ASDQ-I and ASDQ-II, respectively). Whereas constraining all of the correlations among the factors to be zero resulted in a substantially poorer fit (TLIs = 0.750 and .799, respectively), the fit was surprisingly good. This is an important finding because the purpose of higher order factors is to explain these correlations. If the first-order factors are not substantially correlated, then the hierarchical structure must necessarily be weak. These results indicate that the a priori model provides a good fit to the data and provides support for the ability of the students to distinguish self-concepts in a wide array of different subject areas.

### Correlations Among First-Order Factors

Correlations among the first-order factors (Tables 2 and 3) produced by the first-order factor analyses described in the

Table 1  
*Goodness-of-Fit Indices for First-Order and Higher Order Factor Structures*

| Model description                      | $\chi^2$  | <i>df</i> | $\chi^2/df$ | TLI   | BBI  |
|----------------------------------------|-----------|-----------|-------------|-------|------|
| First-order factor structures          |           |           |             |       |      |
| ASDQ-I study (Grades 5-6)              |           |           |             |       |      |
| 13 correlated factors <sup>a</sup>     | 1,189.09  | 624       | 1.91        | .912  | .858 |
| 13 uncorrelated factors                | 2,512.54  | 702       | 3.58        | .750  | .700 |
| 1 general factor                       | 5,693.79  | 702       | 8.11        | .310  | .320 |
| Null model                             | 8,374.61  | 741       | 11.30       | 0     | 0    |
| ASDQ-II study (Grades 7-10)            |           |           |             |       |      |
| 16 correlated factors <sup>a</sup>     | 2,093.07  | 960       | 2.18        | .939  | .909 |
| 13 uncorrelated factors                | 5,678.21  | 1080      | 5.26        | .779  | .752 |
| 1 general factor                       | 15,953.12 | 1080      | 14.77       | .286  | .303 |
| Null model                             | 22,894.00 | 1128      | 20.30       | 0     | 0    |
| Second-order factor structures         |           |           |             |       |      |
| ASDQ-I study (Grades 5-6)              |           |           |             |       |      |
| 8 first-order factors (core academic)  |           |           |             |       |      |
| 1 general factor                       | 339.41    | 20        | 16.97       | .623  | .720 |
| 2 higher order factors <sup>a</sup>    | 203.76    | 17        | 11.99       | .741  | .832 |
| 2 higher order factors <sup>b</sup>    | 7.52      | 10        | 0.75        | 1.006 | .994 |
| Null model                             | 1,214.54  | 28        | 43.38       | 0     | 0    |
| All 13 first-order factors             |           |           |             |       |      |
| 1 general higher order factor          | 715.01    | 65        | 11.00       | .546  | .602 |
| 2 higher order factors <sup>a</sup>    | 539.14    | 57        | 9.46        | .616  | .700 |
| 2 higher order factors <sup>b</sup>    | 41.91     | 38        | 1.10        | .995  | .977 |
| 4 higher order factors <sup>a</sup>    | 399.18    | 59        | 6.77        | .738  | .778 |
| 4 higher order factors <sup>b</sup>    | 42.56     | 42        | 1.01        | 1.000 | .965 |
| Null model                             | 1,797.47  | 78        | 23.04       | 0     | 0    |
| ASDQ-II study (Grades 7-10)            |           |           |             |       |      |
| 10 first-order factors (core academic) |           |           |             |       |      |
| 1 general higher order factor          | 1,104.75  | 35        | 31.56       | .629  | .705 |
| 2 higher order factors <sup>a</sup>    | 201.27    | 29        | 6.94        | .928  | .946 |
| 2 higher order factors <sup>b</sup>    | 22.96     | 19        | 1.21        | .997  | .994 |
| Null model                             | 3,751.73  | 45        | 83.37       | 0     | 0    |
| All 16 first-order factors             |           |           |             |       |      |
| 1 general higher order factor          | 2,850.99  | 104       | 27.41       | .397  | .470 |
| 2 higher order factors <sup>a</sup>    | 1,290.34  | 95        | 13.58       | .713  | .760 |
| 2 higher order factors <sup>b</sup>    | 54.71     | 47        | 1.16        | .996  | .990 |
| 4 higher order factors <sup>a</sup>    | 652.99    | 85        | 7.68        | .848  | .879 |
| 4 higher order factors <sup>b</sup>    | 70.03     | 61        | 1.15        | .997  | .987 |
| Null model                             | 5,378.84  | 120       | 44.82       | 0     | 0    |

Note. TLI = Tucker-Lewis index; BBI = Bentler-Bonett index; ASDQ-I = Academic Self Description Questionnaire I; and ASDQ-II = Academic Self Description Questionnaire II.

<sup>a</sup>A priori model. <sup>b</sup>A posteriori model.

Table 2

Correlations Among 13 First-Order Factors in the Academic Self Description Questionnaire I (ASDQ-I) Study (Grades 5-6)

| ASDQ-I factor                    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13 |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|----|
| 1. Computer Studies <sup>a</sup> | —    |      |      |      |      |      |      |      |      |      |      |      |    |
| 2. Spelling <sup>a</sup>         | .276 | —    |      |      |      |      |      |      |      |      |      |      |    |
| 3. Mathematics <sup>a</sup>      | .326 | .296 | —    |      |      |      |      |      |      |      |      |      |    |
| 4. Physical Education            | .080 | .080 | .122 | —    |      |      |      |      |      |      |      |      |    |
| 5. Reading <sup>a</sup>          | .346 | .624 | .209 | .037 | —    |      |      |      |      |      |      |      |    |
| 6. Art                           | .395 | .074 | .160 | .326 | .139 | —    |      |      |      |      |      |      |    |
| 7. Science <sup>a</sup>          | .616 | .417 | .414 | .241 | .475 | .430 | —    |      |      |      |      |      |    |
| 8. Music                         | .383 | .378 | .340 | .029 | .338 | .219 | .332 | —    |      |      |      |      |    |
| 9. Social Studies <sup>a</sup>   | .514 | .449 | .395 | .236 | .521 | .436 | .911 | .295 | —    |      |      |      |    |
| 10. Handwriting <sup>a</sup>     | .156 | .441 | .206 | .236 | .237 | .233 | .228 | .249 | .259 | —    |      |      |    |
| 11. Religion                     | .356 | .286 | .194 | .166 | .313 | .325 | .372 | .212 | .398 | .165 | —    |      |    |
| 12. Health                       | .338 | .088 | .137 | .732 | .167 | .395 | .513 | .099 | .507 | .180 | .343 | —    |    |
| 13. General School <sup>a</sup>  | .461 | .619 | .695 | .180 | .568 | .228 | .682 | .336 | .732 | .256 | .263 | .360 | —  |

<sup>a</sup>Core academic factors.

preceding section were the basis of subsequent analysis. These correlations are relations among latent constructs that have been corrected for measurement error and thus are larger than those that would be obtained from simply correlating scale errors representing the different factors. Several characteristics of particular relevance are as follows:

1. If the correlation between any two factors approaches 1.0, then students may not distinguish between these factors.

2. There is an implicit assumption that the core academic scales (those with superscripts in Tables 2 and 3) chosen to represent those in Figure 1, Panel B are more central to academic self-concept than are the remaining scales (e.g., physical education, art, and music). If the General School factor is consistently more highly correlated with the core academic scales than with the remaining scales, then there is support for this assumption.

3. Scales that are not substantially correlated with the academic core scales will not be well represented by the two higher order factors posited in the Marsh/Shavelson model (Figure 1, Panel B). Scales that are highly correlated with each other but not highly correlated with the core academic scales suggest the need for more than two higher order factors. Scales

that are not substantially correlated with any other scales will not be well represented by any higher order factors.

*ASDQ-I Study (Grades 5-6).* The correlations among the 13 factors derived from the ASDQ-I study (Table 2) were all positive, but they varied from .037 (Physical Education and Music) to .91 (Science and Social Studies). The General School factor was substantially more highly correlated with the core academic factors (.256 to .732, *Mdn* = .619) than with the other factors (.180 to .336, *Mdn* = .300). The two sets overlapped in that the Religion and Health factors were somewhat more highly correlated with the General School scale than was the Handwriting factor. Physical Education was substantially correlated with Health (.732) but not with any other scales, suggesting that a second-order Physical Education factor may be necessary. The Art, Music, and Religion factors were not substantially correlated with any of the remaining 10 scales suggesting that they cannot be well explained by second-order factors.

*ASDQ-II Study (Grades 7-10).* The correlations among the 16 factors derived from the ASDQ-II study (Table 3) varied from -.03 (Physical Education and Music) to .98 (English Language and English Literature). The extremely

Table 3

Correlations Among 16 First-Order Factors in the Academic Self Description Questionnaire II (ASDQ-II) Study (Grades 7-10)

| ASDQ-II factor                     | 1    | 2    | 3    | 4    | 5     | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   | 16 |
|------------------------------------|------|------|------|------|-------|------|------|------|------|------|------|------|------|------|------|----|
| 1. Computer Studies <sup>a</sup>   | —    |      |      |      |       |      |      |      |      |      |      |      |      |      |      |    |
| 2. English Language <sup>a</sup>   | .302 | —    |      |      |       |      |      |      |      |      |      |      |      |      |      |    |
| 3. History <sup>a</sup>            | .274 | .561 | —    |      |       |      |      |      |      |      |      |      |      |      |      |    |
| 4. Mathematics <sup>a</sup>        | .382 | .337 | .330 | —    |       |      |      |      |      |      |      |      |      |      |      |    |
| 5. Physical Education              | .098 | .097 | .155 | .061 | —     |      |      |      |      |      |      |      |      |      |      |    |
| 6. English Literature <sup>a</sup> | .256 | .982 | .526 | .292 | .105  | —    |      |      |      |      |      |      |      |      |      |    |
| 7. Art                             | .343 | .171 | .260 | .121 | .165  | .187 | —    |      |      |      |      |      |      |      |      |    |
| 8. Science <sup>a</sup>            | .402 | .407 | .431 | .553 | .117  | .356 | .202 | —    |      |      |      |      |      |      |      |    |
| 9. Commerce <sup>a</sup>           | .238 | .483 | .371 | .343 | .165  | .449 | .076 | .370 | —    |      |      |      |      |      |      |    |
| 10. Music                          | .354 | .264 | .288 | .244 | -.032 | .302 | .357 | .280 | .177 | —    |      |      |      |      |      |    |
| 11. Geography <sup>a</sup>         | .280 | .346 | .440 | .346 | .165  | .354 | .215 | .328 | .348 | .307 | —    |      |      |      |      |    |
| 12. Industrial Arts                | .362 | .107 | .179 | .204 | .265  | .139 | .744 | .209 | .092 | .278 | .232 | —    |      |      |      |    |
| 13. Foreign Languages <sup>a</sup> | .370 | .427 | .343 | .337 | -.004 | .400 | .286 | .356 | .266 | .440 | .320 | .249 | —    |      |      |    |
| 14. Religion                       | .379 | .477 | .446 | .223 | .167  | .466 | .324 | .297 | .365 | .311 | .345 | .268 | .392 | —    |      |    |
| 15. Health                         | .328 | .377 | .433 | .235 | .545  | .394 | .291 | .311 | .300 | .202 | .315 | .346 | .226 | .469 | —    |    |
| 16. General School <sup>a</sup>    | .423 | .663 | .591 | .745 | .251  | .603 | .213 | .673 | .559 | .295 | .469 | .218 | .403 | .492 | .444 | —  |

<sup>a</sup>Core academic factors.

high correlation between the two English scales suggests that students may not distinguish between these two scales, which may cause complications in subsequent higher order factor analyses. The General School factor was substantially more highly correlated with the core academic factors (.40 to .75, *Mdn* = .591) than with the other factors (.21 to .49, *Mdn* = .29). The two sets overlap in that Health and Religion were somewhat more highly correlated with General School than were Computer Studies, Foreign Languages, and, perhaps, Geography. Physical Education was substantially correlated with Health (.55) but was not substantially correlated with any other factors, suggesting that a second-order Physical Education factor may be necessary. Art was substantially correlated with Industrial Arts, and to a lesser extent, Music and Religion, but was not substantially correlated with other factors, suggesting that a second-order Art factor may be necessary.

### *Higher Order Factor Analyses*

For both studies, the initial analyses were conducted on the set of core academic factors selected to represent those in Figure 1, Panel B. Models with just one (General Academic) and two (Verbal/Academic and Math/Academic) higher order factors were tested, but it was predicted that two higher order factors would be needed. The a priori models positing two higher order factors are similar to the model in Figure 1, Panel B, although the specific components of academic self-concept vary somewhat. The parameter estimates and fit indices for the initial, a priori models positing two higher order factors were reasonable. Nevertheless, inspection of the modification indices indicated that the fit of these models could be improved by freeing additional parameters. Support for the Marsh/Shavelson model was then evaluated in relation to the parameter estimates derived from both the initial a priori model and the final a posteriori model. Subsequent analyses were conducted on the entire set of first-order factors in each study. These additional first-order factors were included specifically to test the limits of the generality of the Marsh/Shavelson model. It was not anticipated that a model with two higher order factors, such as the one shown in Figure 1, Panel B, would be sufficient to explain relations among the larger sets of first-order factors. At least two additional higher order factors—Physical Education and Art—were thought to be required in addition to the Math/Academic and Verbal/Academic factors in Figure 1, Panel B. Models positing one, two and four higher order factors were tested in each study.

### *ASDQ-I Study (Grades 5–6)*

*Core academic scales.* Correlations among self-concepts in eight core academic subjects were posited to reflect two higher order factors. The fit of the model positing only one higher order factor was not adequate (*TLI* = .623; Table I), and it is not considered further. The fit of the initial a priori model based on Figure 1, Panel B, which posited two higher order factors (*TLI* = .741) was better. An evaluation of this a priori solution, however, revealed several problems. First, the

overall goodness of fit for the model was not particularly good, and the modification indices suggested that additional parameters were needed. Second, whereas the first higher order factor was posited to represent Mathematics, the factor loadings for Science, Social Studies, and Computer Studies were all higher than that for Mathematics (see Table 4). Third, three of the eight scales (Computer Studies, Mathematics, and Handwriting) had residual variances greater than .5, indicating that less than half of the variance in these first-order factors could be explained by the higher order factors.

Additional a posteriori models were examined using the automatic model modification option in LISREL VII (Jöreskog & Sörbom, 1988). Three limitations were placed on the fixed parameters considered in this process: (a) The first-order Math and Science factors were not allowed to load on the second-order Verbal factor; (b) the first-order Reading factor was not allowed to load on the second-order Math factor; and (c) parameters that resulted in improper solutions were not freed. It is important to emphasize that the final a posteriori model resulting from this process is necessarily able to fit the data (i.e., the chi-square will be nonsignificant and the goodness of fit will be very high). The important questions, however, are the following: (a) How similar are the parameter estimates from this a posteriori model to those that are based on the original a priori model? and (b) Do the parameter estimates from the final a posteriori model support the theory underlying the original a priori model? The parameter estimates based on the original a priori model are generally similar to those based on the final a posteriori model (Table 4); none differed by more than .15 and most differences were much smaller. More important, the substantive interpretation of the factors is similar for both the a priori and a posteriori solutions.

Although parameter estimates for both the a priori and a posteriori solutions are generally supportive of the Marsh/Shavelson model, there are important limitations to this support. First, the second-order factor intended to represent Mathematics can better be characterized as a Science factor. Second, the residual variances for many of the first-order factors are large, indicating that much of the variance in each of these factors is unique to that factor and cannot be explained in terms of the higher order factors. Third, the correlation between the two higher order factors is substantial and does not support the contention that the higher order factors are relatively uncorrelated.

*The entire set of scales.* Correlations among the entire set of 13 ASDQ-I first-order factors were fit by models positing one (General Academic), two (Math/Academic and Verbal/Academic as in Figure 1, Panel B), and four (Math/Academic and Verbal/Academic, Physical Education, and Art) higher order factors.

The ability of a priori models positing either one or two higher order factors to fit the data was poor (*TLIs* = .546 and .616, respectively). Inspection of the modification indices for the two-factor model indicated that this model was unable to account for the large correlation between Physical Education and Health, and, to lesser extents, correlations between Art and Music and between Art and Computer Studies. By freeing enough different residual correlations among first-order fac-

Table 4  
*Academic Self Description Questionnaire I Study (Grades 5–6): Two Higher Order Factor Solutions Based on the 8 Core Academic Scales and Parameter Estimates for the Initial and Final Solutions*

| Factor          | Higher order factors |       |         |       | Residual variance <sup>a</sup> |       |
|-----------------|----------------------|-------|---------|-------|--------------------------------|-------|
|                 | Math                 |       | Verbal  |       | Initial                        | Final |
|                 | Initial              | Final | Initial | Final |                                |       |
| Factor loadings |                      |       |         |       |                                |       |
| First order     |                      |       |         |       |                                |       |
| CS              | .612                 | .651  | .0      | .0    | .626                           | .576  |
| SP              | .0                   | .0    | .851    | .732  | .276                           | .470  |
| MA              | .445                 | .518  | .0      | .0    | .802                           | .470  |
| RD              | .0                   | .0    | .739    | .865  | .454                           | .260  |
| SC              | .973                 | .937  | .0      | .0    | .054                           | .119  |
| SS              | .875                 | .644  | .108    | .224  | .118                           | .361  |
| HW              | .0                   | .0    | .432    | .309  | .813                           | .904  |
| GS              | .454                 | .544  | .485    | .314  | .314                           | .396  |
| Correlations    |                      |       |         |       |                                |       |
| Higher order    |                      |       |         |       |                                |       |
| Math            | —                    | —     |         |       |                                |       |
| Verbal          | .553                 | .600  | —       | —     |                                |       |

*Note:* All parameters are presented in standardized form. Parameters with values of .0 and 1.0 were fixed values, whereas all others were freely estimated. CS = Computer Studies; SP = Spelling; MA = Mathematics; RD = Reading; SC = Science; SS = Social Studies; HW = Handwriting; and GS = General School.

<sup>a</sup>For the initial solution, all residual covariances were fixed at zero. For the final solution, selected residual covariances were estimated, but space limitations preclude their presentation.

tors, an a posteriori model positing only two higher order factors was able to fit the data. The five additional first-order factors (Physical Education, Health, Art, Religion, and Music), however, were not well represented in the a posteriori model; most of the variance in these factors was unexplained by the two higher order factors. From this perspective it is clear that additional higher order factors are needed. The ability of the a priori model with four higher order factors to fit the ASDQ-I data ( $TLI = .738$ ) was better than that of the two-factor model. Here again, however, the modification indices suggested the need to free additional parameters. Each of the solutions with four higher order factors—a priori and a posteriori—were, however, improper in that the residual variance associated with the Health factor was slightly negative. In order to achieve proper solutions, this residual variance was set at a small positive value (.01) for all four-factor models were fit subject to this added constraint. Inspection of the solutions for the a priori solutions (Table 5) revealed substantial differences for several of the a priori parameter estimates. In particular, there were large changes in factor loadings for the Art, Music, Handwriting, and Religion factors. Handwriting was originally posited to be associated only with the second-order Verbal factor, but in the a posteriori solution it also loaded on the second-order Art factor. In the a priori model, Music and Religion were posited to be associated only with the Art factor. In the a posteriori model, however, both of these factors had substantial factor loadings on the second-order Verbal factor and smaller factor loadings on the second-order Art factor. Owing in part to this shift in the Music and Religion factors, the first-order Art factor better

represented the second-order Art factor in the a posteriori model than in the a priori model.

A particularly interesting feature of the four-factor models was that the General School first-order factor was hypothesized to load only on the second-order Math and Verbal factors and not on the second-order Physical Education and Art factors. For the a priori solution, the final a posteriori solution, and each of the interim a posteriori solutions, the modification indices supported this a priori structure. Modification indices for the factor loadings of the General School factor on the Physical Education and Art factors were consistently small. This suggests that two additional higher order factors may not be particularly important to overall academic self-concept.

The a posteriori solution based on the model with four higher order factors was reasonable, but the results should be evaluated in light of several limitations. First, all solutions were technically improper in that the residual variance term for the first-order Health factor was negative. Second, because there were substantial differences in the a priori and a posteriori solutions, the results of both should be viewed cautiously. Third, the Handwriting, Music, and Religion factors were not well represented in that most of the variance in these first-order factors remained in the residual variance term.

#### *ASDQ-II Study (Grades 7–10)*

*Core academic scales.* Models with one and two higher order factors were considered. The model with only one higher

Table 5

*Academic Self Description Questionnaire I Study (Grades 5–6): Four Higher Order Factor Solutions Based on All 13 Scales and Parameter Solutions for the Initial and Final Solutions*

| Factor             | Higher order factors |       |         |       |                    |       |         |       |                                |       |
|--------------------|----------------------|-------|---------|-------|--------------------|-------|---------|-------|--------------------------------|-------|
|                    | Math                 |       | Verbal  |       | Physical Education |       | Art     |       | Residual variance <sup>a</sup> |       |
|                    | Initial              | Final | Initial | Final | Initial            | Final | Initial | Final | Initial                        | Final |
| Factor loadings    |                      |       |         |       |                    |       |         |       |                                |       |
| First order        |                      |       |         |       |                    |       |         |       |                                |       |
| CS                 | .604                 | .668  | .0      | .0    | .0                 | .0    | .0      | .0    | .635                           | .554  |
| SP                 | .0                   | .0    | .881    | .805  | .0                 | .0    | .0      | .0    | .223                           | .349  |
| MA                 | .455                 | .472  | .0      | .0    | .0                 | .0    | .0      | .0    | .793                           | .801  |
| PE                 | .0                   | .0    | .0      | .0    | .735               | .754  | .0      | .0    | .460                           | .433  |
| RD                 | .0                   | .0    | .723    | .767  | .0                 | .0    | .0      | .0    | .477                           | .412  |
| AR                 | .0                   | .0    | .0      | .0    | .0                 | .0    | .565    | .808  | .681                           | .351  |
| SC                 | .955                 | .932  | .0      | .0    | .0                 | .0    | .0      | .0    | .088                           | .135  |
| MU                 | .0                   | .0    | .0      | .406  | .0                 | .0    | .408    | .141  | .833                           | .794  |
| SS                 | .950                 | .979  | .0      | .0    | .0                 | .0    | .0      | .0    | .097                           | .041  |
| HW                 | .0                   | .0    | .439    | .221  | .0                 | .0    | .0      | .266  | .807                           | .869  |
| RE                 | .0                   | .0    | .0      | .329  | .0                 | .0    | .551    | .375  | .697                           | .713  |
| HE                 | .0                   | .223  | .0      | .0    | .995               | .894  | .0      | .0    | .010                           | .010  |
| GS                 | .512                 | .456  | .420    | .465  | .0                 | .0    | .0      | .0    | .317                           | .309  |
| Correlations       |                      |       |         |       |                    |       |         |       |                                |       |
| Higher order       |                      |       |         |       |                    |       |         |       |                                |       |
| Math               | —                    | —     |         |       |                    |       |         |       |                                |       |
| Verbal             | .568                 | .616  | —       | —     |                    |       |         |       |                                |       |
| Physical Education | .535                 | .322  | .152    | .102  | —                  | —     |         |       |                                |       |
| Art                | .781                 | .571  | .518    | .147  | .588               | .570  | —       | —     |                                |       |

*Note.* All parameters are presented in standardized form. Parameters with values of zero were fixed, whereas all other parameters were freely estimated. CS = Computer Studies; SP = Spelling; MA = Mathematics; PE = Physical Education; RD = Reading; AR = Art; SC = Science; MU = Music; SS = Social Studies; HW = Handwriting; RE = Religion; HE = Health; and GS = General School.

<sup>a</sup> For the initial solution, all residual covariances were fixed at zero. For the final solution, selected residual covariances were estimated but space limitations precluded their presentation.

order factor, however, was not able to fit the data adequately (TLI = .629) and is not considered further.

In order to test the Marsh/Shavelson model (Figure 1, Panel B), correlations among 10 core academic scales were posited to represent two higher order factors. In the a priori model (Table 6), Mathematics, Science, and Computer Studies were posited to be associated only with the second-order Math factor, whereas English Language, English Literature, and Foreign Languages were posited to be associated only with the second-order Verbal factor. In addition, due to the extremely high correlation between English Language and English Literature (.98), a residual covariance relating the residual variances associated with these two first-order factors was posited. The solution for this model provides reasonable support for the Marsh/Shavelson model, and the fit (TLI = .928) is good. As posited, Math, Science, and, to a lesser extent, Computer Studies all have substantial loadings on the second-order Math factor. English Language, English Literature, and, to a lesser extent, Foreign Languages all have substantial loadings on the second-order Verbal factor. History, Commerce, and Geography were posited to be associated with both second-order factors. History and, to a lesser extent, Commerce, were more strongly associated with the second-

order Verbal factor than the second-order Math factor, whereas Geography was about equally associated with both second-order factors. General School was associated with both second-order factors, but was substantially more strongly associated with the second-order Math factor.

A number of large modification indices indicated suggested the need for additional, a posteriori adjustments. These adjustments resulted in several substantively important changes in the parameter estimates. In the final a posteriori model, Foreign Languages was associated with both higher order factors, although its relation to the second-order Verbal factor was greater than its relation to the second-order Math factor. As in the ASDQ-I study (Grades 5–6), there was a substantial residual covariance term relating Math and General School factors. This resulted in a smaller association between the first-order Math factor and the higher order Math factor. In the a posteriori model, the second-order Math factor was somewhat more strongly related to Science than to Math. Also, General School was almost equally associated with the two second-order factors.

Both the initial and final models (Table 6) provided support for the Marsh/Shavelson model, but several limitations should be noted. First, in the a posteriori model, the second-

Table 6  
*Academic Self Description Questionnaire II Study (Grades 7–10): Higher Order Factors  
 Based on 10 Core Academic Scales*

| Factor          | Higher order factors |       |         |       | Residual variance <sup>a</sup> |       |
|-----------------|----------------------|-------|---------|-------|--------------------------------|-------|
|                 | Math                 |       | Verbal  |       | Initial                        | Final |
|                 | Initial              | Final | Initial | Final |                                |       |
| Factor loadings |                      |       |         |       |                                |       |
| First order     |                      |       |         |       |                                |       |
| CS              | .451                 | .511  | .0      | .0    | .797                           | .737  |
| EG              | .0                   | .0    | .827    | .830  | .316                           | .311  |
| HI              | .084                 | .200  | .623    | .529  | .536                           | .551  |
| MA              | .812                 | .688  | .0      | .0    | .410                           | .524  |
| EL              | .0                   | .0    | .768    | .764  | .347                           | .417  |
| SC              | .708                 | .806  | .0      | .0    | .499                           | .348  |
| CO              | .181                 | .206  | .466    | .454  | .638                           | .638  |
| GE              | .274                 | .382  | .264    | .214  | .759                           | .709  |
| FL              | .0                   | .260  | .481    | .330  | .769                           | .715  |
| GS              | .682                 | .515  | .374    | .504  | .057                           | .170  |
| Correlations    |                      |       |         |       |                                |       |
| Higher order    |                      |       |         |       |                                |       |
| Math            | —                    | —     |         |       |                                |       |
| Verbal          | .661                 | .610  | —       | —     |                                |       |

*Note.* All parameters are presented in standardized form. Parameters with values of .0 and 1.0 were fixed values, whereas all others were freely estimated. CS = Computer Studies; EG = English Language; HI = History; MA = Mathematics; EL = English Literature; SC = Science; CO = Commerce; GE = Geography; FL = Foreign Languages; GS = General School.

<sup>a</sup> For the initial solution, all residual covariances were fixed at zero (except for a residual covariance of .340 between residual variances for English Literature and English Language). For the final solution, selected residual covariances were estimated but space limitations preclude their presentation.

order Math factor was actually somewhat more strongly associated with Science than with Math. As in the ASDQ-I study (Grades 5–6), there was a substantial residual covariance between Math and General School. This indicates that Math is more strongly associated with General School than can be accounted for by the a priori two-factor solution. Second, 5 of the 10 first-order factors had residual variances greater than .5 for both the initial and final a posteriori solutions. Thus, whereas the two-factor solution provides a good explanation of relations among the first-order factors, there is substantial variance in the first-order factors that is not explained by the higher order factors.

*The entire set of 16 first-order factors.* Higher-order factor models (Table 7) were posited to explain relations among the entire set of 16 first-order factors. As in the ASDQ-I study (Grades 5–6), a preliminary attempt was made to fit models with one and two higher order factors. Although the a priori two-factor model fit the data (TLI = .713) substantially better than the one-factor model (TLI = .397), neither was able to adequately fit the data. For the a priori model positing two higher order factors, there were substantial residual covariances relating Art to Industrial Arts and to Music, Physical Education to Health, and Music to English and Computer Studies. Although it was possible to achieve a good fit by freeing enough residual covariance terms, it was clear that additional second-order factors were needed.

The ability of the a priori model with four higher-order factors to fit the data (TLI = .848) was substantially better

than that of the two-factor model. Here again, however, the modification indices indicated the need to fit additional parameters. A comparison of the a priori and a posteriori solutions (Table 6) reveals several substantively important differences. Computer Studies was originally posited to be associated only with the second-order Math factor, but in the a posteriori model it was more substantially associated with the second-order Art factor. In the a posteriori solution, Math and General School were related by a substantial residual covariance term (see earlier discussion) so that the association of the first-order Math factor to the higher order Math factor was reduced in the a posteriori model. Also, there was a substantial residual covariance term relating Art and Industrial Arts so that the relation of these two first-order factors to the second-order Art factor was reduced in the a posteriori solution.

As in the ASDQ-I study (Grades 5–6), the first-order General School factor was posited to load only on the second-order Math and Verbal factors and not on the second-order Physical Education and Art factors. This a priori hypothesis was supported by an inspection of the modification indices for the a priori solution, the final a posteriori solution, and each of the interim a posteriori solutions; modification indices for the factor loadings of the first-order General School factor on the second-order Physical Education and Art factors were consistently small. This suggests that these additional two higher order factors are not particularly important to overall academic self-concept.

Table 7  
*Academic Self Description Questionnaire II Study (Grades 7–10): Four Higher Order Factor Solutions Based on All 16 Scales, Initial and Final Solutions*

| Factor          | Higher order factors |       |         |       |                    |       |         |       | Residual variance <sup>a</sup> |       |
|-----------------|----------------------|-------|---------|-------|--------------------|-------|---------|-------|--------------------------------|-------|
|                 | Math                 |       | Verbal  |       | Physical Education |       | Art     |       | Initial                        | Final |
|                 | Initial              | Final | Initial | Final | Initial            | Final | Initial | Final |                                |       |
| Factor loadings |                      |       |         |       |                    |       |         |       |                                |       |
| First order     |                      |       |         |       |                    |       |         |       |                                |       |
| CS              | .444                 | .278  | .0      | .0    | .0                 | .0    | .0      | .469  | .803                           | .572  |
| EG              | .0                   | .0    | .809    | .806  | .0                 | .0    | .0      | .0    | .345                           | .347  |
| HI              | .047                 | .048  | .668    | .611  | .0                 | .0    | .0      | .113  | .510                           | .527  |
| MA              | .803                 | .700  | .0      | .0    | .0                 | .0    | .0      | .0    | .355                           | .503  |
| PE              | .0                   | .0    | .0      | .0    | .785               | .776  | .0      | .0    | .384                           | .407  |
| EL              | .0                   | .0    | .761    | .746  | .0                 | .0    | .0      | .0    | .420                           | .442  |
| AR              | .0                   | .0    | .0      | .0    | .0                 | .0    | .888    | .614  | .211                           | .634  |
| SC              | .702                 | .793  | .0      | .0    | .0                 | .0    | .0      | .0    | .508                           | .371  |
| CO              | .178                 | .134  | .471    | .504  | .0                 | .0    | .0      | .0    | .634                           | .635  |
| MU              | .0                   | .0    | .269    | .191  | .0                 | -.290 | .351    | .610  | .773                           | .602  |
| GE              | .171                 | .142  | .337    | .298  | .0                 | .0    | .158    | .236  | .724                           | .710  |
| IN              | .0                   | .0    | .0      | .0    | .171               | .156  | .795    | .532  | .282                           | .644  |
| FL              | .0                   | .0    | .446    | .395  | .0                 | -.265 | .256    | .457  | .698                           | .589  |
| RE              | .0                   | -.291 | .566    | .692  | .0                 | .0    | .251    | .432  | .568                           | .468  |
| HE              | .140                 | .0    | .444    | .369  | .613               | .585  | .147    | .154  | .367                           | .320  |
| GS              | .708                 | .483  | .348    | .521  | .0                 | .0    | .0      | .0    | .047                           | .157  |
| Correlations    |                      |       |         |       |                    |       |         |       |                                |       |
| Higher order    |                      |       |         |       |                    |       |         |       |                                |       |
| Math            | —                    | —     |         |       |                    |       |         |       |                                |       |
| Verbal          | .670                 | .681  | —       | —     |                    |       |         |       |                                |       |
| Physical        |                      |       |         |       | —                  | —     |         |       |                                |       |
| Education       | .310                 | .156  | .186    | .102  | —                  | —     |         |       |                                |       |
| Art             | .252                 | .475  | .292    | .147  | .209               | .381  | —       | —     |                                |       |

Note. All parameters are presented in standardized form. Parameters with values of .0 and 1.0 were fixed values, whereas all others were freely estimated. CS = Computer Studies; EG = English Language; HI = History; MA = Mathematics; PE = Physical Education; EL = English Literature; AR = Art; SC = Science; CO = Commerce; MU = Music; GE = Geography; IN = Industrial Arts; FL = Foreign Languages; RE = Religion; HE = Health; and GS = General School.

<sup>a</sup> For the initial solution, all residual covariances were fixed at zero (except for a residual covariance of .366 between residual variances for English Literature and English Language; thus the residual variances are presented as a single column. For the final solution, selected residual covariances were estimated but space limitations preclude their presentation.

The solutions based on the four higher order factors are reasonable, but the results should be evaluated in light of several reservations. First, because there were differences in the a priori and a posteriori solutions, each should be viewed cautiously. Second, 6 (Computer Studies, History, Commerce, Music, Geography, and Religion) of the 16 first-order factors are not well represented by the higher order model in that their residual variance terms were greater than .5 in both a priori and a posteriori models.

#### Summary, Implications, and Directions for Further Research

##### *Implications for the Marsh/Shavelson Model*

The original Shavelson et al. (1976) model of self-concept hypothesized that self-concepts in specific school subjects could be explained in terms of a single higher order dimension of academic self-concept. A growing body of research subse-

quently demonstrated that at least two higher order academic factors—Math/Academic and Verbal/Academic—were required and led to the Marsh/Shavelson revision. Support for the Marsh/Shavelson model, however, came primarily from studies in which only three first-order academic factors—Math, Verbal, and General School—were considered. Indeed, no studies that I know of have considered more than a few components of academic self-concept, and most have considered only one. Thus, previous research is not adequate for testing the Marsh/Shavelson model.

In testing theoretical models it is widely recommended that the limits of the model be evaluated by including conditions under which the model is likely to fail, but this recommendation is seldom heeded in social science research. The Marsh/Shavelson model was specifically limited to core academic subjects (Figure 1, Panel B), and so it is not surprising that it failed to explain correlations among the expanded set of academic self-concepts. Thus the results establish important limitations in the Marsh/Shavelson model.

What are the implications of this study for the Marsh/Shavelson model? There is reasonable support for the model when consideration is limited to self-concepts in academic core subjects, but support is lacking when consideration is expanded to include self-concepts in other school subjects. Hence, support for the model is based in part on the somewhat arbitrary decision concerning which school subjects are "core" academic subjects. There was, however, some empirical support for the separation used here. The General School scale was substantially related to the second-order Math/Academic and Verbal/Academic factors but not to either of the additional higher order factors—Art and Physical Education—that were needed to explain self-concepts in other school subjects. Similarly, the General School scale was more highly correlated with self-concepts in the core subjects than with self-concepts in the other school subjects. It is also likely that some of the self-concepts in these other school subjects (e.g., Physical Education) are more highly correlated with nonacademic facets of self-concept (e.g., Physical Ability) than academic facets. Further research is needed to determine whether self-concepts in other school subjects, such as those considered here, contribute to academic self-concept and whether they should be considered a part of the structure of academic self-concept. Even if the particular distinction between core and other school subjects adapted here needs to be refined, it may still be useful. Pending the outcome of further research, it seems useful to retain the Marsh/Shavelson model as a summary of relations among self-concepts in core academic subjects but to note its limitations.

### *Math/Verbal Correlations*

Marsh, Byrne, and Shavelson (1988) found almost no correlation between math and verbal self-concepts and posited that the second-order factors would also be nearly uncorrelated. The lack of correlation between math and verbal self-concepts was consistent across the three self-concept instruments (the SDQ-III and two others) in that study and was consistent with previous SDQ studies (e.g., Marsh, 1986). In this investigation, however, Math correlated .209 with Reading in the Grades 5–6 study (Table 2) and .292 and .337 with English Literature and English Language, respectively, in the Grades 7–10 study (Table 3). These correlations are not large, particularly considering that they are corrected for unreliability, and they are substantially lower than correlations that are typically found between mathematics and verbal achievement test scores. They are, however, clearly greater than zero. Furthermore, the correlations between the two higher order Math and Verbal factors vary from .5 to .7 in the various higher order models (Tables 4–7). Hence, math and verbal self-concepts were more strongly correlated here than in previous research. Particularly because the math and verbal items on the ASDQ were derived from SDQ instruments, this inconsistency is puzzling.

I had hypothesized Marsh (1986; Marsh, Byrne, & Shavelson, 1988) that students use verbal skills as part of the frame of reference they use to evaluate their math skills, and vice versa. Hence, good math skills contribute to a high math self-concept but detract from the verbal self-concept, whereas

good verbal skills contribute to a high verbal self-concept but detract from the math self-concept. The internal comparison process indicates that academic self-concepts are much more differentiated than corresponding academic skills. This process, however, may be accentuated when considering only two content-specific components of academic self-concept. Previous research has often considered math and verbal self-concepts in combination with other areas of nonacademic self-concept but not with other subject-specific components of academic self-concept such as those considered here. Hence, the internal comparison process used in the present investigation could be expanded to compare academic skills in mathematics, for example, with skills in many other content areas instead of just skills in English. Further evaluation of this suggestion has important implications for how students formulate their academic self-concepts but is beyond the scope of the present investigation. An important initial step would be to relate academic performance measures in specific academic subjects to corresponding areas of academic self-concepts such as those considered here to determine, for example, whether math skills contribute negatively to verbal self-concept as I predicted (Marsh, 1986).

### *Practical Implications for the Application of Academic Self-Concept*

What are the practical implications of this study for researchers who want to use academic self-concept measures in other areas of research? It is important to emphasize that much of the variance in many of the first-order factors was not explained by the higher order factors (i.e., residual variances of the first-order factors were large). Whereas the two higher order factors can explain correlations among the first-order factors in academic core subjects with reasonable accuracy, the actual levels of self-concept on many of the first-order factors cannot be accurately inferred from the two higher order factors. Thus, support for the theoretical model should not be interpreted to mean that academic self-concepts in subjects like computer studies, handwriting, geography, history, foreign languages, and commerce can be well represented by more general components of academic self-concept. The results show quite the opposite. Researchers specifically interested in self-concepts in particular academic subjects should measure self-concepts with scales specific to those subjects in addition to, perhaps, other academic self-concept scales. I recommend this even more strongly for researchers interested in self-concepts in other school subjects such as physical education, art, and music.

Because previous research has not considered a diversity of academic self-concepts, a substantively important question is whether or not students differentiated among self-concepts associated with specific school subjects. Perhaps the most remarkable finding of this investigation was that first-order factor solutions in each study so clearly identified so many different components of academic self-concept. Apparently, students differentiate self-concepts in different school subjects to a much greater extent than has been previously recognized. This finding has important practical implications for researchers who are interested in studying self-concept in particular

school subjects. Furthermore, the design of the instruments used here, if not the specific scales, provides researchers with an easy way to measure academic self-concept in different school subjects that is applicable across most educational settings.

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