**BAR04474**

# Evolvement of Students' Goals and Academic Self-Concept: A Multidimensional and Hierarchical Conceptualisation

**Katrina L. Barker, Martin Dowson & Dennis M. McInerney**
**SELF Research Centre, University of Western Sydney, Australia**

This research was supported by an Australian Research Council Grant A00000808Correspondence concerning this article should be addressed to Katrina Barker, School of Education and Early Childhood Studies, University of Western Sydney, Locked Bag 1797, Building 4, Bankstown Campus Locked Bag 1797, PENRITH SOUTH DC NSW 1797, Australia.

The purpose of this study is to examine the potential multidimensional and hierarchical structure of student's motivational goals and academic self-concept (SC). Specifically, this paper tests the ability of first- and second-order measurement models comprising achievement motivation variables (mastery, performance & social goals) and academic self-concept variables (English and math self-concept) to fit data collected over two years from 1 515 Australian High School students. The study also tests whether the second-order model fits equally well across sex groups. Results of the first-order Confirmatory Factor Analyses (CFA) demonstrate that the motivation items drawn from the General Achievement Goal Orientation Scale (GAGOS), and the self-concept items drawn from the Academic Self Description Questionnaire II (ASDQ II), appropriately measure their target constructs. The higher-order CFA results provided support for an hierarchical representation of goals and self-concept, with goodness-of-fit indices for Time 1 (T1) and Time 2 (T2) ranging from .86 to .92. This model fitted the data equally well for males (with goodness-of-fit indices for T1 and T2 ranging from .83 to .92) and females (with goodness-of-fit indices for T1 and T2 ranging from .85 to .92). Thus, the study provides a measurement framework, which is largely sex-invariant, and within which the interaction of multiple achievement goal orientations and academic self-concept variables may be examined.

## Achievement Motivation and Academic Achievement

Much research has been conducted into relations between students' academic achievement motivation and their academic achievement (e.g. Ainley, 1993; Covington, 2000; Linnenbrink & Pintrich, 2000; McInerney, Simpson, & Dowson, 2003). Achievement goal theory represents one significant strand of this research. Achievement goal theory has evolved from its initial conceptualisation as involving two essential constructs, mastery goals and performance goals. More recently, studies have examined the pursuit of multiple goals (e.g., mastery, performance, work-avoidance, and social), with a specific focus on the multiple goals independent and interactive effects (Barron & Harackiewicz, 2001; Dowson & McInerney, 2001; Harackiewicz, Barron, Pintrich, Elliot & Thrash, 2002; Linnenbrink & Pintrich, 2000; Pintrich, 2000).

On measures of academic performance and achievement, there is little debate about the positive effects of mastery goals (which focus students on personal development and the acquisition of new skills and knowledge). However, performance goals (which focus students on maintaining favorable judgments of their ability by demonstrating superior performance relative to others) demonstrate inconsistent relations with academic performance and achievement. Negative, null and positive effects of performance goals on academic outcomes are all evidenced in the literature (Harackiewicz, Barron, Tauer, Carter & Elliot, 2000; Kaplan & Middleton, 2002).

Although not as extensively examined as mastery and performance goals, students' social goals are another important class of goals that influence academic performance (Bempechat & Boulay, 2001; Dowson & McInerney, 2003). Social reasons for trying to achieve in academic situations are the dominant concerns for individuals pursuing social goals (McInerney, Roche, McInerney & Marsh, 1997; Urdan & Maehr, 1995). Few direct links between social goals and academic achievement have been established in the literature (Urdan & Maehr, 1995). However, there is reason to suspect that social goals may be linked to achievement, either by supporting the positive effects of other goals on achievement, or ameliorating their negative effects (Covington, 2000).

Central to the purpose of the present study was an exploration of three positively oriented goals (mastery, performance approach, and social goals). These goals are 'positively oriented' in the sense that they express students' purposes for achieving, rather than their purposes for avoiding achievement (such as is that case with work-avoidance or performance-avoidance goals). Thus, the present study was primarily concerned with

students' goals that orient students towards academic achievement, in contrast to goals that orient students' way from academic achievement. For this reason, avoidant-type goals were not included in this study. An additional purpose for focusing upon positively oriented goals was to avoid methodological complexities. Negative items and negative constructs, especially when used alongside positive items and constructs can lead to difficulties in model construction and validation (e.g. through the presence of negative item method factors) (Marsh, 1994; 1996).

Figure 1 is a pictorial representation of the literature reviewed above. It suggests that the paths to academic achievement from mastery and performance goals have been relatively extensively researched in contrast to the path to academic achievement from social goals.

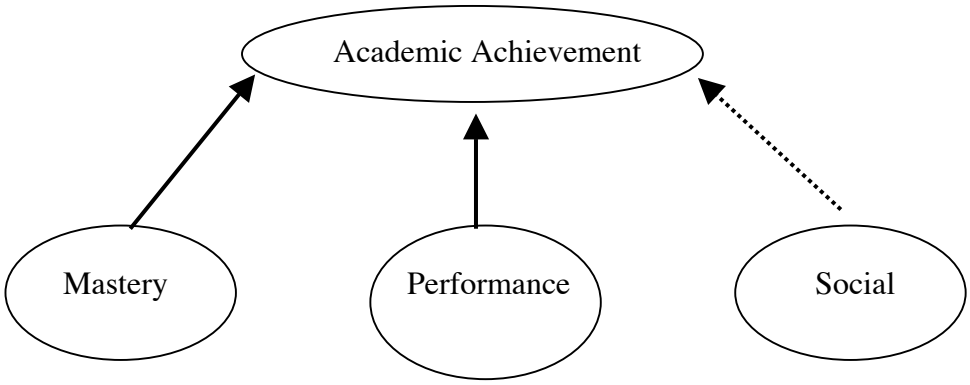


Figure 1: Mastery, Performance and Social Goals and Achievement

The examination of multiple goals (mastery, performance and social) allows for scrutiny of the individual goals, and some (first-order) interactions between them. However, an exclusive focus on goals at the base (first-order) level, limits the opportunity to investigate the potential hierarchical structure of these goals and, hence, the full scope (i.e. first- and second- order) interactions between them (McInerney, Marsh & Yeung, 2003). For this reason, examining individual goals and their effect on achievement may provide a fragmented and superficial view of student motivation. Examining a higher-order factor structure for goal orientations, in contrast, may enable a 'common quality' of various goal orientations to be extrapolated, which represents a pooled or generalised notion of purposes for motivation, and which may be useful for explaining and predicting achievement outcomes. To our knowledge only one other study (McInerney et al., 2003)

explores this two level approach to examining multiple goals and their effect on achievement.

This study builds on this previous research by retaining a hierarchal model of students' goals, and integrating it with a hierarchical model of students' self-concept (explained further below). Specifically, the higher-order models in this research posit a higher-order factor labelled "Purposes for Achievement". Thus, in the overall hierarchical structure, the distinguishing feature of each goal at the first-order level is its specific content, such that each individual goal represents a different purpose for achievement. The overarching construct, in contrast, represents the fact that each goal is a purpose for achievement, regardless of its particular content. In this way, the model represents the opportunity to validate the theoretical structure of Goal Theory as a whole, which suggests that individual goals are integrated by their common definition as "purposes for achievement", but differentiated according to the different content of these purposes.

Figure 2 depicts the hierarchical structure discussed above. It suggests that the paths between each of the first-order goals and the higher-order factor "Purposes for Achievement" have yet to be extensively explored in the literature. Moreover, because this higher-order factor has yet to be widely investigated, the structural inter-relationships between the first-order factors, specifically mastery, performance and social goals, has yet to be investigated. In other words, even where correlations between multiple goals have been examined (e.g. Elliot & Church, 1997; Pintrich, 2000; Urdan, 1997), the ability of these correlations to imply the hierarchical structure suggested by Goal Theory has rarely been investigated (McInerney et al., 2003). Finally, Figure 2 suggests that, although not explicitly examined in this study, the relationship of purposes for achievement to actual achievement at the second-order level, has not been examined.

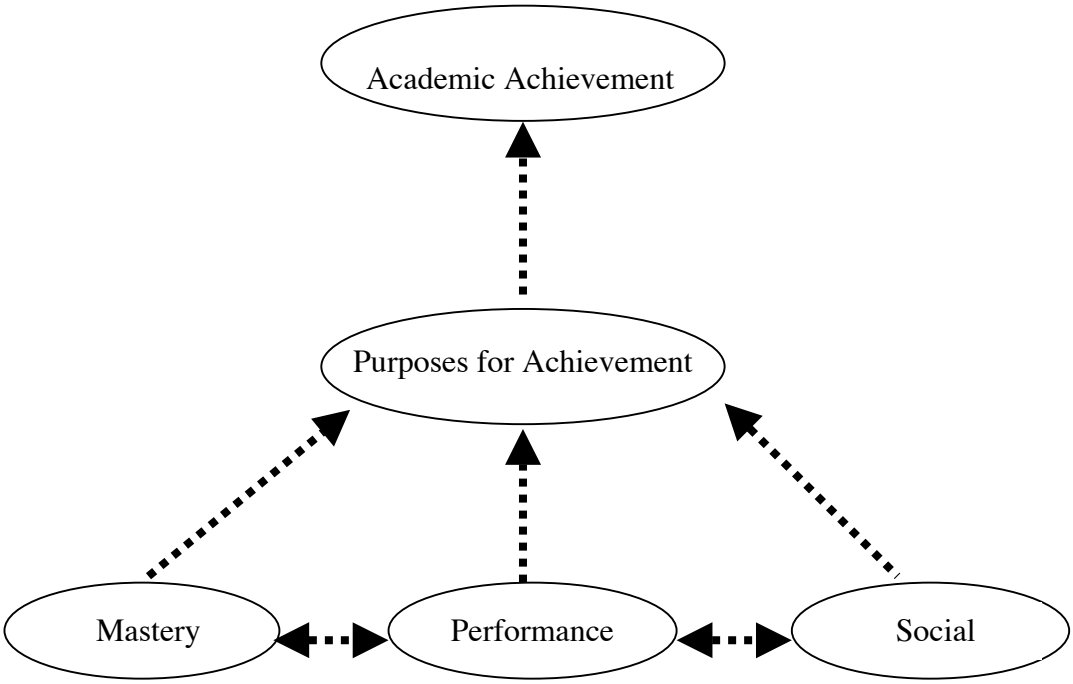


Figure 2: Hierarchical structure for goals (purposes for achievement).

**Academic Self-concept and Academic Achievement**

A substantial body of literature indicates that self-concept is strongly related to academic achievement (e.g. Bandura, 1986; Hodge, Smit, Crist, 1995; Schunk, 1981; Skaalvik & Valas, 1999; Zimmerman, 1989). In particular, links between domain specific self-concepts and achievements appear to be even more substantial than links between global academic self-concept and achievement (Marsh & Yeung, 1997). For example, the relationship between maths self-concept and maths achievement is stronger than the relationships between global self-concept, or other domain specific self-concepts such as English self-concept, and maths achievement (Skaalvik & Valas, 2001; Zanobini & Usai, 2002).

Studies examining relations between self-concept and academic achievement have typically taken an 'either-or' approach to investigating relations between self-concept and achievement. Thus, studies have either tested globalised measures of academic self-concept and achievement or domain specific measures of self-concept and achievement (Hodge et al., 1995; Koumi & Meadow, 1997). However, the interactive effects of domain specific self-concepts, their structural relationship to global self-concept, and the

impact of this entire hierarchical structure on achievement has not typically been tested (although see Marsh, 1992; Marsh & Yeung, 1998; Yeung, Chui & Lau, 1999 for some recent exceptions to this generalisation). For this reason, the present study examines both the first-order (domain specific, multidimensional) and second-order (global, hierarchical) structure of self-concept. This study extends upon previous research, however, by examining this hierarchical structure of self-concept alongside the hierarchical structure of goals.

Figure 4 represents the multidimensional and hierarchical nature of self-concept and its hypothesised relation to academic achievement, using a two-domain (maths and English) structure.

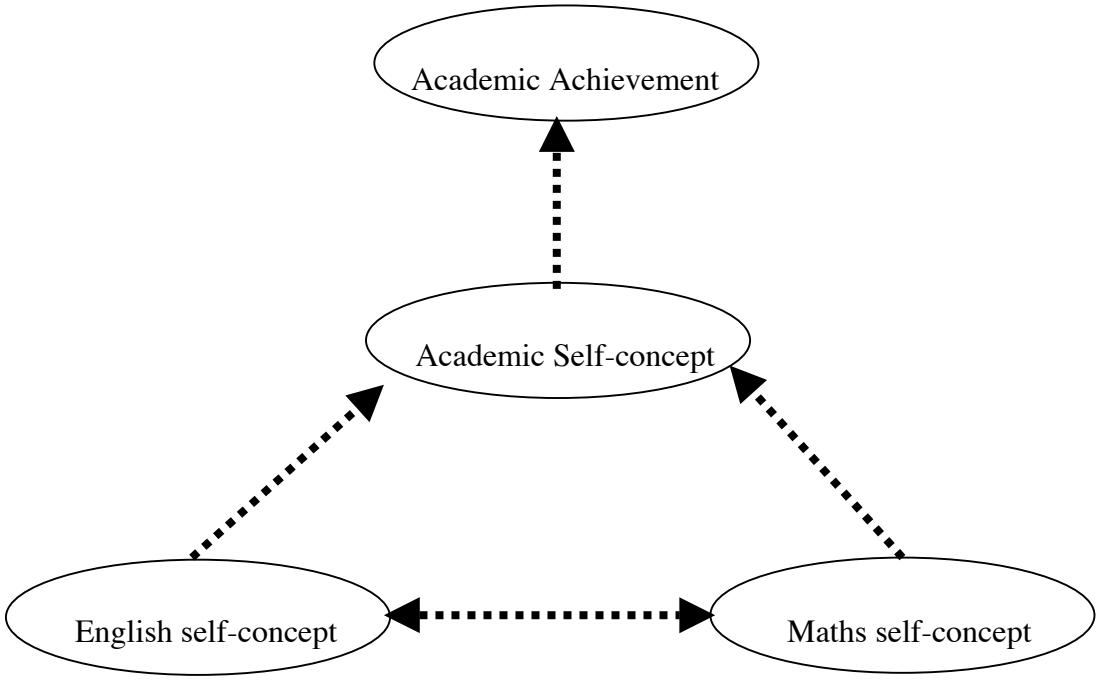


Figure 4: Multi-dimensional and hierarchical structure of self-concept.

**Rationale for Combining Achievement Motivation with Academic Self-Concept**

The section above has suggested that both self-concepts and motivational goals are (a) influential in students' academic performance and achievement, and (b) structurally more complex than many studies might suggest. For these reasons, it is not unreasonable to suggest that self-concept and goals together, especially when operationalised as

multidimensional and hierarchical constructs, may provide a fuller explanation for students' achievement than either taken alone, especially when over-simplified structures for these constructs have been investigated. A basic requirement of such an approach, however, will be to design and validate instruments which capture the multidimensional and hierarchical structure of both self-concept and goals. (This is the specific focus of this study.) Also, a theoretical rational for why a combination of constructs from two largely distinct literatures should be explored is also required. Such a rationale is provided immediately below.

Given any achievement-related situation there are at least two fundamental variables, the *task* itself (e.g., a sporting activity, a maths test or poetry writing) and the person doing the task (the *self*). These variables are 'fundamental' in the sense that a task cannot be "achievement-related" unless there is a person (a self) to construe the task as an achievement-related one, and a person cannot construe a task as achievement-related unless there is a task to complete in the first-place. Goal Theory essentially suggests that self-perceptions of the purpose and structure of the task are influential in academic performance and achievement (Harackiewicz, Barron, Tauer, Carter & Elliot, 2000; Kaplan & Maehr, 1999; Skaalvik, 1997a). Conversely, self-concept theory suggests that self-perceptions of relative ability are influential in academic performance and achievement (Anderman, Anderman & Griesinger, 1999; Marsh & Craven, 1997). Thus, if task and self are the key variables in achievement-related tasks, then Goal Theory and Self-Concept Theory suggest that perceptions of task and self are fundamental psychological drivers of performance and achievement arising from engagement in those tasks. Thus, if only Goal Theory or only Self-Concept Theory is used to examine achievement-related behaviours, and indeed achievement itself, then either key perceptions concerning tasks, or key perceptions concerning self may be missing from the respective analyses. To the extent that if this is the case, then a holistic account of <u>both</u> foundational variables in achievement-related behaviours may be missing.

In addition to the above, perceptions of the purposes of a *task* and perceptions of the ability of *self* may be interconnected in a learning situation such that perceptions of *task purpose* effects perceptions of *self ability*. For example, there is considerable evidence (e.g. Harackiewicz, Barron, & Elliot, 1998) that if one perceives a task to be competitive in nature this may negatively impact upon self-perceptions of relative ability. On the other hand, non-competitive tasks may enhance self-perceptions of relative ability. Conversely, poor perceptions of ability (low self-concept) may lead to disengagement in

achievement-related tasks, and high self-concept may lead to enhanced engagement in tasks (see Zusho & Pintrich, 2001). Thus, perceptions of the purposes of a task and the abilities of the self are not only fundamental to achievement-related behaviours, but are also interactive in determining engagement (or not) in achievement-related behaviours. This latter reason provides further justification for investigating the simultaneous affects of perceptions of task and self on academic achievement.

The above discussion postulates that the nature of the *task* impacts upon perceptions of *self*, and that these causally related influences affect achievement outcomes. An alternative (perhaps complementary) perspective is that perceptions concerning "Why am I doing this?" (goal orientation), and perceptions concerning "Can I do this?" (self-concept), may interact reciprocally to influence both academic engagement and academic achievement. For example, one individual may perceive that the purpose of a task is to demonstrate competitive superiority (i.e. "I am doing this to win"), but be unsure that they have the ability to "win". Another student, may perceive the same task as competitive, but be sure of their ability to win. Yet another student may perceive the purpose of the task to be mastery (competence) related, yet perceive themselves to be incompetent, and so on. The point is that the relative salience of the 'mix' of task and self perceptions is crucial in determining engagement in a task, and hence achievement outcomes from the task. Thus, it may be (from the paragraph above) that perceptions of task affect perceptions of self, which in turn affect academic engagement and achievement. Alternatively, (from this paragraph) perceptions of task and self may interact to influence engagement and achievement. Whatever the case, a pre-requisite for investigating both these alternatives is an instrument capable of simultaneously measuring both goals and self-concept.

Figure 5 combines Figures 2 and 4 to demonstrate how achievement goals and academic self-concept may interact to affect academic achievement.

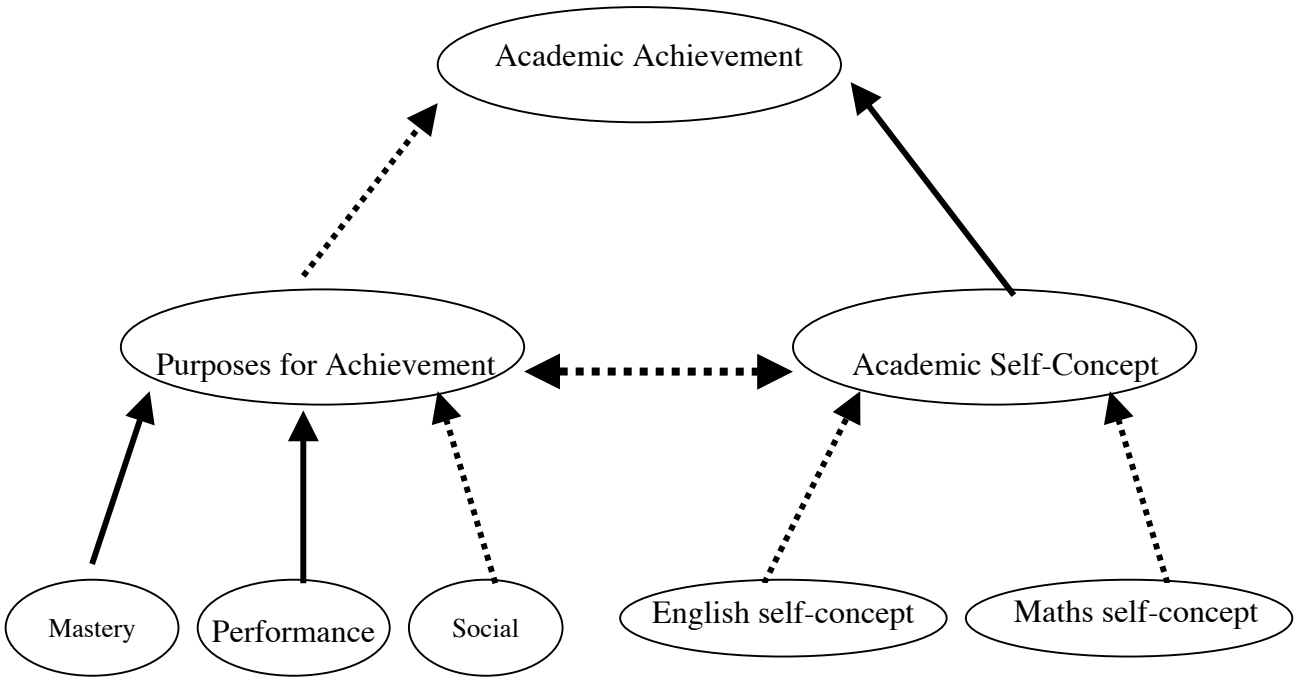


Figure 5: First- and Second Order Structure of Goals and Self-Concepts Leading to Achievement.

## Purpose

To date, few researchers have explored relations between self-concept, goals and achievement (although see Anderman, Anderman, & Griesinger, 1999; Martin & Debus, 1998; Skaalvik, 1997b; and Skaalvik, Valas, & Sletta, 1994; for some exceptions to this generalisation). Of these studies, most have been limited to an investigation of mastery and performance goals with self-concept, and did not include a hierarchical structure for either goals or self-concept. Within this context, the purpose of the present study was to build upon this previous work by providing a measurement framework within which the interaction of multiple goals, domain specific self-concepts, and their higher-order factors may be examined simultaneously. Importantly, we planned to assess the stability of the proposed (lower and higher order) models using two waves of data by employing a test and retest design.

Specifically, we wished to examine whether multiple goals (mastery, performance and social) represent three distinct goals that delineate varying purposes for achievement. We also wished to examine whether academic self-concept could be represented in two

specific domains (i.e., English and maths). Exploring correlations between the multiple first-order factors provided the opportunity to demonstrate the multidimensionality of goals and academic self-concept. However, it also provides the opportunity to test whether the first-order factors may support two second-order factors, which we labelled "Purposes for Achievement" and "Academic Self-concept". Thus, examining correlations between the first-order factors provides the opportunity to demonstrate a hierarchical representation of goals and academic self-concept.

Finally, we desired to test whether both the first-order and second-order representations of goals and self-concept fitted the data equally well across sex groups. This is important because males and females may understand and express their purposes for achievement and self-concepts in different ways (Johnsson-Smaragdi & Josson, 1995). Thus, it is important to know whether the one instrument adequately captures the potentially different perceptions of males and females with respect to their motivation and self-concept

## Method

### Participants

Participants in the study were 1 515 secondary school students in Years 7, 8 and 9 in the first year of data collection and Years 8, 9 and 10 in the second year. The participants were from eleven high schools broadly representative of school settings in New South Wales, Australia. Fifty-two percent of these students were female and 48% were males, with the mean age of students at Time 1 being 13.10 years and at Time 2 being 14.20 years.

### Measures

Recent research on the multidimensionality of self-concept focuses on domain-specific self-concepts (Lau, Yeung, Jin & Low, 1999). Marsh's (1989) Self-Description Questionnaire (SDQ) measures students' self-concept in a variety of non-academic and academic domains. The SDQ comprises seven non-academic scales (e.g., physical appearance and physical ability) and three academic scales (e.g., maths, verbal and general school). Marsh and colleagues (Marsh, 1989; Marsh, Relich, & Smith, 1983) designed the Self-Description Questionnaire II in order to examine adolescents' multidimensional self-concept between the ages of 12 and 18 years (Gonzalez-Pienda et al., 2002). Based on the

SDQ II, Marsh (1990) developed the Academic Self-Description Questionnaire II. The ASDQ II examines academic self-concepts in specific domains. Two scales from the ASDQ II were adopted for the purposes of this study. Five items measured English self-concept (eg. "I am good at English.") and 5 items measured math self-concept (eg. "I am good at maths."). These items, their numerical identifiers, and their alpha estimates of reliability at both Time 1 and Time 2, are recorded in Table 1. Students responded to the items in Table 1 on a five-point likert scale ranging from "strongly disagree" to "strongly agree".

[Insert Table 1 about here.]

The nature of students' motivation was evaluated using the General Achievement Goal Orientation Scale (GAGOS) developed by McInerney (1997). Constructed from McInerney's Inventory School Motivation (ISM) instrument (McInerney & Sinclair, 1991, 1992) and influenced by Maehr's Personal Investment Model (PIM) (Maehr, 1984; Maehr & Braskamp, 1986), the GAGOS has demonstrated sound psychometric properties (Barker, McInerney, & Dowson, 2002; Barker, McInerney, & Dowson, 2003).

The GAGOS measures three general goal orientations (General Mastery, General Performance and General Social). Each of the three general orientations subsume at least two components. General Mastery subsumes task involvement (e.g., I am most motivated when I am good at something), and effort (e.g., I am most motivated when I see my work improving). General Performance subsumes competitiveness (e.g.,. I am most motivated when I am doing better than others), power (e.g., I am most motivated when I am noticed by others), competition (e.g., I am most motivated when I am doing better than others) and extrinsic motivation (e.g., I am most motivated when I get a good mark). General Social subsumes affiliation (e.g., I am most motivated when I work with others), and social concern (e.g., I am most motivated when I am helping others). Rather than inferring motivation, as is the approach in the ISM, the GAGOS intentionally denotes the term "motivated" at the beginning of each item stem (i.e., I am most motivated when…). Respondents subsequently acknowledged whether they were most motivated in a mastery, performance or social goal situation.

The GAGOS comprises five items measuring General Mastery, eight items measuring General Performance, and five items measuring General Social orientation. These items, their numerical identifiers, and their alpha estimates of reliability at both

Time 1 and Time 2 are recorded in Table 2. As with items from the ASDQ II, students responded to the items in Table 2 on a five-point likert scale ranging from "strongly disagree" to "strongly agree".

[Insert Table 2 about here.]

Procedure

The items listed in Tables 1 and 2 were combined with additional items comprising the ISM, and randomly ordered among 114 items forming a single survey instrument. A standardised explanation of the purpose of the survey was provided for participants before each administration. The term motivated was defined for all participants to ensure their understanding of the term. The questionnaire was then read aloud to the students in order to (a) ensure that most participants completed the survey within the time allotted, (b) overcome reading and language difficulties of some students, (c) ensure consistency in administration procedures from school to school and (d) assist students with learning difficulties. At each session there were at least two research assistants present to assist students to complete the survey. The same questionnaire and procedure was followed for both waves of data collection. The first wave of data was collected in November 2001, and the second wave in November 2002.

Analyses

Confirmatory Factor Analyses (CFAs: e.g., Hau, Kong & Marsh, 2000; Kaplan, 2000) using LISREL and Reliability Analyses using SPSS (Pedhazur & Pedazur-Schmelkin, 1991) were used to determine the psychometric properties of the combined GAGOS and ASDQ II scales at Time 1 and Time 2, for the full sample and for sex groups within the sample. The CFAs proceeded in two phases. Phase 1 incorporated the first-order models and Phase 2 the second (or higher) order models.

*Phase 1 CFAs*. Fourteen first-order nested models were tested in a structured approach to determining the properties of the combined scales. These models were:

(a) Model 1 (M1): the null (no factor) model for the full set of 28 items at Time 1.

(b) Model 2 (M2): the hypothesised (five factor) model for the full set of 28 items at Time 1.

(c) Model 3 (M3): the null model with the six poorly fitting items from M2 deleted at Time 1.

(d) Model 4 (M4): the hypothesised (five factor) model with the revised set of 22 items at Time 1.

(e) Model 5 (M5): the null model with the revised set of 22 items at Time 2.

(f) Model 6 (M6): the hypothesised (five factor) model with the revised set of 22 items at Time 2.

(g) Model 7 (M7): the null model with 22 items for males at Time 1.

(h) Model 8 (M8): the hypothesised model with 22 items for males at Time 1.

(i) Model 9 (M9): the null model with 22 items for males at Time 2.

(j) Model 10 (M10): the hypothesised model with 22 items for males at Time 2.

(k) Model 11 (M11): the null model with 22 items for females at Time 1.

(l) Model 12 (M12): the hypothesised model with 22 items for females at Time 1.

(m) Model 13 (M13): the null model with 22 items for females at Time 2.

(n) Model 14 (M14): the hypothesised model with 22 items for females at Time 2.

*Phase 2 CFAs*. Twelve second-order models were tested to determine the multi-dimensional and hierarchical structure of goals and self-concept, and to assess the stability of the solutions over the two waves of data collection. The multiple goals construct was related to the higher order factor Goals while English and maths self-concept were related to the higher order factor Academic Self-concept. The models tested were:

(a) Model 15 (M15): the second-order null model with 22 items for the total sample at Time 1.

(b) Model 16 (M16): the hypothesised second-order model (following Figure 5 with five first-order and two second-order factors) with 22 items for the total sample at Time 1.

(c) Model 17 (M17): the second-order null model at Time 2 for the total sample.

(d) Model 18 (M18): the second-order hypothesised model at Time 2 for the total sample.

(e) Model 19 (M19): the second-order null model at Time 1 for males.

(f) Model 20 (M20): the second-order hypothesised model at Time 1 for males.

(g) Model 21 (M21): the second-order null model at Time 2 for males.

(h) Model 22 (M22): the second-order hypothesised model at Time 2 for males.

(i) Model 23 (M23): the second-order null model at Time 1 for females.

(j) Model 24 (M24): the second-order hypothesised model at Time 1 for females.

(k) Model 25 (M25): the second-order null model at Time 2 for females.

(l) Model 26 (M26): the hypothesised model at Time 2 for females.

*Strict confirmability*. Although CFAs are labelled "Confirmatory", typically CFA researchers do not test one model alone (a strictly confirmatory approach), but of often make post-hoc adjustments to models in order to make models fit sample data better. Thus, many CFA studies are really quasi-confirmatory, or even outright exploratory (Byrne, 1998). In the present study we followed this quasi-confirmatory approach for the first wave of data. However, for the second wave of data we followed a strictly confirmatory approach. Thus, both the first- and second-order models for Time 2 tested a 22 item model (albeit generated with the first wave of data) without modification. This strictly confirmatory approach is a feature of the present study, and represents a strong test of the factorial structure of the instrument.

*Evaluating model fit*. The indices used to assess the fit of models in this study were the Chi-square/degrees of freedom ratio, the Goodness of Fit Index (GFI), the Adjusted Goodness of Fit index (AGFI), the Tucker Lewis Index (TLI), the parsimony Relative Non-centrality Index (PRNI) and the Root Mean Square Error of Approximation (RMSEA) (Byrne, 1998). Kelloway (1998, p.27) describes the GFI as "a ratio of the sum of the squared discrepancies [between the sample variance/covariance matrix and the model-implied variance-covariance matrix] to the observed variances". The AGFI differs from the GFI because adjustments have been made to take into account the degrees of freedom implied in the model. Values above 0.9 indicate good fit to the data for both the GFI and the AGFI (Loehlin, 1998).

The TLI and the PRNI both compare a null model with a hypothesised model. In a null model all variables are typically specified to be uncorrelated, that is, no relationship between the variables is specified (Kelloway, 1998). Null models serve as a valuable baseline for comparing alternative models which imply specified covariances between the observed variables (Byrne, 1998). The TLI and PRNI should ideally be greater than 0.95, although values greater than 0.90 indicate acceptable fit (Marsh, Balla, & Hau, 1996). In the present study, these indices were computed using formulae given in Marsh et al. (1996).

The RMSEA takes into account an error of approximation in the implied population covariance matrix, thus relaxing the stringent requirement in the Chi-square/degrees of freedom statistic that the model holds exactly in the population. The RMSEA should ideally be less than 0.05. However, values between 0.05 and 0.08 indicate reasonable fit (Byrne, 1998; Diamantopoulos & Siguaw, 2000).

*Testing nested models*. Where CFA (and other types of) models are 'nested' i.e. one model (the 'child' model) contains a sub-set of variables in another model (the 'parent' model), a Chi-square difference test ($\Delta\chi^2$) between the two models may be computed (see Marsh, Dowson, Pietsch, & Walker, in press). This test is conducted by subtracting the Chi-square and associated degrees of freedom for the child model from the Chi-square and associated degrees of freedom for the parent model. The remaining Chi-square value (compared against the remaining degrees of freedom) acts as measure of how much better the child model fits to the parent model. Where this difference is significant, the child model can be said to fit the data better than the parent model. The $\Delta\chi^2$ test can be used to test models at the same level (e.g. nested first-order models), or models at different levels (e.g. first-order models with nested higher-order models).

## Results

### Reliability

Results from the reliability estimates are reported in Tables 1 and 2. Reliability estimates for the scales ranged from .77 to .91 for Time 1 and .75 to .92 for Time 2. The analyses indicate the ASDQ items had generally higher reliability than the GAGOS scales (.87 to .92 for the ASDQ scales compared to .75 to .82 for the GAGOS scales). Nevertheless, the lowest reliability of any scale at any Time was .75, suggesting that the scales as a whole demonstrated substantial reliability.

### Model Fit

Overall results for the goodness-of-fit of the first order models are presented in Table 3 and 4. Results for the second order models are presented in Table 5. All hypothesised models considered in this study converged to proper solutions.

[Insert Tables 3, 4 and 5 about here.]

Factor Structure of Achievement Goals and Academic Self-concept

Model 2 (M2) tested the hypothesis that the 28 initial items loaded on five factors. The fit for this model did not reach criterion values. As a result, six poorly fitting items (i.e. items with low factor loadings, high uniquenesses, and relatively high modification indices) were removed from Model 2 (M2). These items were A37MAG, A58PERG, A62PERG, A90PERG, A98PERG, and A108SOCG.

It is important to provide potential theoretical explanations for why the items above were deleted. The fact that A37MAG proved problematic could be attributed to the fact that the remaining four items relate to competence and feelings associated with increasing competence i.e., improving, being good at something, becoming better and being confident. In contrast, A37MAG is a more negatively phrased item that relates to solving a problem. Three of the four deleted performance goal items (A58PERG, A62PERG, A90PERG) relate to the extrinsic component of the General Performance orientation. It appears that the extrinsic component in this study doesn't relate to power, performance and competition. The item A98PERG focuses on the importance of becoming a leader. This item may have been interpreted as a social reason for engaging in the task rather than a component related to power. The social concern item A108SOCG may have been misinterpreted by participants as they may not have understood the term, "showing concern for others". The item may, thus, be open to varying interpretations as to how one actually demonstrates "concern".

The resulting model (Model 4) was tested with the same constraints as M2 i.e. the remaining items loading on their same 'target' factors, with no cross-loadings allowed). M4 showed a better fit to the data than M2. Unlike M2, M4's GFI, AGFI and PRNI are above 0.90 and the RMSEA is less than for M2. The TLI was still below 0.90, but was nevertheless substantially higher than that for M2. Thus, removing the six poorly fitting items from the original hypothesised model led to improved overall model fit. In order to assess whether M4 was a significantly improved overall fit to the data than M2, $\Delta\chi^2$ for the difference between the two models was computed. $\Delta\chi^2$ for this comparison was 1436.24 with 141 degrees of freedom. This difference is significant, indicating that M4 represents a significant improvement in fit over M2.

The revised model (M4) was then tested without alteration with the second wave of data (M6). M6 also fitted the data well, with the Chi-square for the M6 being slightly larger than for M4, but fit indices being essentially comparable to that for M4. These results support the convergent and discriminant validity of the measures, and indicate support for the multidimensionality of both achievement goals and academic self-concept for both waves of data.

First-Order Models for Males and Females

The models for Time 1 (M4) and Time 2 (M6) fitted the data well and were used to determine whether the models fit equally well for males and females across both waves of data. At Time 1, the model for males (M8) demonstrated a marginal fit for the data, with only one index reaching criterion values. The Time 1 model for females (M12) showed a much better fit for the data, with three of five indices reaching criterion levels, an the other tow approaching criterion values. At Time 2, the fit of the model for males (M10) was substantially better than at Time 1, with two of five indices reaching criterion values, the other three indexes approaching criterion values, and the Chi-square lower than for M8. Conversely, the model for females at Time 2 was not as good a fit for the data, with only two indices reaching criterion values, and the Chi-square for M14 being substantially larger that for M12. These results suggest that the models for sex groups are not as stable as the Models for the sample as a whole.

Higher Order Representations of Achievement Goals and Academic Self-concept

Model 16 (M16) at Time 1 and Model 18 (M18) at Time 2, tested the ability of an hierarchical representation of multiple achievement goals and self-concepts (as per Figure 5) to fit the data. M16 (the higher-order version of M4) and M18 (the higher-order version of M6), demonstrated a good fit to the data. Most indices for these Models met criterion values, and the other indices approached these values. Significant and substantial paths were evident from mastery 0.76, performance 0.57 and social 0.55 goals to the higher-order factor (Purposes for Achievement). Similar paths were evident from English Self-concept 0.60 and Maths Self-concept 0.40 to Global Self-Concept.

The $\Delta\chi^2$ for the difference between Model 16 and Model 4 (Time 1 second-order versus Time 1 first-order model) was 41.21 with 4 degrees of freedom, which was significant. This indicated that the second-order model was not as good a representation

of the data as the first-order model. However, to the second order model is more parsimonious than the first-order model (i.e. it has more degrees of freedom), and the fit indices for the two models are either identical or comparable in all cases. In the case of the Time 2 second-order versus Time 2 first-order models (Model 18 versus Model 6) the second-order model fits the data better than the first order model, with a lower Chi-square and higher degrees of freedom. This said, $\Delta\chi^2$ for the difference between these two models was 8.11 with 4 degrees of freedom, which is not significant. Moreover, the fit indices for these two models were identical in all cases. This suggest that the first and second-order models for Time 2 are comparable, with the second order models again being more parsimonious, and hence probably preferable.

Taken together, these results appear to support a hierarchical representation of both achievement goals and academic self-concept for Time 1 and Time 2, with the case perhaps stronger for Time 2 (which again was tested using strict confirmatory procedures).

Second-Order Models for Males and Females

The higher order models for Time 1 (M16) and Time 2 (M18) were used to determine whether the models fit equally well for males and females for the two waves of data. At Time 1, the higher-order models for males (M20) and females (M24) demonstrated comparable fit to the data when compared with their respective first-order models (M8 and M12). In both cases all fit indices were either identical or near-identical between the second- and first-order models. The same was true at Time 2 for both males (M22 versus M10) and females (M26 versus M14). $\Delta\chi^2$ for the difference between Model 20 and Model 8 was 37.68, between Model 24 and Model 12 was 36.37, between Model 22 and Model 10 was 31.56, and between Model 26 and Model 14 was 36.23. All these differences (with 4 degrees of freedom for each) were significant. However, again the higher-order models are more parsimonious, and with comparable fit-indices to their respective first-order models, may be accepted as equivalent models for the data.

## Discussion

The present study essentially comprised three related components. The first was an examination of the (first-order) multidimensional nature of achievement motivation and

academic self-concept i.e. an examination of multiple goals and domain specific self-concepts. The second was an examination of a hierarchical representation of achievement goals and academic self-concept, positing Purposes for Achievement and Global Self-concept as the higher order factors. The third was an examination of whether both the first-order and second-order models fitted the data equally well across sex groups.

First-Order Models and the Multidimensionality of Goals and Self-Concept

The first-order modelling process for the sample as a whole demonstrated that the modified 22 item model was a good fit for the data at Time 1 (M4) and, without alteration, at Time 2 (M6). This suggests that that the multidimensional model was a good representation of the data at both Times. This, in turn, lends support to the theoretical argument goals and self-concept should be viewed as multi- rather than uni-dimensional constructs. Results of this study are, thus, congruent with other theoretical (e.g. Urdan and Maehr) qualitative (e.g. Dowson & McInerney, 2001, 2003) and quantitative studies (e.g. . McInerney & Marsh, 2003; McInerney, Roche, McInerney, & Marsh, 1997) which also support the multidimensionality of students goals. In particular, the models in this study worked well with the inclusion of social goals as a first-order construct. This, consistent with other studies (e.g. Dowson & McInerney, 2003) suggests that social goals in addition to academic (mastery and performance) goals are important for students in educational settings. For these reasons, the study provides a measurement framework within which the interaction of multiple goal orientations and self-concept variables may be examined further.

Sex Differences

The above said, the total-sample models may disguise some underlying sex-group measurement dynamics. Thus, at Time one the first-order model for Males (M8) did not fit he data as well as the first-order model for females (M12). At Time 2 the reverse was the case. So, at both Times the superior fit of the model with one sex masked, at least to some extent, the poorer fit of the model with the other sex. If nothing else, this result demonstrates the importance of testing models with important sub-groups within a given sample.

From a psychometric perspective, the reason that models may fit to a greater or lesser extent is revolves around the fact that items which are said to measure the same factor should correlate more highly with each other than items that are said to measure

different factors. When this doesn't occur, it suggests either that (a) the survey items do not measure their underlying factors well, or (b) that, for other reasons, the underlying factors are not substantially differentiated by participants. In the present case, the fact that the model fitted well with both sexes on at least one occasion, suggests the possibility that participants perceptions of the underlying factors implied by the survey may be changing over time.

This, in turn, suggests two further possibilities. One is that the extent to which students' multiple goals and domain specific self-concepts are differentiated by males and females may vary over time. So, for example, at any given time males or females may perceive their different purposes for learning to be more or less differentiated from their perceptions of their ability. Or it may be that certain goals, or domain specific self-concepts are more highly differentiated at certain times than others and again differentially so for males and females. What socio-psychological factors may be at work to bring about such change are indeterminate in this study. However, it does leave open the interesting possibility that external forces or circumstances may effect the way males and females perceive not just their goals and self-concepts (which is well established in the literature e.g. Marsh, Barnes, Cairns, & Tidman, 1984; Skaalvik & Rankin, 1994; Wigfield & Eccles, 1994), but the extent of <u>distinctions between</u> these goals and self-concepts (which is not well established in the literature). So, for example, the extent to which I perceive mastery and performance goals to be differentiated constructs may vary as a function of sex over time. The same is true for any number of combinations of variables in the present study.

A second, perhaps more straight forward, possibility is that the extent to which goals and self-concepts are differentiated by males and females may vary as a function of age. For example, females may develop a more holistic self-concept and a more holistic understanding of their purposes for achievement, with age. Conversely, males may develop a more differentiated self-concept and differentiated set of purposes for their learning as they age. These suggestions would be consistent with adolescent research which suggests that males tend to converge on particular ways of thinking about themselves and the world during adolescent, whereas females tend to diverge and become more 'exploratory' about themselves and their ways of thinking about the world (e.g. Coleman, & Hendy, 1999). If this is true, it highlights the difficulties in one-size-fits all, and one-time-fits-all approaches to measurement in the psychological domain – especially during periods of rapid personal change, such as adolescence.

We are not trying to escape the fact that our models may simply be unstable over time, with at least the sub-groups of males and females participating here. However, we are suggesting that the underlying psychological dynamics of participants are at least one possible cause for the variation in model fit between males and females observed in this study.

Hierarchical Models

Similar to other studies, this study found support for an hierarchical achievement goal (Dowson & McInerney, 2003; McInerney, 1997) structure and an hierarchical academic self-concept (Yeung, Chui & Lau, 1999) structure. However, we extend this previous literature by including social goals in the hierarchical structure of goals, by positing a higher-order factor for students' goals (Proposes of Achievement), and by combining a hierarchical structure of goals with a hierarchical structure for self-concept. The fact that this model was a good fit for the data at both times lends support to the theoretical augment for a hierarchical structure of goals and self-concepts. Moreover, the fact that higher-order model fit the data better at Time 2 than the first-order Time 2 model (again using a strictly confirmatory approach) suggest that the higher-order models may be preferred to the first-order model. Even at Time 1, where the second-order models was not as good a fit for the data as the first-order model, in terms of the fit indices it still represents an good model in its own right. Thus, in competition with their respective first-order models, there is some evidence that the higher-order models are at least not much worse, and perhaps even better than their first-order counterpart. Also, in both cases, they are more parsimonious.

*Sex Differences*. The higher-order models exhibit the same pattern of sex differences as the first-order models, with the females models fitting better at Time 1 than Time 2 and vice versa. The overall fit of the higher-order models was not as good as for the first-order models at the sex-group level, with all $\Delta\chi^2$ differences between the higher-order and first-order models being significant. However, again the higher-order models are more parsimonious than the first-order models, and in terms of the fit-indices, the models are essentially equivalent. Marsh (1992) and Yeung, Chui, and Lau (1999) suggest that to the extent that higher-order models represent model fit not much worse than their comparative first-order models, they may be accepted as a reasonable representation of the data.

## Conclusion

Findings from this research provide support for both combined first-order and second-order models of academic achievement motivation and academic self-concept. However, support for these models is not unequivocal at the sex-group level. For this reason, further research investigating the reasons for this sex-group model instability will need to be conducted. Both psychometric and developmental perspectives may be bought to bear on this investigation.

## References

Ainley, M. D. (1993). Styles of engagement with learning: Multidimensional assessment of their relationship with strategy use and school achievement. Journal of Educational Psychology, 85, 395-405.

Anderman, E.M., Anderman, L.H., & Griesinger, T. (1999). The relation of present and possible academic selves during early adolescence to grade point average and achievement goals. The Elementary School Journal, 100, (1), 3-17.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall.

Barker, K., McInerney, D.M., & Dowson, M. (2002). Toward a model of achievement motivation and self-concept. Paper presented at the 2nd International Biennial Conference, University of Western Sydney, Sydney, Australia, 6-8 August.

Barker, K., McInerney, D.M., & Dowson, M.. . (2003). Toward a model of achievement motivation and academic achievement self-concept: Longitudinal analysis. Paper presented to be presented at the annual meeting of the American Educational Research Association, Chicago.

Barron, K. E., & Harackiewicz, J.M. (2001). Achievement goals and optimal motivation: Testing multiple goal models. Journal of Personality and Social Psychology, 80, 706-722.

Bempechat, J., & Boulay, B.A. (2001). Beyond dichotomous characterisations of student learning: New directions in achievement motivation research. In D.M. McInerney & S. Van Etten (Eds.), Research on sociocultural influences on motivation and learning (pp. 17-36). Greenwich, CT: Information Age Press.

Bouffard, T., Vezeau, C., & Bordeleau, L. (1998). A development study of the relation between combined learning and performance goals and students' self-regulated learning. British Journal of Educational Psychology, 68, 309-318.

Byrne, B.M. (1998). Structural equation modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming. Mahwah, New Jersey:Lawrence Erlbaum Associates, Publishers

Byrne, B. M., & Shavelson, R.J. (1987). Adolescent self-concept: Testing the assumption of equivalent structure across gender. American Educational Research Journal, 24, 365-385.

Coleman, J.C., & Hendy, L.B. (1999). The Nature of Adolescence. New York: Routledge.

Covington, M. V. (2000). Goal theory, motivation, and school achievement: An interactive review. Annual Review of Psychology, 171-198.

Diamantopoulos, A., & Siguaw, J.A. (2000). Introducing LISREL. London: SAGE Publications.

Dowson, M., & McInerney, D.M. (2001). Psychological parameters of students' social and work avoidance goals: A qualitative investigation. Journal of Educational Psychology, 93(1), 35-42.

Dowson, M., & McInerney, D.M. (2003). What do students say about their motivational goals?: Towards a more complex and dynamic perspective on student motivation. Contemporary Educational Psychology, 28, 91-113.

Elliot, A.J., & Church, M.A. (1997). A hierarchical model of approach and avoidance achievement motivation. Journal of Personality and Social Psychology, 72, 218-232.

Elliot, A.J., & McGregor, H.A. (1999). Test anxiety and the hierarchical model of approach and avoidance achievement motivation. Journal of Personality and Social Psychology, 76, 628-644.

Harackiewicz, J.M., Barron, K.E., & Elliot, A.J. (1998). Rethinking achievement goals: When are they adaptive for college students and why? Educational Psychologist, 33, 1-21.

Harackiewicz, J. M., Barron, K.E., Tauer, J.M., Carter, S.M. & Elliot, A.J. (2000). Revision of achievement goal theory: Necessary and illuminating. Journal of Educational Psychology, 92, 316-330.

Harackiewicz, J.M., Barron, K.E., Pintrich, P.R., Elliot, A.J. & Thrash, T.M. (2002). Revision of achievement goal theory: Necessary and illuminating. Journal of Educational Psychology, 94, 638-645

Hodge, D. R., Smit, E.K., & Crist, J.T. (1995). Reciprocal effects of self-concept and academic achievement in sixth and seventh grade. Journal of Youth and Adolescence, 24, 295-315.

Johnsson-Smaragdi, U., & Josson, A. (1995). Self-evaluation in an ecological perspective: Neighbourhood, family and peers, schooling and media use. In K.E. Rosengren (Eds.). Media effects and beyond: Culture, socialisation and lifestyles. London: Routledge.

Kaplan, A., & Maehr, M. (1999). Achievement goals and student well being. Contemporary Educational Psychology, 24, 330-358.

Kaplan, A., & Middleton, M.J. (2002). Should childhood be a journey or a race? Response to Harackiewicz et al (2002). Journal of Educational Psychology, 94, 646-648.

Kelloway, K.E. (1998). Using LISREL for structural equation modeling. Thousand Oaks: SAGE Publications.

Koumi, I., & Meadows, S. (1997). The multidimensional, hierarchical model of academic self-concept: The case of Greek secondary school pupils. Evaluation and Research in Education, 11, 173-182.

Linnenbrink, E. A., & Pintrich, P.R. (2000). Multiple pathways to learning and achievement: The role of goal orientation in fostering adaptive motivation, affect, and cognition. In S.C. Sansone. & J. M. Harackiewicz (Eds.), Intrinsic and extrinsic motivation: The search for optimal motivation and performance. New York: Academic Press.

Loehlin, J.C. (1998). Latent variable models. Mahwah, New Jersey: Lawrence Erlbaum Associates, Publishers.

Marsh, H. W. (1990). The structure of academic self-concept: The Marsh/Shavelson model. Journal of Educational Psychology, 82, 623-636.

Marsh, H.W. (1992). Content specificity of relations between academic achievement and academic self-concept. Journal of Educational Psychology, 84, (1), 35-42.

Marsh, H. W. (1996). Positive and negative global self-esteem: A substantively meaningful distinction or artifactors? Journal of Personality & Social Psychology, 70,810-819.

Marsh, H. W. (1994). Using the National Educational Longitudinal Study of 1988 to evaluate theoretical models of self-concept: The Self-Description Questionnaire. Journal of Educational Psychology, 86, 439-456.

Marsh, H.W., Balla, J.R., & Hau, K. (1996). An evaluation of incremental fit indices: A clarification of mathematical and empirical properties. In G.A. Marcoulides, & R.E. Schumacker (Eds.). Advanced structural equation modelling: Issues and techniques. Mahwah, NJ: Lawrence Erlbaum

Marsh, H.W., Barnes, J., Cairns, L., & Tidman, M. (1984). Self-Description Questionnaire: Age and sex effects in the structure and level of self-concept for preadolescent children. Journal of Educational Psychology, 76, 940-956.

Marsh, H. W., & Yeung, A.S. (1997). Coursework selection: Relations to academic self-concept and achievement. American Educational Research Council, 34, 691-720.

Martin, A.J. & Debus, R.L. (1998). Self-reports of mathematics self-concept and educational outcomes: the roles of ego-dimensions and self-consciousness. British Journal of Educational Psychology, 68, 517-535.

McInerney, D. M. (1997). Relationship between motivational goals, sense of self, self-concept and academic achievement for Aboriginal students. 10th Annual Aboriginal Studies Association Conference, University of Western Sydney, Bankstown Campus, Milperra, 12-14 July, 2000.

McInerney, D.M., Roche, L., McInerney, V., & Marsh, H.W. (1997). Cultural perspectives on school motivation: The relevance and application of goal theory. American Educational Research Journal, 34, 207-236.

McInerney, D. M., Marsh, H.W., & Yeung, A.S. (2003). Toward a hierarchical goal theory model of school motivation. Journal of Applied Measurement, 4, 26-51.

McInerney, D. M., Roche, L.A., McInerney, V., & Marsh, H.W. (1997). Cultural perspectives on school motivation: The relevance and application of goal theory. American Educational Research Journal, 34(1), 207-236.

McInerney, D.M., Simpson, & Dowson, M. (2003). Educating adolescents in Australia. In F. Pajares, & T. Urdan, International Perspectives on Adolescence .25-43. Greenwich, Connecticut: Erlbaum.

Pedhazur, E.J., & Pedazur-Schmelkin, L. (1991). Measurement, design, and analysis: An integrated approach. Hillsdale, NJ: Lawrence Erlbaum.

Pintrich, P. R. (2000). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. Journal of Educational Psychology, 92, 544-555.

Schunk, D. H. (1981). Modeling and attributional effects on children's achievement: A self-efficacy analysis. Journal of Educational Psychology, 73, 93-105.

Skaalvik, E.M. (1997a). Self-enhancing and self-defeating ego orientation: Relations with task and avoidance orientation, achievement, self-perceptions, and anxiety. Journal of Educational Psychology, 89, 408-422.

Skaalvik, E.M. (1997b). Issues in research on self-concept, In M. Maehr & P. Pintrich (Eds.), Advances in motivation and achievement (Vol. 10, pp. 51-97). Greenwich, CT: JAI Press.

Skaalvik, E. M., & Valas, H. (1999). Relations among achievement, self-concept, and motivation in mathematics and language arts: A longitudinal study. The Journal of Experimental Education, 67, 135-146.

Skaalvik, E. M., Valas, H., & Sletta, O. (1994). Task involvement and ego involvement: Relations with academic achievement, academic self-concept and self-esteem. Scandinavian Journal of Educational Research, 38, 231-243.

Urdan, T. C. (1997). Achievement goal theory: Past results, future directions ( Vol. 10). Greenwich CT: JAI Press Inc.

Wigfield, A., & Eccles, J.S. (1994). Children's competence beliefs, achievement values and general self-esteem. Changes across elementary and middle school. Journal of Early Adolescence, 14, 107-138.

Yeung, A. S., Chui, H.S., & Lau, I.C. (1999). Hierarchical and multidimensional academic self-concept of commercial students. Contemporary Educational Psychology, 24, 376-389.

Zanobini, M., & Usai, C.M. (2002). Domain-specific self-concept and achievement motivation in the transition from primary to low middle school. Journal of Educational Psychology, 22, 203-217.

Zimmerman, B. J. (1989). A social-cognitive view of self-regulated academic learning. Journal of Educational Psychology 81, 329-339.

Zusho, A., & Pintrich, P. (2001). Motivation in the second decade of life. In T.C. Urdan, & F, Pajares (Eds.), Adolescence and education. USA: Information Age Publishing.

Table 1

ASDQ II Items

| **English Self-concept Items (T1: α = . 87; T2: α = .88)** | |
|---|---|
| ENGLSC1 | I am good at English |
| ENGLSC2 | I have always been good at English |
| ENGLSC3 | Work in English is easy for me |
| ENGLSC4 | I get good marks in English |
| ENGLSC5 | I learn things quickly in English |

| **Maths Self-concept Items (T1: α = .91; T2: α =.92)** | |
|---|---|
| MATHSC6 | I am good a mathematics |
| MATHSC7 | I have always been good at mathematics |
| MATHSC8 | Work in mathematics is easy for me |
| MATHSC9 | I get good grades marks in mathematics |
| MATHSC10 | I learn things quickly in mathematics |

Note: Numbers in brackets refer to Cronbach's alpha reliability for each scale at Time 1 and Time 2.

Table 2.

Achievement Motivation Items

| **Mastery Goal** | **(T1: α = .77; T2: α = .75)** |
|---|---|
| A27MAG | I am most motivated when I see my work improve |
| A32MAG | I am most motivated when I am good at something |
| A37MAG | I am most motivated when I solve a problem |
| A42MAG | I am most motivated when I am becoming better at my work |
| A50MAG | I am most motivated when I am confident that I can do my schoolwork |
| **Performance Goal** | **(T1: α = .82; T2: α = .82)** |
| A58PERG | I am most motivated when get a reward |
| A62PERG | I am most motivated when I get good marks |
| A72PERG | I am most motivated when I am noticed by others |
| A78PERG | I am most motivated when I am competing with others |
| A83PERG | I am most motivated when I am in charge of a group |
| A90PERG | I am most motivated when I am praised |
| A95PERG | I am most motivated when I am doing better than others |
| A98PERG | I am most motivated when I become a leader |
| **Social Goal** | **(T1: α = .75; T2: α = .75)** |
| A35SOCG | I am most motivated when I work with others |
| A55SOCG | I am most motivated when I am in a group |
| A67SOCG | I am most motivated when I work with friends at school |
| A101SOCG | I am most motivated when I am helping others |
| A108SOCG | I am most motivated when I am showing concern for others |

Note: Numbers in brackets refer to Cronbach's alpha reliability for each scale at Time 1 and Time 2.

Table 3

First-Order Model Fit Statistics

| Model | $\chi^2$ | df | $\chi^2$/df | GFI | AGFI | TLI | PRNI | RMSEA | Model Description |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **First-Order Models** |
| M1 | 15249.38 | 378 | 40.34 | | | | | | Null model T1 (28 items) |
| M2 | 2724.29 | 340 | 8.01 | 0.87 | 0.85 | 0.80 | 0.84 | 0.07 | Hypothesised model T1 |
| M3 | 11433.01 | 231 | 49.49 | | | | | | Null model T1 (22 items) |
| M4 | 1288.05 | 199 | 6.47 | 0.92 | 0.90 | 0.87 | 0.90 | 0.06 | Hypothesised model T1 (22 items) |
| M5 | 13323.89 | 231 | 57.81 | | | | | | Null model T2 (22 items) |
| M6 | 1369.74 | 199 | 7.02 | 0.92 | 0.90 | 0.87 | 0.91 | 0.07 | Hypothesised model T2 (22 items) |
| M7 | 5887.99 | 231 | 25.50 | | | | | | Null model T1 (22 items males) |
| M8 | 806.08 | 199 | 4.07 | 0.90 | 0.87 | 0.84 | 0.89 | 0.07 | Hypothesised model T1 (22 items males) |
| M9 | 6854.84 | 231 | 29.67 | | | | | | Null model T2 (22 items males) |
| M10 | 724.98 | 199 | 3.64 | 0.91 | 0.89 | 0.88 | 0.92 | 0.06 | Hypothesised model T2 (22 items males) |
| M11 | 5741.36 | 231 | 24.85 | | | | | | Null model T1 (22 items female) |
| M12 | 615.86 | 199 | 3.09 | 0.93 | 0.91 | 0.87 | 0.92 | 0.06 | Hypothesised model T1 (22 items females) |
| M13 | 6694.56 | 231 | 28.98 | | | | | | Null T2 (22 items females) |
| M14 | 852.96 | 199 | 4.29 | 0.91 | 0.88 | 0.85 | 0.90 | 0.07 | Hypothesised model |

Note:

For both Tables 3 and 4: GFI = Goodness-of-fit; AGFI = Adjusted Goodness-of-fit; TLI = Tucker-Lewis Index; PRNI = Parsimony Relative Noncentrality Index; RMS = Root Mean Square Error Approximation. A null model is a model that specifies no relationship between the variables composing the model. The null model is used as a baseline to compare the hypothesised model (a model in which the relationship between variables has been specified) in both the TLI and PRNI.

$$\text{TLI} = \frac{[\text{Chi-square/degrees of freedom (null model)}] - [\text{Chi-square/degrees of freedom (hypothesised model)}]}{\text{Chi-square/(degrees of freedom} - 1)\text{ (null model)}}$$

$$\text{PRNI} = \frac{[\text{Chi-square} - \text{degrees of freedom (null model)}] - [\text{Chi-square} - \text{degrees of freedom (hypothesised model]}}{\text{Chi-square} - (\text{degrees of freedom} - 1\text{ (null model)}}$$

$$\text{RMSEA} = \text{Square Root } [\,(\text{Chi-square} - \text{degrees of freedom})\ (n - 1)\text{ degrees of freedom}]$$

Table 4

First-Order Factor Solutions Time 1 and Time 2 for the Best 22 Items

| | | **First-order Factors T1** | | | | | **First-order Factors T2** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MAG | PERG | SOCG | ENGSC | MATHSC | MAG | PERG | SOCG | ENGSC | MATHSC |
| MAG | 27 | **.66** | .00 | .00 | .00 | .00 | **.69** | .00 | .00 | .00 | .00 |
| | 32 | **.59** | .00 | .00 | .00 | .00 | **.64** | .00 | .00 | .00 | .00 |
| | 42 | **.73** | .00 | .00 | .00 | .00 | **.78** | .00 | .00 | .00 | .00 |
| | 50 | **.62** | .00 | .00 | .00 | .00 | **.66** | .00 | .00 | .00 | .00 |
| PERG | 72 | .00 | **.64** | .00 | .00 | .00 | .00 | **.55** | .00 | .00 | .00 |
| | 78 | .00 | **.60** | .00 | .00 | .00 | .00 | **.66** | .00 | .00 | .00 |
| | 83 | .00 | **.58** | .00 | .00 | .00 | .00 | **.55** | .00 | .00 | .00 |
| | 95 | .00 | **.65** | .00 | .00 | .00 | .00 | **.71** | .00 | .00 | .00 |
| SOCG | 35 | .00 | .00 | **.67** | .00 | .00 | .00 | .00 | **.73** | .00 | .00 |
| | 55 | .00 | .00 | **.61** | .00 | .00 | .00 | .00 | **.67** | .00 | .00 |
| | 67 | .00 | .00 | **.47** | .00 | .00 | .00 | .00 | **.33** | .00 | .00 |
| | 101 | .00 | .00 | **.50** | .00 | .00 | .00 | .00 | **.40** | .00 | .00 |
| ENGLSC | 1 | .00 | .00 | .00 | **.80** | .00 | .00 | .00 | .00 | **.88** | .00 |
| | 2 | .00 | .00 | .00 | **.74** | .00 | .00 | .00 | .00 | **.76** | .00 |
| | 3 | .00 | .00 | .00 | **.67** | .00 | .00 | .00 | .00 | **.72** | .00 |
| | 4 | .00 | .00 | .00 | **.81** | .00 | .00 | .00 | .00 | **.79** | .00 |
| | 5 | .00 | .00 | .00 | **.71** | .00 | .00 | .00 | .00 | **.74** | .00 |
| MATHSC | 6 | .00 | .00 | .00 | .00 | **.85** | .00 | .00 | .00 | .00 | **.88** |
| | 7 | .00 | .00 | .00 | .00 | **.80** | .00 | .00 | .00 | .00 | **.85** |
| | 8 | .00 | .00 | .00 | .00 | **.78** | .00 | .00 | .00 | .00 | **.80** |
| | 9 | .00 | .00 | .00 | .00 | **.83** | .00 | .00 | .00 | .00 | **.87** |
| | 10 | .00 | .00 | .00 | .00 | **.80** | .00 | .00 | .00 | .00 | **.83** |

Table 5

Second-Order Model Fit Statistics

| Model | $\chi^2$ | df | $\chi^2$/df | GFI | AGFI | TLI | PRNI | RMSEA | Model Description |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **Second-order Models** |
| M15 | 11433.01 | 231 | 49.49 | | | | | | Null model T1 |
| M16 | 1329.26 | 203 | 6.55 | 0.92 | 0.90 | 0.86 | 0.90 | 0.06 | Hypothesised model T1 |
| M17 | 12679.17 | 231 | 54.89 | | | | | | Null model T2 |
| M18 | 1361.63 | 203 | 6.7 | 0.92 | 0.90 | 0.87 | 0.91 | 0.07 | Hypothesised model T2 |
| M19 | 5887.99 | 231 | 25.49 | | | | | | Null model T1 males |
| M20 | 843.76 | 203 | 4.16 | 0.90 | 0.87 | 0.83 | 0.89 | 0.07 | Hypothesised model T1 males |
| M21 | 6854.85 | 231 | 29.67 | | | | | | Null model T2 males |
| M22 | 756.63 | 203 | 3.73 | 0.91 | 0.89 | 0.87 | 0.92 | 0.06 | Hypothesised model T2 males |
| M23 | 5741.36 | 231 | 24.85 | | | | | | Null model T1 females |
| M24 | 652.43 | 203 | 3.21 | 0.92 | 0.90 | 0.87 | 0.92 | 0.06 | Hypothesised model T1 females |
| M25 | 6694.56 | 231 | 28.98 | | | | | | Null model T2 females |
| M26 | 889.19 | 203 | 4.38 | 0.90 | 0.88 | 0.85 | 0.89 | 0.07 | Hypothesised model T2 females |