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ABSTRACT

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Verbal and Math Self-concepts: An Extension of the Internal/External Frame of Reference Model

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Running Head: Verbal & Math Self-concepts

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ABSTRACT

The internal/external (I/E) frame of reference model describes relations among Verbal self-concept (VSC), Math self-concept (MSC), and corresponding achievement scores (VACH, MACH). In support of the model Marsh (1986) found that: a) VSC and MSC were nearly uncorrelated; b) the effect of VACH on VSC, and of MACH on MSC, were positive; but c) the effects of VACH on MSC, and of MACH on VSC, were negative (higher skills in one area lead to lower self-concepts in the other area). However, the support was limited to responses just to the Self Description Questionnaires by Australian subjects. In the present investigation the findings were replicated with each of three different self-concept instruments for responses by Canadian senior high school students. An extension of the original model to include school grades across all classes, school self-concept, general self-concept, and gender did not affect support for the I/E model. However, this extension provided remarkably strong support for the specificity of multiple dimensions of self, and perhaps for the influence of sex stereotypes on academic self-concepts beyond what can be explained in terms of academic achievement.

In support of the construct validity of a multifaceted self-concept, research has found academic achievement to be more highly correlated with academic self-concept than with nonacademic and general self-concepts (Byrne, 1984), and achievement in particular content areas to be most highly correlated with self-concepts in the matching content areas (Marsh, 1986). Marsh (1986) proposed the internal/external (I/E) frame of reference model to describe why Verbal self-concept (VSC) and Math self-concept (MSC) are so distinct from each other and in their relations to the corresponding areas of academic achievement. The purpose of this investigation is to replicate and extend the theoretical and empirical support for this model, and to examine substantively related issues.

The I/E Frame of Reference Model.

The I/E model was developed in response to an apparent problem with the Shavelson model of self-concept (Shavelson, Hubner & Stanton, 1976). Shavelson posited self-concept to be a multifaceted, hierarchical construct, and he presented a possible representation of his hierarchical model where general self-concept (GSC) appears at the apex and is divided into academic and nonacademic self-concepts. According to his model self-concepts in particular academic areas (e.g., math, English, etc.) combine to form a general academic self-concept. Shavelson based his model, in part, on conceptually similar models of ability which posit a higher-order ability factor as well as more specific components of ability (e.g., Vernon, 1950). Also, achievement scores in mathematics and English typically correlate .5 to .8 with each other, and academic achievements and self-concepts are posited to be substantially related. Thus Shavelson posited that the different academic self-concepts would be substantially correlated and could be incorporated into a single facet of academic self-concept.

Marsh and Shavelson (1985) used responses by students in grades 2 - 5 to test the Shavelson model. While their findings generally supported the Shavelson model, the hierarchy proved to be more complicated than originally anticipated and led to a revision of the model. Of particular relevance to the present investigation, VSC and MSC were nearly uncorrelated, and did not combine with School self-concept (SSC) to form a single, second-order academic factor. Instead the results argued for two second-order academic factors representing verbal/academic and math/academic self-concepts. The authors noted that the surprising separation of MSC and VSC was also observed with responses by older subjects on the SDQ II and the SDQ III. In subsequent research with late-adolescent responses to the SDQ III (Marsh, in press) VSC and MSC were again relatively uncorrelated with each other and could not be adequately explained with a single higher-order academic factor. It was this separation between MSC and VSC that led to the development of the I/E model.

According to the I/E model, MSC and VSC are formed in relation to both external and internal comparisons, or frames of reference. For the external process, students compare their self-perceptions of their own mathematics achievement (MACH) and verbal achievement (VACH) with the perceived abilities of other students in their frame of reference and use this external relativistic impression as one basis of their academic self-concept in each of the two areas. However, the model also posits an internal comparison process for which students compare their self-perceived MACH with their self-perceived VACH and use this internal, relativistic impression as a second basis of their academic self-concept in each of the two areas.

The external process has been well documented in self-concept research (e.g., Marsh & Parker, 1984) and more generally as a social comparison process (Suls & Miller, 1977). Since VACH and MACH are substantially correlated, this external comparison process should lead to a positive correlation between VSC and MSC as originally anticipated in the Shavelson model. The internal comparison process, though more unusual in other theoretical accounts, is like the compensatory model described by Byrne (1984) that was proposed by Winne and Marx (1981) to explain why academically less able students perceived themselves as relatively more successful on physical and social facets. Since MACH and VACH are compared with each other, and it is the difference between the two that contributes to a high self-concept in one area or the other, the internal process should lead to a negative correlation between VSC and MSC. The joint operation of both processes, depending on the relative strength of each, will lead to the near-zero correlations that have been observed in empirical research. The I/E model also predicts a negative direct effect of MACH on VSC, and of VACH on MSC. For example, a high MSC will be more likely when MACH is good (the external comparison) and when MACH is better than VACH (the internal comparison). Thus, once math skills are controlled for, it is the difference between MACH and VACH that is predictive of MSC, and high VACH will actually detract from a high MSC. According to the I/E model having good mathematics skills detracts from verbal self-concept and having good verbal skills detracts from mathematics self-concept.

Figure 1 summarizes the predicted relations among VACH, MACH, VSC, and MSC. In this model, academic achievements are hypothesized to be one causal determinant of academic self-concepts, but does not argue against a more dynamic model where subsequent levels of academic achievement and self-concept are each determined by prior levels of achievement and self-concept. According to the path model, VACH and MACH are highly correlated with each other while VSC and MSC are nearly uncorrelated. VACH has a strong, positive direct effect on VSC but a small, negative direct effect on MSC. Similarly, MACH has a strong positive effect on MSC but a weaker, negative effect on VSC (see Marsh, 1986 for further discussion).

Insert Figure 1 About Here

Marsh (1986) focused on two sources of evidence to support the I/E model. First, he reported correlations between MSC and VSC based on responses to the Self Description Questionnaires from 11 different studies that spanned ages from preadolescents to young adults. Except for the youngest children, those in second and third grades, the correlations were consistently close to zero. Next he tested the model in Figure 1 with data from six of the studies that also had MACH and VACH scores. These results demonstrated that the direct effects of MACH on VSC, and of VACH on MSC were consistently negative. However, in discussing the implications of the study, Marsh (p. 146) noted that: "because all the studies were based on responses by Australians to one of the three SDQ instruments, the generalizability of the model should be tested with other instruments and different groups of subjects."

Marsh (1986) also noted the potential relevance of sex differences to the I/E model. Because sex differences are frequently found in both self-concept and achievement research, sex differences may be related to the I/E model. In order to test this suggestion, Marsh demonstrated that the relative lack of correlation between MSC and VSC was consistent across responses by males and females, and that support for the I/E model (Figure 1) came from some studies in which respondents were primarily males or primarily females. Sex was not included in any of the path analyses, but was included in a study of sixth grade students from predominantly single-sex schools (Marsh, Smith & Barnes, 1985). For this sample, the inclusion of sex had nearly no effect on the path coefficients used to test the I/E model. However, there is a need to test the generality of these findings with older students (since sex differences may vary according to age) and with students who attend coeducational classes.

Ethington and Wolfle (1986) proposed a path model that resembled the I/E model in several important characteristics to examine the causal influence of math and verbal abilities on math attitudes. Their results, based on the High School and Beyond study conducted in the United States, included responses by 8,912 women and 7,643 men in their sophmore year of high school. Althouh not the focus of their study, their findings showed that the direct effect of math ability on math attitudes was positive whereas the direct effect of verbal ability on math attitudes was negative for both men and women. Because their study did not include a verbal attitude scale, and because attitudes toward mathematics may not be the same as math self-concept, the Ethington and Wolfle results are not directly annalogous to those reported by Marsh (1986). Nevertheless, the results seem to provide further support for the generality of the I/E model.

Substantive Issues of Sex Differences and Construct Validity

Sex Differences. The inclusion of gender is theoretically relevant to the study of the I/E model, but the examination of such sex differences is also a substantively important issue. Historically, self-concept researchers have frequently examined sex differences in GSC (Wylie, 1979) and more recently researchers have shown that sex differences vary systematically with the particular facet of self-concept (e.g., Byrne & Shavelson, 1986; Marsh, 1985; Marsh, Barnes, Cairns, & Tidman, 1984; Marsh, Parker & Barnes, 1985). Furthermore, the relation between sex differences in academic achievement and those in self-concept is particularly relevant to such current concerns as the performance of women in mathematics (e.g., Meece, Parsons, Kaczala, Goff and Futterman, 1982).

Marsh, Smith and Barnes (1985) found that sixth-grade girls had lower Math self-concepts than boys even though their performance in mathematics on standardized tests and according to teacher ratings was significantly higher than that of boys. Placing their research in the context of other findings (e.g., Meece et al, 1982) they suggested that MSC for girls dropped relative to that of boys before the corresponding drop in MACH, indicating that MSC may have a causal role in the subsequent decline in MACH. In the same study boys had lower scores for VACH and VSC, but the sex difference in VSC could be explained in terms of boys lower VACH. An important issue raised by this research is the extent to which sex differences in MSC, VSC and SSC can be explained by corresponding sex differences in MACH, VACH, and overall school achievement (SACH). Because sex stereotypes suggest that girls have better VACH than boys, their VSC may be even higher than can be explained by objective achievement differences. Likewise, because sex stereotypes suggest the boys have better MACH than girls, their MSC may be even higher than can be explained by objective achievement differences. Consequently, because sex stereotypes across all school subjects are more balanced than for MACH or VACH, any sex differences in SSC may merely reflect differences in SACH. Hence, the inclusion of sex in the I/E model may contribute to understanding sex differences in specific areas of achievement, in specific facets of self-concept and the relation between the two sets of sex differences.

Construct Validity. The construct validity of specific facets of academic self-concept (MSC, VSC, and SSC) requires that specific measures of academic achievement (MACH, VACH, and SACH) be more strongly related to the matching facet of academic self-concept than to other areas of academic self-concept or GSC (see Marsh & Shavelson, 1985; Marsh, Parker & Smith, 1983). However, because the different achievement scores are so highly correlated, simple correlations between them and self-concept scores are difficult to interpret. An alternative approach is to consider the influence of achievement in one area after partialling out the influence of achievement in other areas. This approach is encompassed in the path model (Figure 1) used to test the I/E model. Particularly when the path model is extended to include GSC, SSC and SACH, the model provides a strong test of the construct validity of the specific facets of academic self-concept.

The Present Investigation

The present investigation is based on further analyses of data from Byrne and Shavelson (in press; 1986). Canadian students, 11th and 12th graders from two coeducational high schools, responded to the VSC, MSC, SSC, and GSC scales from three different self-concept instruments including the SDQ III. School grades for mathematics, English, and all school subjects were used as indicators of MACH, VACH, and SACH respectively. In the initial analyses the I/E model (Figure 1) was tested with responses from each of the self-concept instruments separately and with combined self-concept scores derived from all the instruments. These analyses test the generalizability of support for the I/E model to non-Australian respondents and to different self-concept instruments.

The present investigation also extends the original I/E model in that new variables consisting of SSC, GSC, SACH and gender were added. As well as having potential theoretical relevance to the I/E model, relations involving each of these additional variables are substantively important. The I/E model provides a methodological approach for examining sex differences in multiple areas of self-concept and in multiple areas of achievement, and particularly the relations between the two sets of sex differences. The inclusion of these new variables and the use of three different self-concept instruments also provides a powerful test of the construct validity of the specific facets of academic self-concept.

Methods

The sample, procedures, and instrumentation are described in more detail by Byrne (Byrne & Shavelson, 1986; in press). Subjects were 516 males and 475 females who attended grades 11 or 12 in two coeducational high schools in suburbs of Ottawa, Canada. VSC, MSC, and SSC were each measured by the SDQ III (Marsh, Barnes & Hocevar, 1985; Marsh & O'Niell, 1984; Marsh, Richards & Barnes, 1986), the Self-concept of Ability Scale (SCA; Brookover, 1962; Shavelson & Bolus, 1982), and the Affective Perception Inventory (API; Soares & Soares, 1979). GSC was measured by the SDQ III, the API, and the Self-esteem Scales (SES; Rosenberg, 1965). Because the SCA does not contain a GSC scale and because both the SES and SCA were originally intended to be Guttman scales, responses to these two instruments are considered together in some of the analyses. Students responded to a total of 165 items that comprised these 12 scales with response scales consisting of 8 (SDQ III), 4 (API), 4 (SES), or 5 (SCA) response categories. In addition to responses to these 12 self-concept scales, school grades were available for each student in English (VACH), mathematics (MACH), and across all school subjects (SACH). These grades represented cumulative teacher assessments of classroom work and were students' final averages in VACH, MACH and SACH. The grades used in the study were those reported on the April report cards that were issued two weeks prior to the administration of the self-concept instruments.

Statistical Analyses.

Marsh (1986) proposed that tests of the I/E model be conducted with factor analytically derived scores instead of raw scale scores. A preliminary factor analysis provides a test of the validity of the proposed factor structure. If the results support the validity of the posited factor structure, then the empirically weighted responses are likely to better represent the self-concept factors than would scales derived from unweighted raw responses. If the factor analysis does not support the posited self-concept factors, then the results of subsequent analyses may be dubious. Consistent with his recommendation, Marsh (1986) found support for the I/E model to be somewhat stronger for factor analytically derived scores than for raw scale scores.

In preliminary analyses, coefficient alpha estimates of reliability (see Table 1) were computed for each of the 12 scales and factor analyses were conducted separately for the SDQ III responses, the API responses, and the combination of the SCA and SES responses. Exploratory factor analyses using a principal factors extraction of four factors followed by an oblique rotation (Hull & Nie, 1981) were conducted on responses to each instrument and used to generate factor scores. The factor analysis of SDQ III responses resulted in four clearly defined factors corresponding to the intended scales, but the intended scales were not so clearly identified with responses to the SCA and the API. In the factor analysis of the SCA (and SES) items, GSC (based on SES responses) was clearly identified. However, items from the VSC, MSC, and SSC scales sometimes loaded with other items representing the same content area as predicted, but sometimes with items having the same wording except for the academic area referred to (on the SCA the SSC, VSC, and MSC scales are worded the same except for the words school, English and mathematics). Hence the SCA factor structure was complicated by method effects produced by the idiosyncratic wording of specific items (see Carmines & Zeller, 1979, for further discussion of this type of idiosyncratic method effect). In the factor analysis of the API items, three of the four factors -- all but the SSC -- were clearly defined; many of the SSC items had larger loadings on at least one of the other factors than on the SSC factor (see Byrne & Shavelson, in press, for details). However, problems with the factor analysis of the API may have been related to the wording of individual items as with the SCA.

For factor analyses of self-concept responses, Marsh (in press; Marsh & O'Niell, 1984; Marsh, Smith & Barnes, 1985) argued for the use of subscale scores -- each subscale based on responses to two or more items designed to reflect the same scale -- as is typical in achievement research where factor analyses are rarely conducted at the item level. In addition to pragmatic advantages such as reducing costs associated with the factor analysis and increasing the ratio of subjects to variables, the use of such subscales instead of individual items produces measured variables that are likely to: be more reliable; be more generalizable; contain less unique variance due to the idiosyncratic characteristics of individual items; and to more closely approximate a normal distribution. The last two advantages are particularly relevant to suggested weaknesses of the factor analyses of SCA and API responses described above. For this reason, three subscales were used to represent each of the 12 self-concept scales by computing the average response to randomly selected thirds of the items from each scale, and the factor analyses like those described above were conducted with these subscale scores instead of item responses. These subsequent factor analyses of SDQ III responses, API responses, and the combination of SCA and SES responses each clearly identified the MSC, VSC, SSC, and GSC factors. In all three factor analyses subscale scores loaded substantially higher on the factor each was designed to measure (target loadings varied from .67 to .89, .58 to .91, and .64 to .92 respectively for the SDQ, the API, and the SCA/SES items) than on other factors (nontarget loadings varied from -.13 to .18, -.07 to .21, and -.04 to .29 respectively). Correlations among the 12 factor scores derived from these three factor analyses are presented in Table 1.

Statistical analyses were based on correlations among the 12 self-concept scores described above, VACH, MACH, SACH, and gender (1=male, 2=female). In addition, total scores for each of the four facets of self-concept were computed by summing the scores from the three different instruments. In order to make results for different instruments as comparable as possible, a single correlation matrix (Table 1) was constructed for all the variables with listwise deletion of missing values (SPSS, 1985). Although results are only presented for correlations based on factor analytically derived scores, results based on raw scale scores produced substantively similar conclusions. Path coefficients used to test the I/E model were estimated with a series of multiple regressions (SPSS, 1985) based on these correlations.

Insert Table 1 About Here

Results and Discussion: Support For The I/E Model

Four path models (Figure 2) based on the original I/E model (Figure 1) were conducted for responses from each self-concept instrument and the combined self-concept scores from all three instruments. Statistically significant path coefficients for the four path models are presented in Figure 2 for the combined self-concept scores, and all path coefficients for all of the analyses are presented in Tables 2 and 3. The purpose of these analyses is to test the generality of support for the original I/E model across the different self-concept instruments and to examine the influence of including additional variables in the path models. Model 1 (Figure 2) differs from the original model due to the inclusion of GSC and SSC. However, because of the ordering of variables in the path model, the the inclusion of these variables does not affect those path coefficients from the original I/E model.

Insert Figure 2 and Tables 2 and 3 About Here

<u>Support For The Original I/E Model.</u>

The I/E models posits that the correlation between VSC and MSC will be small and substantially smaller than the correlation between VACH and MACH. Support for this prediction comes from both the correlations (Table 1) and the path analyses (Tables 2 and 3). The correlation (Table 1) between VSC and MSC is close to zero for the API scores ($r = .08$, $p < .05$) and does not differ significantly from zero for the SDQ III (-.05), SCA (.03), or combined (.00) scores. Furthermore, correlations between VSC and MSC assessed by different instruments (e.g., MSC on the SDQ III and VSC on the API) are all negative, though none of these is statistically significant. In contrast to these near-zero correlations between VSC and MSC, VACH and MACH are substantially correlated (.52). Path coefficients connecting VSC and MSC are partial correlations in which the effect of preceding variables (i.e., sex, SACH, VACH, and MACH depending on the path model) are partialled out. While these partial correlations between VSC and MSC are slightly more positive and sometimes statistically significant for particular instruments or path models, none of these partial correlations is statistically significant for any of the path analyses of the combined self-concept scores (Figure 2). In summary, the replicability and generality of this first prediction is supported.

The I/E model further predicts that VACH will have a substantial positive effect on VSC but a smaller negative effect on MSC, and that MACH will have a substantial positive effect on MSC but a smaller negative effect on VSC. Each of these four path coefficients is statistically significant for all four path models, and this same pattern of results occurs for the combined scores (Figure 2) and for scores from each self-concept instrument considered separately (Tables 2 and 3). In summary, the replicability and generality of this second prediction is supported.

<u>The Influence of Additional Variables on the I/E Model.</u>

New variables were added to the original I/E model in order to see their influence on the model and tests of its predictions. Because the inclusion of SSC and GSC can not influence any of the path coefficients in the original I/E model, the additional variables of interest are sex and SACH. The discussion of these findings emphasizes the combined self-concept scores (Figure 2) but are consistent with the results for each self-concept instrument considered separately.

Because there are systematic sex differences in MSC and VSC, it is possible that results predicted by the I/E model might be attributable to these sex differences. For the combined scores (Figure 2) the introduction of sex produced a small drop in the size of the negative path coefficient leading from VACH to MSC because girls have somewhat higher VACH but lower MSC than do boys. However, the introduction of sex had nearly no effect on the path between MACH and VSC because girls have slightly higher MACH and slightly higher VSC than do boys. In summary I/E predictions are supported whether or not sex is included.

Because SACH is substantially correlated with both VACH and MACH, it was anticipated that controlling for the effect of SACH might: a) decrease the positive effect of MACH on MSC and increase the negative effect of MACH on VSC; b) decrease the positive effect of VACH on VSC and increase the negative effect of VACH on MSC. The inclusion of SACH (Model 2 vs. Model 1 and Model 4 vs. Model 3) reduced the positive influence of MACH on MSC, but had nearly no effect on the negative influence of MACH on VSC. The inclusion of SACH had nearly no effect on the positive influence of VACH on VSC, but made the negative influence of VACH on MSC slightly more negative. In relation to this finding, it is interesting to note that SACH is somewhat more highly correlated with VACH than MACH, but that SACH is more highly correlated with MSC than VSC. The I/E predictions are supported whether or not SACH is included.

In summary, it was anticipated that the inclusion of sex and SACH in the original I/E model might influence the support for the model's predictions. However, though their inclusion had a small effect on some of the original coefficients, the support for the I/E model is consistent across all four path models.

Results and Discussion: Other Substantive Issues

Construct Validity of Multidimensional Self-concepts.

The construct validity of multidimensional self-concepts requires that academic achievement is more highly correlated with academic facets of self-concept than with GSC, and that academic achievement in specific content areas (e.g., MACH) is more highly correlated with matching areas of self-concept (e.g., MSC) than with nonmatching areas (e.g., VSC). The results of the present investigation provide strong support for this predicted pattern of results.

GSC is not significantly correlated with VACH, MACH or SACH. This finding is consistent for 12 correlations based on GSC measured by the SDQ III, the API, the SES, and the combined GSC score (Table 1), and for all of the 48 corresponding path coefficients in Models 1 - 4 (Tables 2 and 3).

Because of the substantial correlations between VACH, MACH, and SACH, the content specificity of particular facets of academic self-concept is not so evident in the zero-order correlations. However, the results of Model 3 (Figure 2) is ideally suited for making such comparisons; each path coefficient relating any one achievement score to any one of the self-concept scores represents the effect of that achievement score after partialling out the effect of the other two achievement scores. MSC is substantially and positively related with MACH, modestly and negatively related with VACH, and nearly unrelated with SACH. VSC is substantially and positively related with VACH, modestly and negatively related with MACH, and relatively uncorrelated with SACH. SSC is substantially correlated with SACH, and nearly uncorrelated with either VACH or MACH. This pattern is consistent for self-concept scores from the SDQ III, the API, the SCA, and the combined scores, and is virtually unaffected by the inclusion of sex (Model 4).

In summary, the results of the present investigation provide remarkably strong support for the multidimensionality of self-concept and the content specificity of GSC, VSC, MSC, and SSC. In particular, the path analytic results suggest that GSC is unaffected by VACH, MACH or SACH, only VACH has a positive influence on VSC, only MACH has a positive influence on MSC, and only SACH has a positive influence on SSC. Other researchers have argued for the content specificity of different facets of academic self-concept (e.g., Marsh & Shavelson, 1985). However, we know of no other research that provides such strong support for the specificity of the different academic facets or the generality of this specificity across different self-concept instruments.

<u>Sex Differences in Multidimensional Self-concepts and Academic Achievements.</u>

Based on previous research summarized earlier it was anticipated that girls would have higher VACH and VSC scores than boys, that boys would have higher MACH and MSC scores than girls, and that sex differences in SACH and

SSC would fall somewhere in between those observed for English and mathematics scores. A critical question, however, is whether sex differences in MSC and VSC are larger than can be explained by corresponding differences in MACH and VACH. Such a finding would suggest that the sex stereotypes influence academic self-concepts in addition to their influence on achievement scores.

Girls, as anticipated, had substantially higher VACH and VSC than did boys. While much of girls' advantage in VSC could be explained by their higher VACH, girls still had higher VSC even after controlling for VACH. Thus, girls had even higher VSC than was explicable in terms of their VACH and this might reflect the influence of sex stereotypes.

Boys, as anticipated, had substantially higher MSC than girls, but they had slightly lower MACH than did girls. Because girls had slightly higher MACH than boys, the girls' lower MSC could not be explained by MACH. Correcting MSC for MACH actually increased the sex differences in MSC rather than decreasing it.

Girls had modestly higher SACH and SSC than did boys. However, once the effects of SACH were partialled out, there were almost no differences between SSC scores for boys and girls. That is, girls' higher SSC scores could be explained in terms of their higher SACH.

The observed findings -- except the higher MACH for girls than boys -- are consistent with sex stereotypes. However, the observed sex difference in MACH facilitates interpretations of the sex difference in MSC. Because girls do not have lower MACH than do boys, their lower MSC cannot be explained in terms of MACH and many alternative explanations are not plausible. However, it should also be noted that girls' advantage over boys for VSC was larger than could be explained by their higher VACH. It was only for SSC that virtually all of the observed sex difference (in favor of girls) could be explained in terms of sex differences in achievement scores.

Traditional sex stereotypes may provide an explanation for the relations between sex differences in self-concept and achievement scores. According to sex stereotypes girls are better at English than boys, and their VSC was higher than could be explained on the basis of their VACH. According to sex stereotypes boys are better at mathematics than girls, and their MSC was higher than could be explained on the basis of their MACH. Across all school subjects sex stereotypes are more balanced and sex differences in SSC were explicable in terms of SACH. It should also be noted that this explanation does not require MACH and VACH to be unaffected by sex stereotypes, but posits sex stereotypes directly influence MSC and VSC in addition to indirect effects through the achievement scores.

The unexpected pattern of results for math scores, as well as the pattern for verbal scores, are similar to earlier findings by Marsh, Smith and Barnes (1985) for responses by sixth grade students. Because previous research has generally shown that girls have lower MSC and MACH by the end of high school, Marsh et al. interpreted their results to indicate that girls' MSC dropped before their MACH. Whereas such an explanation was plausible for 6th graders, it does not seem reasonable for 11th and 12th graders. Marsh et al. also suggested the possibility that sex stereotypes influence achievement indirectly through their influence on corresponding self-concepts, and this suggestion may be plausible in the present investigation. However, support for such a suggestion will be difficult to establish because of the methodological problems in trying to establish the causal ordering of academic self-concept and academic achievement (see Byrne, 1984; 1986).

Summary and Implications

The purpose of this study was to examine the I/E frame of reference model that is designed to explain relations among VSC, MSC, VACH, and MACH. Evidence for the I/E model is based on support for two sets of predictions that: a) the correlation between MSC and VSC will be small and substantially smaller than the correlation between MACH and VACH; and b) the direct effect of VACH on MSC, and of MACH on VSC, will be negative. Support for both these predictions was demonstrated in the present investigation, the support was consistent across scores from different self-concept instruments, and the support was nearly unaffected by the inclusion of gender and SSC in the original I/E model. These findings not only demonstrate the clear separation between Math and Verbal self-concepts -- much clearer than for the corresponding areas of achievement -- but they also demonstrate that academic self-concepts are affected by different processes than are achievement measures in the academic areas which they reflect.

Marsh (1986) noted three directions for further research with the I/E model. The most immediate was the need to replicate the findings with responses by non-Australians and with different self-concept instruments, and the present investigation fulfills this need. Second, he noted that support for the two processes comes primarily from interpretations of correlational data, and that experimental and introspective evidence is needed to further support their existence. Third, even though academic achievement and academic self-concepts are emphasized in the I/E model, it is likely that similar processes are involved in the formation of self-concepts in other areas as suggested by Winne and Marx (1981). These last two suggestions still provide relatively unexplored directions for further research.

The present investigation has focused on the I/E model and two specific facets of academic self-concept, but the results have important implications for self-concept research in general. The findings add to the growing body of support for the multidimensionality of self-concept, the need to separate academic self-concept from general self-concept, and to separate academic self-concepts in specific areas. The remarkably consistent lack of correlation between GSC from all three instruments and each of the achievement scores forcefully illustrates the inappropriateness of using GSC to evaluate an intervention that is intended to affect academic variables. However, the present results also illustrate the need to distinguish among specific facets of academic self-concept, particularly when the logical focus of a study is on a specific academic facet. (Because MSC and VSC are so separate, the inclusion of both serves as a relevant placebo control for the other when the intended effect of an intervention is specific to one of these facets.)

The findings illustrate clear distinctions between academic self-concepts and academic achievements. The academic self-concepts are more clearly differentiated than corresponding areas of academic achievement, and are more complex than a mere subjective reflection of normatively defined academic achievement. In this respect, even though academic self-concept and achievement are positively correlated, academic achievement is a biased indicator of academic self-concept, as is academic self-concept as an indicator of academic achievement.

The results provide further support for the revision of the Shavelson hierarchical model that now posits that two higher-order academic self-concepts -- verbal/academic and math/academic -- are required to explain academic self-concepts in specific areas. The lack of correlation between MSC and VSC demonstrates the inappropriateness of subsuming them into a single academic component.

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Table 1

Correlations Among Variables Considered in the Study

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 SDQ GSC	(94)																		
2 SDQ SSC	19	(90)																	
3 SDQ VSC	22	37	(80)																
4 SDQ MSC	12	36	-05	(93)															
5 API GSC	62	20	18	16	(86)														
6 API SSC	55	59	37	31	62	(85)													
7 API VSC	06	41	68	-05	09	42	(89)												
8 API MSC	10	41	02	-86	16	34	08	(95)											
9 SES GSC	79	24	26	19	62	59	12	19	(87)										
10 SCA SSC	17	65	32	44	17	54	33	'7	23	(87)									
11 SCA VSC	04	43	-54	-01	06	33	65	03	11	49	(90)								
12 SSC MSC	07	34	-04	-82	13	31	-04	80	12	50	03	(94)							
13 Cmb GSC	91	24	25	18	84	66	10	17	91	21	08	12	(94)						
14 Cmb SSC	35	87	41	43	39	83	46	48	41	86	49	45	43	(93)					
15 Cmb VSC	13	46	85	-04	13	44	90	05	19	44	84	-02	17	52	(94)				
16 Cmb MSC	10	39	-02	95	16	34	-01	94	18	50	02	93	17	48	-00	(97)			
17 SACH	-02	53	16	38	-01	36	15	32	05	69	33	41	07	62	25	40	(--)		
18 VACH	-04	47	24	20	-04	32	29	16	03	54	50	18	-02	52	40	19	80	(--)	
19 MACH	-04	34	02	55	-02	26	02	49	01	52	11	62	-02	44	06	59	74	51	(--)
20 Sex	-04	20	12	-17	-17	15	25	-17	-11	09	19	-16	-12	17	22	-18	19	26	10

Note. Correlations, presented without decimal points, greater than .07 and greater than .09 are statistically significant for $p < .05$ and $p < .01$, respectively. Reliability estimates, coefficient alphas based on standardized responses to individual items, appear in the diagonal values. Because the achievement scores and sex were each measured by a single variable, coefficient alphas could not be computed. SDQ = Self Description Questionnaire; API = Affective Perceptions Inventory; SES = Self-esteem Scale; SCA = Self-concept of Ability Scale; Cmb = Combined self-concept scores; GSC = General Self-concept; SSC = School Self-concept; MSC = Math Self-concept; VSC = Verbal self-concept; SACH = School Achievement; VACH = Verbal Achievement; MACH = Mathematics Achievement; Sex (1=male, 2=female).

Table 2

Path Coefficients Relating Variables in Models 1 and 2 (see Figure 2)

Coefficient	Model 1				Model 2			
Relating:	SDQ	API	SCA/SES	Comb	SDQ	API	SCA/SES	Comb
GSC & SSC	.24***	.67***	.27***	.54***	.25***	.69***	.27***	.55***
GSC & MSC	.17***	.19***	.16***	.22***	.16***	.16***	.13***	.20***
GSC & VSC	.24***	.10**	.11**	.19**	.24**	.14**	.12**	.20**
GSC & VACH	-.02	-.04	.03	-.01	-.01	.01	.07	.02
GSC & MACH	-.03	.00	-.01	-.01	-.03	-.01	-.01	-.02
GSC & Sex	---	---	---	---	-.04	-.17***	-.12***	-.12***
SSC & MSC	.28***	.29***	.38***	.40***	.32***	.32***	.38***	.44***
SSC & VSC	.32***	.39***	.40***	.47***	.32***	.38***	.41***	.47***
SSC & MACH	.13***	.14***	.32***	.23***	.14***	.14***	.32***	.23***
SSC & VACH	.40***	.25***	.38***	.40***	.38***	.23***	.39***	.39***
SSC & Sex	---	---	---	---	.09**	.08*	-.04	.05
MSC & VSC	-.04	.13***	.07*	.02	-.03	.18***	.09**	.06
MSC & MACH	.61***	.56***	.71***	.67***	.60***	.54***	.71***	.66***
MSC & VACH	-.12***	-.13***	-.19***	-.15***	-.06*	-.07*	-.13***	-.09**
MSC & Sex	---	---	---	---	-.22***	-.21***	-.20***	-.22***
VSC & MACH	-.14***	-.18***	-.21***	-.20***	-.13***	-.17***	-.20***	-.19***
VSC & VACH	.31***	.38***	.60***	.50***	.29***	.33***	.59***	.48***
VSC & Sex	---	---	---	---	.06	.18***	.06*	.12***
MACH & VACH	.52***	.52***	.52***	.52***	.51***	.51***	.51***	.51***
MACH & Sex	---	---	---	---	.11**	.11**	.11**	.11**
VACH & Sex	---	---	---	---	.26***	.26***	.26***	.26***

Note. Path Coefficients are for Models 1 and 2 that appear in Figure 2 and are based on the correlation matrix in Table 1. Note that whereas path models were tested with each of the four sets of self-concept measures, all analyses used the same achievement measures. SDQ = Self Description Questionnaire; API = Affective Perceptions Inventory; SES = Self-esteem Scale; SCA = Self-concept of Ability Scale; Cmb = Combined self-concept scores; GSC = General Self-concept; SSC = School Self-concept; MSC = Math Self-concept; VSC = Verbal self-concept; SACH = School Achievement; VACH = Verbal Achievement; MACH = Mathematics Achievement; Sex (1=male, 2=female).

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 3

Path Coefficients For Models 3 and 4 (see Figure 1)

Coefficient	Model 3				Model 4			
Relating:	SDQ	API	SCA/SES	Comb	SDQ	API	SCA/SES	Comb
GSC & SSC	.24***	.67***	.27***	.55***	.25***	.70***	.26***	.56***
GSC & MSC	.16***	.19***	.15***	.22***	.16***	.16***	.13***	.19***
GSC & VSC	.24***	.11**	.11**	.16**	.24**	.14***	.12***	.21***
GSC & SACH	.09	.11	.14	.14	.09	.10	.14	.12
GSC & MACH	-.07	-.05	-.07	-.07	-.07	-.05	-.07	-.07
GSC & VACH	-.07	-.10	-.05	-.08	-.06	-.05	-.01	-.05
GSC & Sex	---	---	---	---	-.04	-.17***	-.12***	-.12***
SSC & MSC	.28***	.29***	.37***	.40***	.32***	.32***	.37***	.44***
SSC & VSC	.33***	.41***	.44***	.50***	.32***	.40***	.45***	.50***
SSC & SACH	.52***	.32***	.70***	.60***	.52***	.32***	.70***	.60***
SSC & MACH	-.09*	-.01	.01	-.04	-.09*	.00	.01	-.03
SSC & VACH	.11*	.06	-.02	.06	.08	.04	-.01	.05
SSC & Sex	---	---	---	---	.10**	.08*	-.04	.05
MSC & VSC	-.04	.13***	.07*	.02	-.03	.18***	.09**	.06
MSC & SACH	.11	.09	.17**	.13*	.10	.08	.16**	.12*
MSC & MACH	.56***	.52***	.64***	.61***	.56***	.51***	.63***	.60***
MSC & VACH	-.18***	-.18***	-.28***	-.23***	-.12**	-.11*	-.22***	-.16**
MSC & Sex	---	---	---	---	-.22***	-.21***	-.20***	-.22***
VSC & SACH	.06	-.11	.01	-.02	.06	-.11	.01	-.01
VSC & MACH	-.16***	-.13***	-.21***	-.19***	-.16***	-.12***	-.21***	-.19***
VSC & VACH	.27***	.44***	.60***	.51***	.26***	.39***	.56***	.48***
VSC & Sex	---	---	---	---	.06	.18***	.06*	.12***
SACH & MACH	.80***	.80***	.80***	.80***	.80***	.80***	.80***	.80***
SACH & VACH	.72***	.72***	.72***	.72***	.73***	.73***	.73***	.73***
SACH & Sex	---	---	---	---	.26***	.26***	.26***	.26***
MACH & VACH	.52***	.52***	.52***	.52***	.51***	.51***	.51***	.51***
MACH & Sex	---	---	---	---	.11**	.11**	.11**	.11**
VACH & Sex	---	---	---	---	.26***	.26***	.26***	.26***

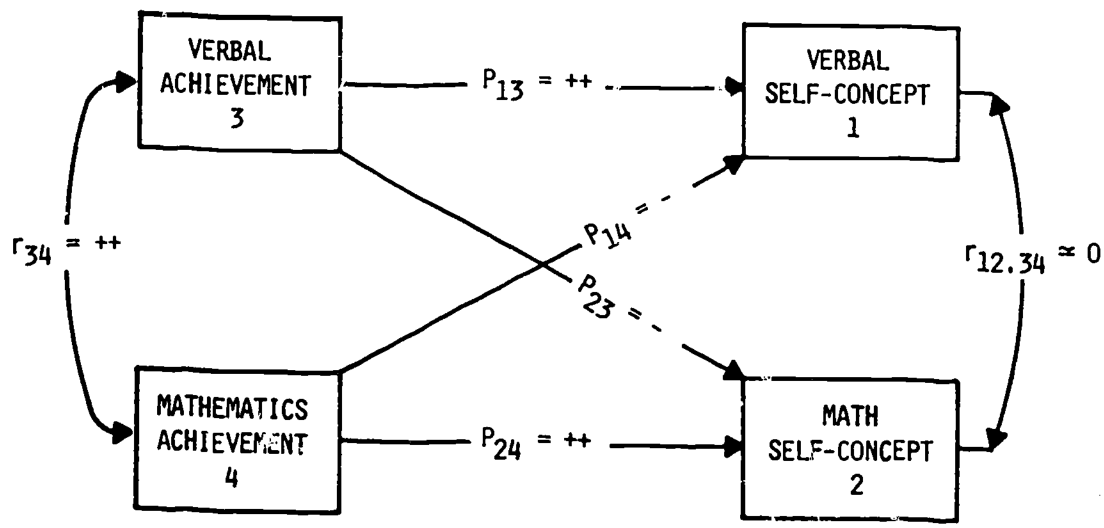
Note. Path Coefficients are for Models 3 and 4 that appear in Figure 2 and are based on the correlation matrix in Table 1. See note in Table 2.

* $p < .05$; ** $p < .01$; *** $p < .001$.

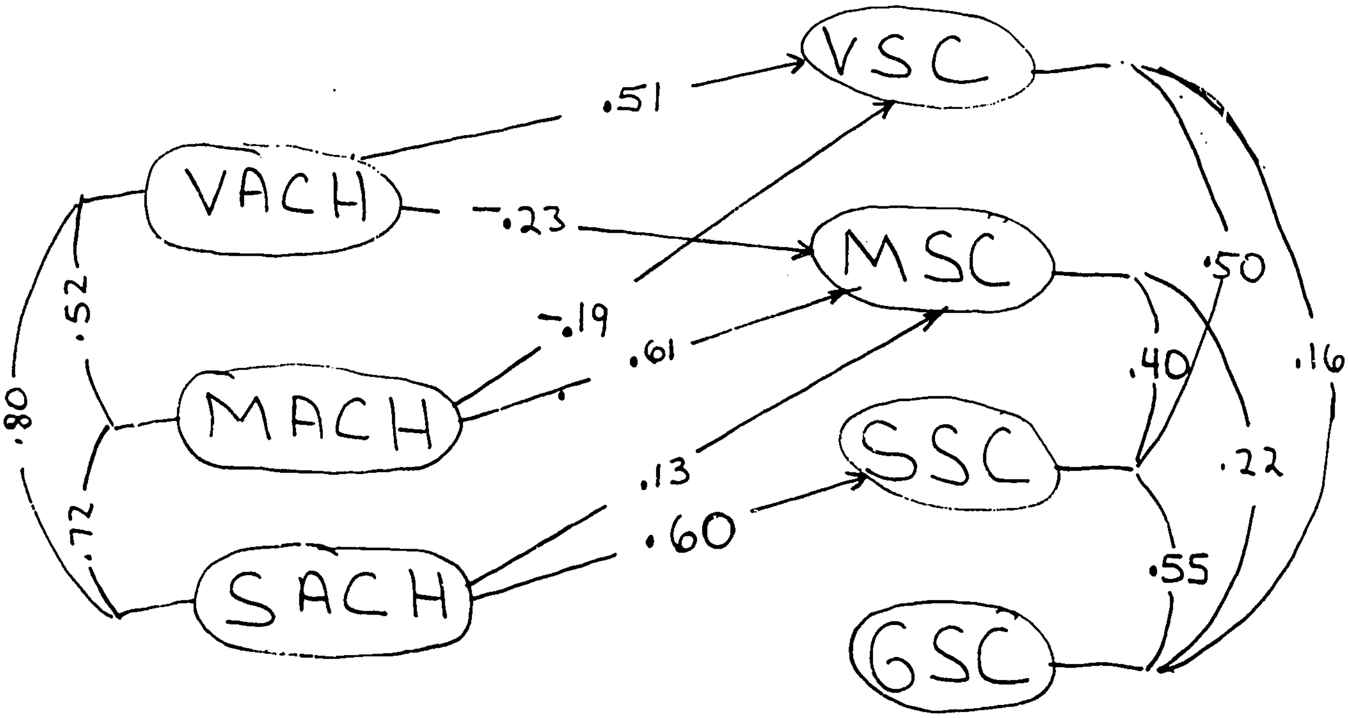
FIGURE CAPTIONS

Figure 1. Path model of the effects predicted by the Internal/External Frame of Reference Model. Coefficients indicated to be "++", "-", and "0" are predicted to be high positive, low negative, and aproximately zero, respectively. Empirical tests of these predictions and entensions of this original model are summarized in Figure 2.

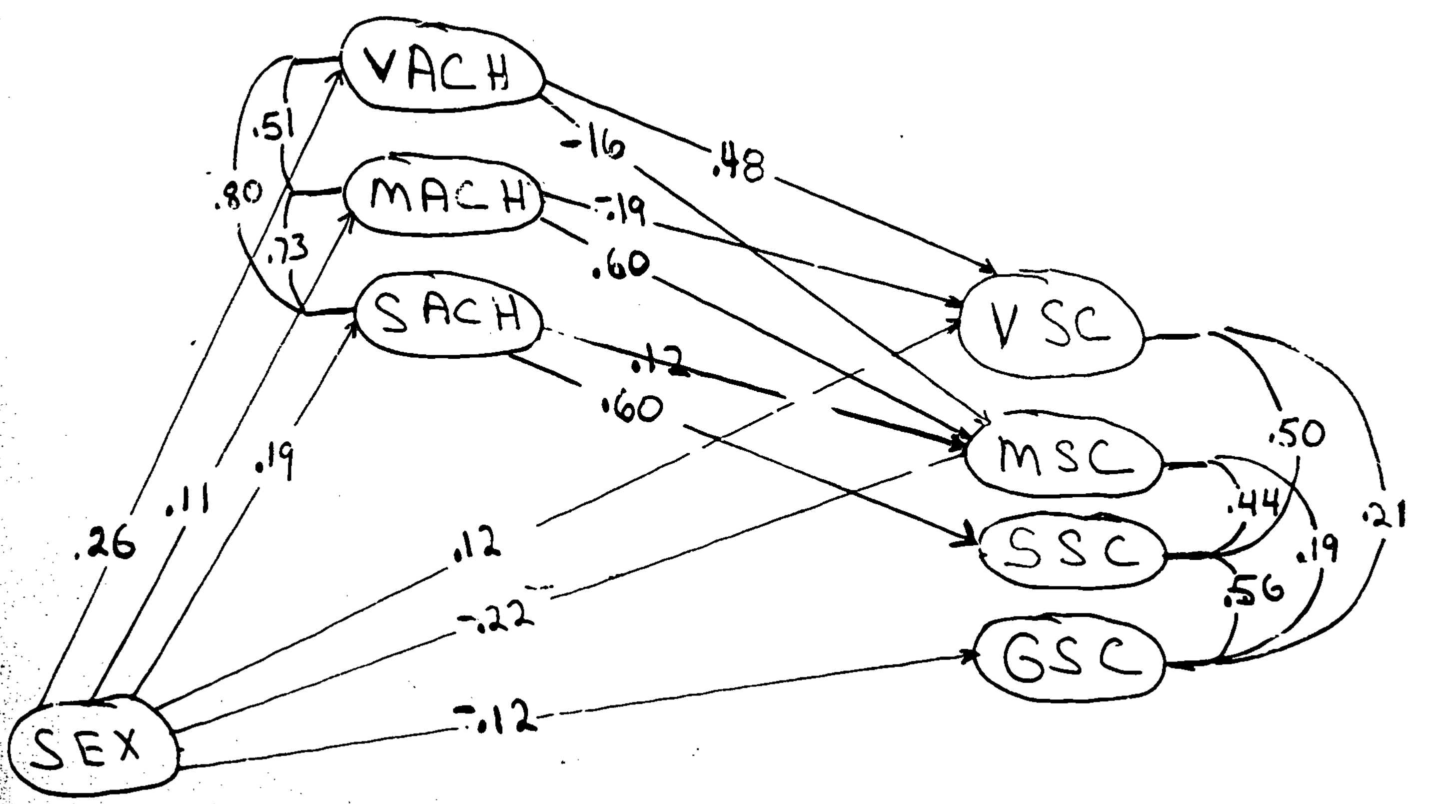
Figure 2. Emperical tests of the Internal/External Model (Model 1) and extensions of this model to include gender (Model 2), achievement across all school subjects (Model 3), and both gender school achievement (Model 4). These results are based on self-concept scores from all three instruments, and the corresponding results for each separate instrument are summarized in Tables 2 and 3. For purposes of presentation, path coefficients that failed to reach statistical significance ($p < .05$) are excluded, but are presented in Tables 2 or 3. Note: SDQ = Self Description Questionnaire; API = Affective Perceptions Inventory; SES = Self-esteem Scale; SCA = Self- concept of Ability; Cmb = Combined self-concept scores; GSC = General Self- concept; SSC = School Self-concept; MSC = Math Self-concept; VSC = Verbal self-concept; SACH = School Achievement; VACH = Verbal Achievement; MACH = Mathematics Achievement; Sex (1=male, 2=female).


VERBAL
ACHIEVEMENT
3
P13 = ++
VERBAL
SELF-CONCEPT
1
r34 = ++
P14 = -
P23 = -
r12.34 ≈ 0
MATHEMATICS
ACHIEVEMENT
4
P24 = ++
MATH
SELF-CONCEPT
2

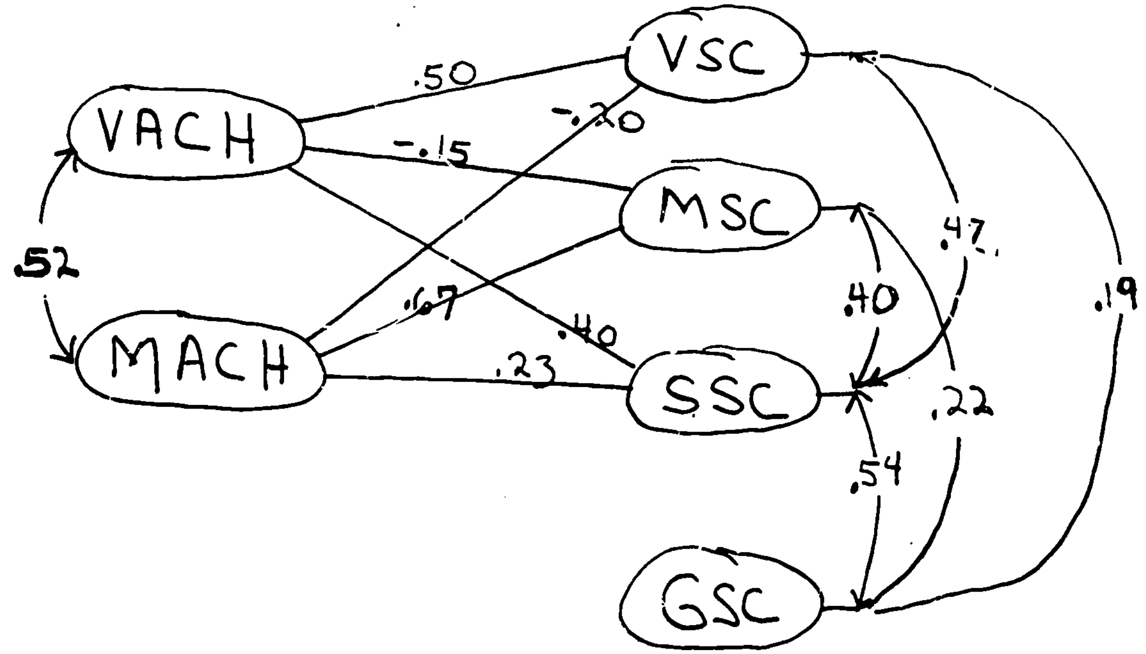
Model 3



Model 4



Model 1



Model 2