An Elucidation and Comparison of Indigenous and Non-Indigenous Australian Upper Primary Students' Self-concepts

Rhonda G. Craven
Alexander S. Yeung
Jinnat Ali
Centre for Educational Research, University of Western Sydney, Australia

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Abstract

The purpose of this research is to: (a) examine the applicability of the Self-Description Questionnaire I (SDQI) for Indigenous and non-Indigenous Australian students to identify a psychometrically sound measure of self-concept for Indigenous upper primary students, and (b) compare and contrast the structure and levels of self-concepts (SC) for these students to elucidate understandings about the nature of Indigenous students' self-concepts in comparison to those of their non-Indigenous peers. Applying a confirmatory factor analytic approach with Indigenous (n = 185) and non-Indigenous (n = 518) primary students (Years 5 and 6), the SDQI factor structure was found to be invariant across the 2 groups. All scales showed strong internal consistency and the factor structure was well defined for both sub-samples. The factor loadings and factor correlations were acceptable. Results of Multiple-Indicator-Multiple-Indicator-Cause (MIMIC) models found small but significant ethnicity effects favouring Indigenous students in Physical SC, but non-Indigenous students had higher School SC and Math SC compared to Indigenous students. Boys had higher Math SC and Physical SC compared to girls but girls had higher SCs in 5 of the 8 factors. A significant ethnicity x gender interaction effect was found for School SC indicating particularly low School SC for Indigenous boys. These results suggest that a tangible approach to improving Indigenous students' academic potential needs to involve enhancing academic self-concepts and that Indigenous boys' academic self-concepts need particular attention.

National reports and all Australian governments have acknowledged that Indigenous Australians are significantly educationally disadvantaged (Commonwealth of Australia, 1994, 1995, 1997; Hughes, 1988; Johnston, 1991; Kemp, 1999; NSW AECG Inc & NSW DET, 2004). Recent research has further supported that Indigenous Australians are probably one of the most disadvantaged Indigenous populations in the world (Cooke, Mitrou, Lawrence, Guimond, & Beaven, 2007; Hill, Barker, & Vos, 2007; Ring & Brown, 2003). According the National Indigenous English Literacy and Numeracy Strategy (NIELNS; 2001) "Indigenous people are the most disadvantaged group within Australia across the full spectrum of socio-economic indicators" (p. 1). The Commonwealth of Australia (2002) has acknowledged "there can be no higher priority in a complex and broad portfolio than to improve educational outcomes for Indigenous Australians" (p. iii). Whereas attempts to improve the situation has often focused on the socio-demographic status of the young Indigenous learners (see Bin-Sallik, 2005), more recent trends of exploring alternative solutions have emphasized psychological variables, such as self-concept, that have the potential of improving education outcomes for young Indigenous learners. However, the paucity of research on Indigenous students' self-concept has limited the potential of capitalizing on advances of self-concept research to enhance Indigenous education. The purpose of this research is to: (a) examine the applicability of the Self-Description Questionnaire I (SDQI) for Indigenous and non-Indigenous Australian Year 5 and 6 students to identify a psychometrically sound measure of self-concept for Indigenous upper primary students, and (b) compare and contrast the structure and levels of self-concepts (SC) for these students to elucidate understandings about the nature of Indigenous students' self-concepts in comparison to those of their non-Indigenous peers.

Educational Disadvantage Experienced by Indigenous Australian Students

Despite the many education initiatives implemented by the Commonwealth and New South Wales (NSW) Governments over the past 20 years, Australian Indigenous students have remained the most educationally disadvantaged group and have the highest dropout rate of any racial or ethnic group in Australia. Reviews of education for Indigenous students have shown that Indigenous people remained the most educationally disadvantaged group in Australia (e.g., Commonwealth of Australia, 1995, 1997; Eckermann, 1999; Kemp, 1999; NSW AECG Inc & NSW DET, 2004). From preschool to higher education, Indigenous people still participate and attend significantly less in education than the rest of the population (Commonwealth of Australia, 1995; Eckermann, 1999; Fogarty & White, 1994; Hewitt, 2000). In some cases, retention rates appear to be even worsening (e.g., Dingman, Mroczka, & Brady, 1995; Purdie, Tripcony, Boulton-Lewis, Fanshawe, & Gunstone, 2000). In addition, a survey conducted in 1994 by the Australian Council for Educational Research (ACER) found that approximately 45% of Indigenous Australian primary students (Aboriginal and Torres Strait Islander) have significantly lower literacy and numeracy achievement compared to approximately 16% of other Australian primary students (Commonwealth of Australia, 1994). Statistics provided in the NATSIEP (Commonwealth of Australia, 1993) show that "10 per cent of all Aboriginal and Torres Strait Islander people aged 15 years and over have post-school educational qualifications, compared with a national proportion of 31 per cent" (p.3).

Evidence from a range of sources indicates that Australian Indigenous students have markedly lower school participation, retention, and success rates than their non-Indigenous counterparts. For instance, results from national literacy testing in 2002 (Australian Government Department of Education, Science and Training, 2003) showed that in Year 3, Indigenous students scored 16% points less than their non-Indigenous peers. By Year 5, this gap had risen to

25% points. In some parts of Australia, differences were as high as 40% points. Many Indigenous students leave school before completing Year 10, and of those who enter the senior secondary years, results show that Indigenous students are less likely to obtain a Year 12 certificate than non-Indigenous students.

Many factors are implicated in this situation (see for example, McInerney, 1989, 1990, 1991; Purdie et al., 2000). Among them are possibly socio-economic factors such as ill health, poverty, high unemployment, poor job prospects, and racial prejudice. Geographic factors such as the placement of poorly prepared and inexperienced teachers in remote areas in which many Indigenous families live, high teacher turnover, isolation from mainstream experiences, and lack of resources may also have an impact on the quality of education experienced by Indigenous students. Home background factors such as the level of parental understanding of the importance and function of education, substandard housing and overcrowding giving poor facilities for home study, and limited Indigenous models of success in a school environment may also be implicated. Other causes posited from time to time include socio-cultural factors such as: language skills; academic achievement motivation; cognitive, motivational and learning style differences; socialization practices at variance to mainstream culture; and peer group influences that are antipathetic to formal schooling. Of the wide range of potential factors, as McConaghy (2000) has emphasized, we need to rethink Indigenous education and explore significant ones that work for the Indigenous students.

The Pervasive Significance of the Self-concept Construct

Research Evidence

The research on academic self-concept has shown self-concept to be an important educational outcome in itself, and also an important factor that contributes to other valued educational outcomes (e.g., Craven, Marsh, & Burnett, 2003; Marsh, 1993). Numerous studies, for example, have identified strong relations between academic self-concept, adaptive academic behaviours, and enhanced academic achievement (e.g., Chapman & Tunmer, 1997; Eccles & Wigfield, 1995; Marsh & Craven, 2006; Marsh & Yeung, 1997a, 1997b; Muijs, 1997; Yeung & Lee, 1999). Recent self-concept research has adopted a multidimensional approach to the specification of key constructs. Hence students who have a high self-concept in academic domains may not have similarly high self-concepts in non-academic domains (e.g., physical self-concept, peer self-concept). Even in the academic dimension, students who have a high self-concept in math may not have a similarly high self-concept in reading.

Research in the last two decades has provided evidence of the strong impacts of students' self-concept on a variety of educational outcomes. Hence the enhancement of self-concept has become a vital goal in many education settings (see Marsh & Craven, 1997, 2006; Craven, Marsh, & Burnett, 2003). Self-concept has been found to be an important variable that impacts on a variety of desirable outcomes including academic achievement in various disciplines. Researchers (e.g., Sommer & Baumeister, 2002) have demonstrated that a high self-concept promotes goals, expectancies, coping mechanisms, and behaviours that facilitate productive achievement and work experiences, and impedes mental health problems.

In academic areas, Marsh and colleagues have developed a reciprocal effects model, which shows that the causal relation between academic self-concept and achievement is conceived as dynamic and reciprocal (e.g., Marsh, Byrne, & Yeung, 1999; Marsh & Craven, 1997; 2006). Hence if students perceive themselves as having high ability in schoolwork, they tend to achieve well, and if they have higher achievement, they tend to have higher perceptions of their own ability. Furthermore, it is also interesting to note that a student's self-perception of ability is often stronger than their actual ability when it comes to the prediction of subsequent academic performance (Pajares & Schunk, 2002).

The Importance of the Self-concept Construct for Indigenous Education

Given the strong evidence found in recent research demonstrating the impact of self-concept on academic work, we may envisage that by enhancing Indigenous Australian students' academic self-concept, they may perform better in academic work. However, it is unclear whether there is any cultural difference in students' academic self-concepts. That is, whether Western theories and research associating self-concept to academic performance is also applicable to Indigenous Australian students may be questionable. More basic to the problem is the primary issue of whether the measurement of self-concept is equally valid for cross-cultural comparisons (e.g., between Indigenous and non-Indigenous samples in the present study). Intuitively, one may speculate that perhaps Indigenous students' comparatively weaker academic achievements are associated with a comparative weaker psychological status in general and a comparatively weaker academic self-concept in particular. To date, a new direction has emerged within the field of educational psychology that has sought to address the inequities between Indigenous Australian students and non-Indigenous Australian students. This direction is an effort to more accurately identify educational determinants that have traditionally escaped the limited focus of socio-demographic descriptive variables (Bin-Sallik, 2005) and is centred on the psychological well-being of Indigenous Australian students. This psychological focus on the educational achievement of Indigenous students has, until recently, been almost ignored, and as such has not been capitalised upon to enhance Indigenous Education.

The Present Investigation

Although the psychological construct of self-concept has been continually identified as a factor that has an important impact on school achievement (Craven & Marsh, 2004), claims for similar impacts on Indigenous students as for non-Indigenous students have been unable to be demonstrated due to the lack of psychometrically sound self-concept instruments for Indigenous populations. Consequently, there is an urgent necessity for identifying a valid and reliable measure of Indigenous students' self-concepts in areas relevant to their academic endeavour. In order to rigorously examine Indigenous students' self-concepts, in this study we first examined the applicability of the SDQI to an Indigenous sample (Aboriginal and Torres Strait Islander). We included also a sample of non-Indigenous Australian students from the same classes (including a wide range of ethnic groups such as British, Arabic, Vietnamese, Chinese, etc.) so that we could test the equivalence of the factor structure of the instrument across the two ethnic groups. Then we used the validated SDQI instrument to compare the self-concepts of the 2 groups of students. Applying a CFA approach, we tested the hypotheses that (a) Indigenous and non-Indigenous students shared a similar structure of self-concept, and (b) Indigenous students had comparatively lower self-concepts in the academic domains. The findings have the potential to guide us into new directions in addressing the multidimensional self-concepts of Indigenous Australians to inform the enhancement of educational outcomes.

Method

Participants

Participants were 5th and 6th grade students from primary schools in urban and rural regions in New South Wales, Australia. The sample included 703 students, comprising Indigenous (*n* =

185) and non-Indigenous (n = 518) students. Their ages were between 9 to 13 years (average age was 10.59 years). Across the full sample, there were 46.7% males.

Materials and Procedure

The Self Description Questionnaire I (SDQI; Marsh, 1992) designed to measure multiple dimensions of self-concept for pre-adolescents was used in this study. The SDQI measures four non-academic areas of self-concept (Physical Ability, Physical Appearance, Peer Relations, and Parent Relations) and three academic self-concept areas (Reading, Mathematics, and school in general), as well as a global perception of self-esteem. The instrument consisted of 63 items that were presented as declarative statements and the students were asked to choose one out of five responses: 1=False, 2=Mostly False, 3=Sometimes False / Sometimes True, 4=Mostly True, 5=True.

Statistical Analysis

In the present study a number of analyses were carried out to determine the psychometric properties of the SDQI for the present sample. The analysis was based on a 63 x 63 covariance matrix for the total group and for each of the two sub-samples. First, a set of descriptive analyses was conducted encompassing assessment of scale means and variances, analysis of distributional properties (skewness and kurtosis), and reliability coefficients. The Cronbach's alpha estimate is an indication of the internal consistency of the factors examined, whereby an alpha value greater than .70 suggests an acceptable internal consistency for the items comprising the examined factor (see Garson, 2005; George & Mallery, 1995; Lewicki & Hill, 2006).

The survey items were then subjected to confirmatory factor analysis (CFA) with LISREL version 8.72 (Jöreskog & Sörbom, 2005) using maximum likelihood estimation (see Bollen, 1989; Byrne, 1998; Jöreskog & Sörbom, 2005; Kaplan, 2000). In a CFA study, the parameters typically consist of factor loadings, factor variances and covariances, and measured variable uniquenesses (i.e., measurement errors associated with each item). In accordance with standard practice in multigroup analysis that forms an important part of the present analysis, covariance matrices were used as input (Cudeck, 1989; Jöreskog & Sörbom, 1993; Kline, 1998).

Both absolute fit statistics and incremental fit statistics were utilized to evaluate the model fit (see Hoyle & Painter, 1995; Tanaka, 1993). The absolute fit statistics included the χ^2 test of exact model fit and the root-mean-square error of approximation (RMSEA; Browne & Cudeck, 1993). The incremental fit statistics (Hoyle & Painter, 1995) included the Comparative Fit Index (CFI; Bentler, 1990) and the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), also known as the non-normed fit index (NNFI; Benter & Bonett, 1980). A small and nonsignificant χ^2 suggests a good model fit because the null hypothesis assumes that the model being tested does fit the data. However, the χ^2 test is not a good indicator of model fit when the sample size is large (Marsh, Balla, & McDonald, 1988). With large samples, very minor differences can yield a significant χ^2, indicating the rejection of a good model (Keith & Witta, 1997). Therefore, considering the relatively large sample size of this study, the results of the χ^2 test were not considered to be critical in evaluating model fit. In general, the CFI and TLI vary along a 0-to-1 continuum in which values equal to or greater than .90 and .95 are typically taken to reflect acceptable and excellent fits to the data, respectively. According to Browne and Cudeck (1993), RMSEA values in the vicinity of .05 indicate "close fit," values near .08 indicate "fair fit," and values above .10 indicate "poor fit."

CFA models. In the present study, we tested a series of CFA models. Models 1 and 2 used the whole sample. Model 1 tested a unidimensional model in which 63 items were posited to load on a single SDQ factor. Model 2 tested a multidimensional model with 63 items loading on eight a priori factors. Based on previous SDQ research, we hypothesized that Model 2 would be a better fitting model. Models 3 and 4 were extensions of Model 2, with Model 3 using only the Indigenous subsample and Model 4 using only the non-Indigenous subsample. To the extent that Models 2, 3, and 4 demonstrated good psychometric properties, we then tested the invariance of the factor structure across the Indigenous and non-Indigenous subsamples.

Factorial invariance across groups. In tests of factorial invariance across the Indigenous and non-Indigenous groups, the hierarchical analytic procedure (see Bollen, 1989; Byrne, 1998; Keith et al., 1995, Marsh & Hau, 2004) was used to test models in an orderly sequence, is recommended in order to determine factor structure equivalence and to identify the source of any non-equivalence across groups. In the present study, the equivalence of self-concept factors between the Indigenous and non-Indigenous samples was crucial because unless the SDQI scales carry the same meaning for both samples, there is no solid ground for group comparisons. Then the series of models also tested the equality of factor variances/covariances and item uniquenesses. In short, the equivalence of factor loadings across groups was considered the most important condition in support of cross-cultural validity of the instrument in this study. The four models were tested in a logical sequence:

MG1: Same number of factors, parameters freed: All parameters (i.e., factor loadings, factor variances/covariances, uniquenesses) were allowed to vary across groups;

MG2: Invariance of factor loadings: Only the factor loadings were specified to be equal across groups (factor variances/covariances and uniquenesses were allowed to vary across groups);

MG3: Invariance of factor loadings and factor variances/covariances: Only uniquenesses were allowed to vary across groups; and

MG4: Full invariance: All parameters were specified to be equal across groups.

Multiple-indicator-multiple-indicator-cause (MIMIC) model. When the equivalence of factor structure was established across the two groups, group comparisons would be conducted. In conducting group comparisons, we applied the MIMIC approach. In MIMIC models, Kaplan (2000; also see Grayson, Mackinnon, Jorm, Creasey, & Broe, 2000; Jöreskog & Sörbom, 2005; Marsh, Ellis, Parada, Richards, & Heubeck, 2005) describes a MIMIC model approach, which is similar to a multivariate regression model in which latent variables (e.g., multiple dimensions of self-concept) are "caused" by discrete contrast or grouping variables (e.g., ethnicity, gender, and ethnicity × gender) that are represented by a single indicator. Although like a multiple regression approach to ANOVA (e.g., Aiken & West, 1991), the MIMIC model has an important advantage in that the dependent variables are latent variables based on multiple indicators corrected for measurement error (Marsh, Tracey, & Craven, 2006). In the MIMIC models, we constructed three single-degree-of-freedom contrast variables to represent the linear effects of ethnicity (1 = Indigenous, 2 = non-Indigenous), gender (1 = male, 2 = female), and ethnicity × gender interaction. The interaction term was calculated by multiplying gender by the zero-centered ethnicity variable. Based on previous research, we hypothesized that Indigenous and non-Indigenous Australian students would differ in their academic self-concept. In particular, Indigenous students were expected to have lower school self-concept than their non-Indigenous peers.

Results and Discussion

Descriptive Statistics and Reliability

Table 1 presents results of preliminary analyses including descriptive statistics, distribution properties, and reliability coefficients for each of the eight factors. Results show that the distributional properties of most scales approximate a normal distribution as indicated by predominantly non-significant indices of skewness and kurtosis. For the parent self-concept and general self-esteem factors, there was relatively higher kurtosis. These data demonstrate that the SDQI is valid from a descriptive scale-level perspective. Reliability estimates were acceptable and varied from .81 to .96 (M = .88) (see Table 1). This average reliability was higher than the target reliability of at least .70 (see Garson, 2005; George & Mallery, 1995; Lewicki & Hill, 2006), providing a basis for subsequent CFAs.

Independent CFA for Each Group

Model 1 (Table 2) testing a unidimensional model with 63 items forming a single factor did not fit the data well (NNFI = .85, CFI = .85, RMSEA = .184). Model 2 (Table 2) testing a multidimensional model clearly identified the eight a priori SDQ factors (NNFI = .97, CFI = .97, RMSEA = .065). All factor loadings (Table 3) were positive and significant (from .47 to .91; median .74). We also examined the pattern of correlations between the eight SDQI factors. Although the factor correlations among the 8 factors varied (.01 to .77), they were clearly distinguishable from each other. Comparing Models 1 and 2, there was support for the multidimensional model (Model 2).

Given the support for a multidimensional factor structure, we further tested the ability of the multidimensional model to fit the data separately for each of the Indigenous and non-Indigenous groups. The solution for each group provided an excellent fit to the data respectively (see Table 2). For the Indigenous group (Model 3), both NNFI and CFI = .94 and RMSEA = .069. For the non-Indigenous group (Model 4), both NNFI and CFI = .96 and RMSEA = .070. All the parameter estimates were reasonable in that all factor loadings were large and statistically significant (all > .30), and the patterns of correlations were logical and the goodness of fit indices were satisfactory in relation to typical standards of good to excellent fits to the data.

Table 1

Descriptive Statistics and Cronbach's alphas, of the SDQ-I for Indigenous and Non-Indigenous

	Appr	Schl	Phys	Read	Prnt	Peer	Math	Genr	*Mean*
Indigenous									
Mean	3.58	3.43	4.22	3.64	4.32	4.06	3.45	4.04	*3.84*
SD	1.06	1.01	0.70	1.10	0.77	0.80	1.27	0.74	*0.93*
Alpha	0.92	0.92	0.78	0.88	0.85	0.86	0.96	0.80	*0.87*
Non-Indigenous									
Mean	3.53	3.58	4.06	3.74	4.36	3.93	3.68	4.12	*3.88*
SD	1.08	0.95	0.85	1.04	0.73	0.86	1.15	0.71	*0.92*
Alpha	0.93	0.93	0.87	0.88	0.86	0.89	0.95	0.82	*0.89*
Total Group									
Mean	3.55	3.54	4.10	3.72	4.35	3.96	3.62	4.10	*3.87*
SD	1.07	0.97	0.81	1.05	0.74	0.84	1.18	0.72	*0.92*
Alpha	0.93	0.93	0.85	0.88	0.86	0.89	0.96	0.81	*0.89*

Note: Appr = Appearance; Schl = School; Phys = Physical Abilities; Read = Reading; Prnt = Parent; Peer = Peer; Math = Mathematics; Genr = General Self-esteem.

Table 2
Summaries of Models and Goodness of Fit Statistics

Model	χ^2	*df*	χ^2/df	RMSEA	NNFI	CFI	Model Description
M1	46750	1890	24.21	.184	.85	.85	Full sample, 63 items load on 1 factor (*N*=703)
M2	7407	1862	3.98	.065	.97	.97	Full sample, 63 items load on 8 factors (*N*=703)
M3	3478	1862	1.87	.069	.94	.94	Indigenous, 63 items load on 8 factors (*N*=185)
M4	6516	1862	3.50	.070	.96	.96	Non-Indigenous, 63 items load on 8 factors (*N*=518)
Testing Invariance across Indigenous and non-Indigenous Groups							
MG1	9995	3724	2.68	.069	.96	.96	INV = none; Free = FL, FV/FCV, Uniq
MG2	10118	3787	2.67	.069	.96	.96	INV = FL; Free = FV/FCV, Uniq
MG3	10188	3815	2.67	.069	.96	.96	INV = FL, FV/FCV; Free = Uniq
MG4	10698	3878	2.76	.071	.96	.96	INV = All
MIMIC	7738	2027	3.82	0.063	0.97	0.97	63 items + 3 criterion variables (*N*=703)

Note: RMSEA = Root mean square error of approximation. NNFI = Non-normed fit index. CFI = Comparative fit index, INV = invariant (parameters constrained to be invariant over the 2 groups). FL = factor loadings, FV/FCV = factor variances/covariances, Uniq = item uniquenesses.

Table 3
Factor Loading and Inter-scale Correlations and Effects of Gender and Ethnicity

Items	Appr	Schl	Phys	Read	Prnt	Peer	Math	Genr
CFA Factor Loadings								
1st	.82*	.69*	.76*	.82*	.62*	.69*	.74*	.55*
2nd	.87*	.74*	.67*	.79*	.68*	.71*	.86*	.48*
3rd	.77*	.74*	.50*	.67*	.67*	.62*	.80*	.61*
4th	.82*	.82*	.60*	.87*	.51*	.68*	.89*	.64*
5th	.76*	.76*	.75*	.69*	.67*	.69*	.82*	.73*
6th	.79*	.82*	.74*	.69*	.80*	.71*	.90*	.72*
7th	.72*	.77*	.82*	.88*	.79*	.71*	.90*	.64*
8th	.73*	.85*	.47*	.76*	.70*	.80*	.91*	--
CFA Factor Correlations								
Appearance (Appr)	1							
School (Schl)	.35	1						
Physical (Phys)	.46	.25	1					
Reading (Read)	.19	.63	.01	1				
Parents (Prnt)	.39	.39	.21	.30	1			
Peer (Peer)	.69	.42	.55	.19	.46	1		
Math (Math)	.23	.65	.27	.29	.27	.29	1	
General (Genr)	.68	.62	.54	.35	.53	.77	.49	1
Effect of Ethnicity and Gender								
Ethnicity (Eth)	-.01	.09*	-.10*	.06	.04	-.07	.07*	.05
Gender (Gen)	.10*	.18*	-.21*	.33*	.09*	.06	-.10*	.09*
Eth x Gen	.02	-.08*	-.06	-.04	-.03	.00	-.03	.02

Note: All parameter estimates are completely standardized. * $p < .05$.

Invariance Between Groups

The results of the series of tests for the comparison of factor models are summarized in Table 2. We first established a baseline model (MG1) that fitted to the two groups but without any constraints imposed. In this model, the factor loadings, factor variance-covariance matrices, and the unique variances were allowed to be freely estimated for the two groups. The baseline model (MG1) provided a good fit (NNFI = .96, CFI = .96, RMSEA = .069). Comparisons of subsequent models (MG2 to MG4) found that the change in chi-square was statistically significant for each step in the hierarchy (Table 2). This is not surprising due to the large sample size.

The first test of invariance (Model MG2), which specified that all factor loadings were equal across the two groups, produced excellent fit statistics (NNFI = .96, CFI = .96, RMSEA = .069), which were similar to baseline Model MG1, which freed all parameters. That is, the NNFI (.96), the CFI (.96) and RMSEA (.069) did not change at all. These results support the invariance of factor loadings according to Cheung and Rensvold (2002).

For Model MG3, the factor loadings and factor variances/covariances were specified to be equal across groups. Although there was some difference between MG3 and MG1 in the chi-square statistics, like Model MG2, the NNFI (.96), the CFI (.96) and RMSEA (.069) did not change. Furthermore, comparing between MG3 and MG2, the NNFI (.96), CFI (.96) and RMSEA (.069) did not change at all. Hence there was also support for the invariance of factor variances/covariances across the subsamples.

In Model MG4, all parameters were specified to be equivalent across groups. When invariance constraint was imposed even on the uniquenesses between two groups, the model (MG4) had an excellent fit and there were no differences between Models MG2, MG3, and MG4. Specifically, the NNFI (.96) and CFI (.96) remained unchanged, while RMSEA (.071) increased only by .002 when all the factor loadings, factor variances/covariances, and uniquenesses were all constrained to be equivalent between the two groups (Table 3).

In conclusion, according to Cheung and Rensvold (2002), there was support for the invariance of the factor loadings, factor variances/covariances, and also the uniquenesses in the model. There was evidence that the 8-facet SDQI self-concept scale had reasonable psychometric properties and the instrument was applicable to both the Indigenous and non-Indigenous sub-samples in this study.

MIMIC Models

Once factorial invariance was established, it was then possible to examine potential differences between groups in their self-concepts. MIMIC models were tested to examine the effects of the independent variables (ethnicity and gender) on latent variables. Specifically, the MIMIC model tested the main effects of ethnicity and gender, and also the ethnicity by gender interaction, by relating these variables to the eight SDQI latent factors (see Table 3). That is, by testing the paths from the three independent variables (ethnicity, gender, and ethnicity x gender interaction), it would be possible to determine whether there were significant main effects of ethnicity and gender on the SDQI self-concept scales, and whether there was a significant interaction between ethnicity and gender on each facet of student self-concept. The MIMIC model (Table 2) had a very good fit to the data (χ^2 = 7738, df = 2027, NNFI = .97 CFI = .97, RMSEA = .063). Derived beta coefficients are presented in Table 3 where significant effects for ethnicity and gender, as well as the significant interaction effects are also indicated.

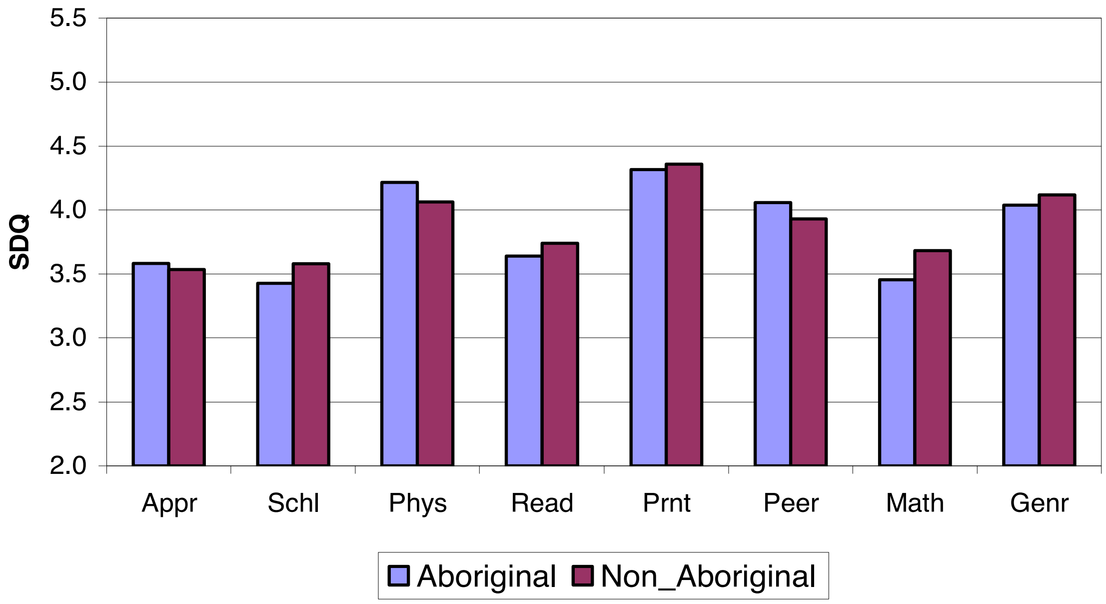

Figure 1: Mean differences for the SDQ between Indigenous and non-Indigenous students

Gender effects. The results show that there are gender differences on a number of facets of self-concept. Females scored significantly lower than males for two of the measures of self-concept – Physical Ability and Math ($p < .05$). However, females scored significantly higher than males for the Appearance, School, Reading, Parents, and General factors. There was no statistically significant effect for the Peer relation self-concept factor.

Ethnicity effects. Indigenous students had significantly higher scores for the Physical Appearance self-concept factor and significantly lower scores for School and Math self-concepts (see Figure 1). There were no further significant main effects found between for the Indigenous and non-Indigenous groups in the other self-concept facets. Figure 1 shows the difference between the Indigenous and non-Indigenous sub-samples in the eight SDQ factors. The patterns show that Indigenous students tended to be lower in their academic-related self-concepts (Reading, Math, School) when compared to non-Indigenous students.

Gender x ethnicity interaction effects. Finally, we examined if there were any significant gender x ethnicity effects. The results show that there was only one significant interaction effect (i.e., School self-concept). Figure 2 shows the pattern of the interaction effect on the basis of the scale scores. It can be clearly seen that the difference in School self-concept between the two ethnic groups was mainly due to a significant difference between male students, with the Indigenous boys having a significantly lower School self-concept.

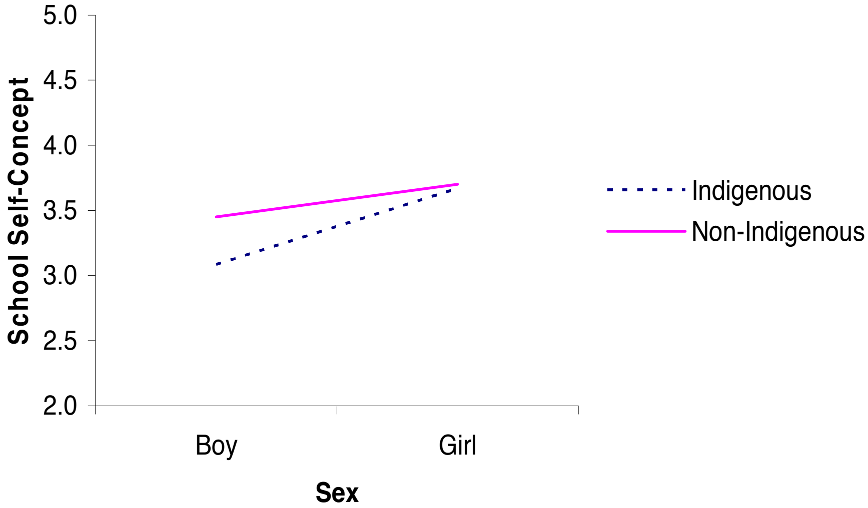

Figure 2. Ethnicity x Gender interaction effect for school self-concept

Discussion

The finding that Indigenous students displayed relatively lower academic self-concepts warrants the attention of educational researchers and practitioners. Given the pivotal role of academic self-concept in educational contexts and the well-documented reciprocal causal relations of academic self-concept and achievement (e.g., Marsh, Byrne, & Yeung, 1999; Marsh & Craven, 1997; Marsh & Yeung, 1997), Indigenous students' relatively low academic self-concept may be expected to result in relatively low academic achievement. The reciprocal effects model (e.g., Marsh, Byrne, & Yeung, 1999; Marsh & Craven, 1997) would also envisage a vicious cycle of Indigenous students experiencing further disadvantage in academic work. Based on this expectation, it would not surprising if Indigenous students would continue to be educationally disadvantaged, as reported in national documents (e.g., Commonwealth of Australia, 1994; 1995; 1997; Hughes, 1988; Johnston, 1991; Kemp, 1999).

The findings of differences in student self-concepts also suggest that attempts to improve the situation of educational disadvantage should consider important psychological constructs such as academic self-concept. Educators should consider supplementing the previous focus on the socio-demographic status of young Indigenous students (see Bin-Sallik, 2005) with an emphasis on psychological variables such as self-concept. Because of the strong research evidence showing a reciprocal causal relation between academic self-concept and academic performance, an emphasis on self-concept enhancement has the potential of improving educational outcomes for Indigenous students..

The significant ethnicity x gender interaction effect was an important finding in this research. The interaction effect shows that Indigenous boys had a particularly low School self-concept. That is, the difference between Indigenous and non-Indigenous students in general School self-concept was mainly due to a particularly low score for Indigenous boys whereas the difference between the girls in the two ethnic groups was limited. In terms of gender differences, the relatively lower self-concepts for Indigenous boys (in five of the eight variables) suggest that the self-concepts of Indigenous boys particularly need more attention. Further to this finding, the interaction effect indicates that whereas boys may need help irrespective of their ethnicity, of particular concern to educators is Indigenous boys' self-concept in relation to school work.

Whereas the findings of the MIMIC analysis have provided significant insights for the educational needs of Indigenous students, the validation of the measurement of self-concepts of young Indigenous Australians has enabled us to make meaningful and valid comparisons. Without ensuring the applicability of the SDQI instrument to the Indigenous sample, we would not be able to draw clear evidence-based conclusions based on theory and research. The research has therefore demonstrated the strength of a construct validation approach to establishing the factor structure of the Indigenous and non-Indigenous samples' self-concepts. The application of the MIMIC approach to group comparison has also provided us with a strong approach to group comparisons with the inclusion of an interaction term for investigating both main and interaction effects. This approach is stronger than most statistical comparisons because it takes into account measurement errors. Like recent research on self-concept, further research on Indigenous students' psychological constructs and educational outcomes should continue to use the strong approaches of structural equation modelling, including the MIMIC technique.

In sum, the research first validated the SDQI measures across Indigenous and non-Indigenous Australian samples. Then based on the validated measures, the self-concepts of the two groups were compared using a MIMIC approach. Whereas the finding that Indigenous students had relatively lower school and math self-concepts warrants attention, the result showing that Indigenous boys had particularly low school self-concept warrants special concern. Further research should capitalize on recent self-concept and advances in sophisticated quantitative techniques to elucidate the specific areas of disadvantage that Indigenous students experience. On the basis of such evidence, educators and researchers may devise effective interventions to improve the current situation.

References

Arbuckle, J. L. (1996). Full information estimation in the presence of incomplete data. In G. A. Marcoulides & R. E. Schumacker (Eds.), *Advanced structural equation modeling: Issues and techniques* (pp. 243-277). Mahwah, N.J.: Lawrence Erlbaum Associates.

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.

Australian Government Department of Education, Science and Training. (2003). *National Report to Parliament on Indigenous Education and Training 2002*.

Bentler, P. M. (1990). Comparative fit indices in structural models. *Psychological Bulletin, 107*, 238-246.

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin, 88*, 588-606.

Bin-Sallik, M. (2005). Preface. In R. G. Craven, A. Tucker, G. Munns, J. Hinkley, H. W. Marsh, & K. Simpson (Eds.), *Indigenous students' aspirations: Dreams, perceptions and realities*. DEST. Canberra: Commonwealth of Australia.

Bollen, K. A., (1989). *Structural equations with latent variables*. New York: Wiley.

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

Byrne, B. M. (2003). Testing for equivalent self-concept measurement across culture. *International Advances in Self Research, 1*, 291-313.

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9,* 233-255.

Commonwealth of Australia (1995). *The Commonwealth Government's response to the National Review of Education for Aboriginal and Torres Strait Islander Peoples*. Canberra: Australian Government Publishing Service.

Commonwealth of Australia. (1993). *Joint policy statement: National Aboriginal and Torres Strait Islander education policy*. Canberra. DEET.

Commonwealth of Australia. (1994). *National review of education for Aboriginal and Torres Strait Islander peoples*. Canberra: Australian Government Publishing Service.

Commonwealth of Australia. (1997). *Australian Reconciliation Convention*. Canberra: AGPS.

Commonwealth of Australia. (2002). The national report to parliament on Indigenous education and training, 2001. Canberra: Commonwealth of Australia.

Cooke, M., Mitrou, F., Lawrence, D., Guimond, E., & Beavon, D. (2007). Indigenous well-being in four countries: An application of the UNDP'S Human Development Index to Indigenous Peoples in Australia, Canada, New Zealand, and the United States. *BMC International Health and Human Rights, 7*(9), 1-39.

Craven, R. G., & Marsh, H. W. (2004). The Challenge for Counsellors: Understanding and addressing Indigenous Secondary Students' Aspirations, Self-concepts and Barriers to Achieving their Aspirations. *Australian Journal of Guidance and Counselling, 14*(1), 16-33.

Cudeck, R. (1989). Analysis of correlation matrices using covariance structure models. *Psychological Bulletin, 105*, 317-327.

Department of Education, Science and Training. (2002b). *The 2001 National Report to Parliament on Indigenous Education and Training*, National Information Exchange on Quality Teaching, Canberra.

Department of Education, Training and Youth Affairs, Australia (DETYA) (2000) *Learning for the Knowledge Society*. An education and training action plan for the information economy. Canberra. ACT.

Dingman, S. M., Mroczka, M. A., & Brady, J. B. (1995). Predicting academic success for American Indian students. *Journal of American Indian Education*, *34*(2), 10-17.

Eckermann, A-K. (1999). Aboriginal education in rural Australia: A case study in frustration and hope. *Australian Journal of Education, 43*, 5-23.

Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information maximum estimation for missing data in structural equation models. *Structural Equation Modeling, 8*(3), 430-457.

Fogarty, G. J., & White, C. (1994). Differences between values of Australian Aboriginal and non-Aboriginal students. *Journal of Cross-Cultural Psychology, 25,* 394-408.

Fouladi, R. T. (2000). Performance of modified test statistics in covariance and correlation structure analysis under conditions of multivariate non-normality. *Structural Equation Modeling, 7,* 356–410.

Grayson, D. A., Mackinnon, A., Jorm, A. F., Creasey, H., & Broe, G. A. (2000). Item bias in the center for epidemiologic studies depression scale: Effects of physical disorders and disability in an elderly community sample. *Journals of Gerontology Series B—Psychological Sciences and Social Sciences, 5*, 273-282.

Hewitt, D. (2000). A clash of worldviews: Experiences frrom teaching Aboriginal students. *Theory into Practice, 39*, 111-118.

Hill, K., Barker, B., & Vos, T. (2007). Excess Indigenous mortality: Are Indigenous Australians more severely disadvantaged than other Indigenous populations? *International Journal of Epidemiology, 36*(3), 580-589.

Hoyle, R. H., & Panter, A. T. (1995). Writing about structural equation models. In Rick H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 158-176). Sage Publications Thousand Oaks, CA.

Hughes, P. (1988). *Aboriginal Education Policy Task Force Report*. Canberra: Commonwealth of Australia.

Johnston, E. (1991). *Royal Commission into Aboriginal deaths in custody*. Canberra: Commonwealth of Australia.

Jöreskog, K. G. & Sorbom, D. (1993). *LISREL 8: Structural equation modelling with the SIMPLIS command language*. Scientific Software International: Chicago.

Jöreskog, K. G., & Sörbom, D. (1996). *LISREL 8: User's reference guide*. SSI Scientific Software International, Chicago.

Jöreskog, K. G., & Sörbom, D. (2005). *LISREL 8.72: Structural equation modeling with SIMPLIS command language*. Chicago: Scientific Software International.

Kaplan, D. (2000). *Structural equation modelling*. Newbury Park, CA: Sage.

Keith, T. Z., & Witta, E. L. (1997). Hierarchical and cross-age confirmatory factor analysis of the WISC-III: What does it measure? *School Psychology Quarterly 12*, pp. 89–107.

Keith, T. Z., Fugate, M. H., DeGraff, M., Diamond, C. M., Shadrach, E. A., & Setvens, M. L. (1995). Using multi-sample confirmatory factor analysis to test for construct bias: An example using the K-ABC. *Journal of Psychoeducational Assessment, 13*, 347–364.

Kemp, D. (1999). Speech. Australian College of Education: Indigenous Education Forum, Alice Springs, 3 November 1999. Presentation by Dr. David Kemp. Commonwealth Minister for Education, Training and Youth Affairs. Canberra: DETYA.

Kline, R. B. (1998). *Principles and practice of structural equation modelling*. New York: Guilford Press.

Marsh, H. W. (1992). *Self Description Questionnaire – II: SDQ II Manual*. Australia: University of Western Sydney.

Marsh, H. W., & Craven, R. G. (2006). Reciprocal Effects of Self-concept and Performance from a Multidimensional Perspective: Beyond Seductive Pleasure and Unidimensional Perspectives. *Perspectives on Psychological Science,* 133-163.

Marsh, H. W., & Hau, K. T. (2004). Explaining paradoxical relations between academic self-concepts and achievements: Cross-cultural generalizability of the internal/external frame of reference predictions across 26 countries. *Journal of Educational Psychology, 96* (1), 56-67.

Marsh, H. W., & Shavelson, R. (1985). Self-concept: Its multifaceted, hierarchical structure. *Educational Psychologist, 20,* 107–125.

Marsh, H. W., Balla, J. R., & McDonald, R. P. (1988). Goodness-of-fit indices in confirmatory factor analyses: the effect of sample size. *Psychological Bulletin, 103,* 391-410.

Marsh, H. W., Ellis, L., Parada, L., Richards, G., & Heubeck, B. G. (2005). A short version of the Self Description Questionnaire II: Operationalizing criteria for short-form evaluation with new applications of confirmatory factor analyses. *Psychological Assessment, 17*, 81-102.

Marsh, H. W., Hau, K. T., & Grayson, D. (2005). Goodness of Fit Evaluation in Structural Equation Modeling. In A. Maydeu-Olivares & J. McArdle (Eds.), *Contemporary*

Psychometrics. A Festschrift for Roderick P. McDonald (pp. 275-340). Mahwah NJ: Erlbaum.

Marsh, H. W., Hau, K. T., Artelt, C., Baumert, J., & Peschar, J. L. (2006). OECD's brief self-report measure of educational psychology's most useful affective constructs: Cross-cultural, psychometric comparisons across 25 countries. *International Journal of Testing, 6*, 311–360.

Marsh, HW, Tracey, DK, & Craven, RG. (2006). Multidimensional self-concept structure for preadolescents with mild intellectual disabilities: A hybrid multi-group-mimic approach to factorial invariance and latent mean differences. *Educational and Psychological Measurement*, *66*, 795-818.

McConaghy, C. (2000). *Rethinking Indigenous education: Culturalism, colonialism & the politics of knowing*. Queensland: Post Pressed.

McDonald, R. P., & Ho, M. H. R. (2002). Principles and practice in reporting structural equation analyses. *Psychological Methods, 7,* 64–82.

McInerney, D. M. (1989). Urban Aboriginals parents' views on education: A comparative analysis. *Journal of Intercultural Studies, 10*, 43-65.

McInerney, D. M. (1990). The determinants of motivation for urban Aboriginal students: A cross-cultural analysis. *Journal of Cross-Cultural Psychology, 21*, 474-495.

McInerney, D. M. (1991). Key determinants of motivation of urban and rural non-traditional Aboriginal students in school settings: Recommendations for educational change. *Australian Journal of Education, 35*. 154-174

NIELNS. (2001). Working together for indigenous youth. A national framework. Canberra: National Indigenous English Literacy and Numeracy Strategy.

New South Wales Aboriginal Education Consultative Group Incorporated, & New South Wales Department of Education and Training. (2004). *The Report of the review of Aboriginal education. Yanigurra Muya: Ganggurrinyma Yaarri Guurulaw Yirringin.guray. Freeing the spirit: Dreaming an equal future*. Darlinghurst: New South Wales Department of Education and Training.

Purdie, N., Tripcony, P., Boulton-Lewis, G., Fanshawe, J., & Gunstone, A. (2000). *Positive self-identity for Indigenous students and its relationship to school outcomes*. Canberra: Department of Education, Training and Youth Affairs.

Ring, I., & Brown, N. (2003). Aboriginal and Torres Strait Islander health-implementation, not more policies. *Journal of Australian Indigenous Issues,* 6(3), 3–12.

Rothstein, R. (May 2004). *Class and Schools*. Economic Policy Institute. www.epinet.org

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-concept: Validation of construct interpretations. *Review of Educational Research*. *46*(3), 407-411.

Tanaka, J. S. (1993). Multifaceted conceptions of fit in structural equation models. In K. A. Bollen, & J. S. Long (Eds.), *Testing Structural Equation Models* (pp. 10-39). Newbury Park, CA: Sage.