# Mathematics Performance and the Role Played by Affective and Background Factors

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In this article, we report on a study examining those factors which contribute to the mathematics performance of a sample of children aged between 8 and 13 years. The study was designed specifically to consider the potency of a number of mathematical affective factors, as well as background characteristics (viz., gender, ethnicity, and socioeconomic status), on children's mathematics performance. Data were collected by surveying the children and drawing on performance ratings from their teachers. A correlation analysis revealed that the relationships between the respective dispositional and background variables with mathematics performance were significant and in the direction as predicted. Moreover, the findings from a logistic regression showed that a combination of these variables was able to appropriately classify students who either were below-average or above-average mathematics performers. We pay particular attention to the influence of certain dispositions with respect to mathematics performance and conclude by detailing the implications of the study for teachers and researchers.

In the last decade or so there has been increased interest in the role of affective factors in the learning of mathematics (Leder & Forgasz, 2006; Schuck & Grootenboer, 2004). There is an assumption that positive mathematical beliefs, attitudes, and feelings will lead to increased mathematical achievement and while this seems like a reasonable proposition, it does warrant further investigation (Grootenboer, 2003a). Also, the relationship between affective factors and learning in mathematics is not simple, linear and unidirectional; rather it is complex and convoluted. Gresalfi and Cobb (2006) suggested that learning in mathematics is more than just the acquisition of skills and knowledge, and, "it is not sufficient to focus exclusively on the ideas and skills that we want students to learn" (p. 55). The significance of mathematical beliefs and attitudes was highlighted by Wilkins and Ma (2003):

> a person's mathematical disposition related to her or his beliefs about and attitude toward mathematics may be as important as content knowledge for making informed decisions in terms of willingness to use this knowledge in everyday life. (p. 52)

Furthermore, affect is a significant and critical dimension of learning (Zembylas, 2004). With this in mind, it seems important to pay close attention to the mathematical classroom experiences of students, as these are critical in the development of affective dispositions and views towards mathematics (Gresalfi & Cobb, 2006; Higgins, 1997).

## The Affective Domain and Mathematics Education

There is no clear definition of the affective domain in the educational literature, not that this has necessarily hindered research (McLeod & McLeod, 2002). Drawing on the work of McLeod (1992) and Goldin (2002), Grootenboer (2003b) developed the following model to conceptualise the affective domain (see Figure 1). While this model has its limitations (e.g., the simplification of a complex concept), it served as a theoretical framework for aspects of this study.

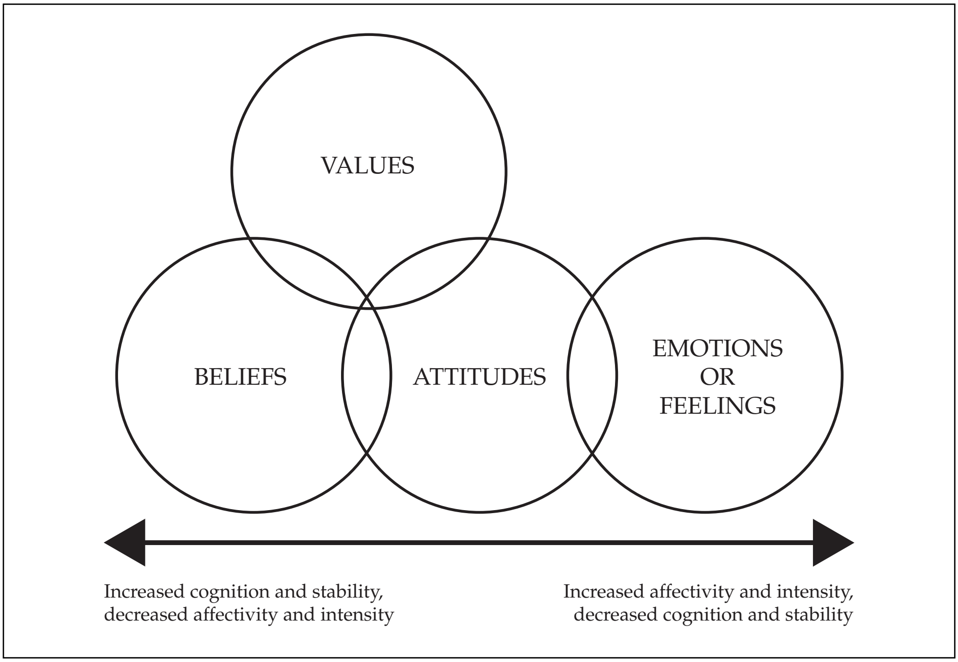


*Figure 1.* A model of conceptions of the affective domain (Grootenboer, 2003b).

## Mathematical Beliefs and Values

Like the affective domain in general, beliefs and values have been variously and interchangeably defined (Op't Eynde, de Corte, & Verschaffel, 2002). Richardson (1996) saw beliefs as "understandings, premises, or propositions about the world that are felt to be true" (p. 103). In terms of mathematical beliefs, Ernest (1989) identified three conceptual groupings:

(1) mathematics as an expanding field of human invention which is dynamic and problem-driven (Problem-solving view);
(2) mathematics as a structured, unchanging body of knowledge (Platonist view); and
(3) mathematics as a collection of procedures, facts and skills (Instrumentalist view).

The Platonist view is akin to a traditional view of mathematics and there are numerous studies that report a prevalence of this perspective amongst students and teachers (e.g., Ambrose, 2004; Young-Loveridge, Taylor, Sharma, & Hawera, 2006). Hersh (1986) suggested that this perspective is problematic as it is not consistent with the nature of mathematics that is fallible and developing, like any form of human knowledge. Grootenboer (2003a) and Young-Loveridge et al. (2006) all report from New Zealand studies that there is evidence of a utilitarian or instrumental view of mathematics amongst students, but there appeared to be few findings that noted a problem-solving perspective of mathematics amongst school students.

Values are often seen as similar to beliefs, but Clarkson, FitzSimons, and Seah (1999) made the distinction that "values are demonstrated in the actions carried out by a person, whereas beliefs can be verbally assented to, but do not necessarily lead to observable behavior in public" (p. 3). Given this perspective of values as enacted beliefs, it is unlikely that a great deal of the data in the current study will relate to values, as none of the data was collected using observational techniques.

## Attitudes towards Mathematics

Attitudes are seen as more affective and less cognitive than beliefs or values (McLeod, 1992) and often they are defined similarly, and used interchangeably, with dispositions (Brahier & Speer, 1995). In general, attitudes are directed towards something (in this case, mathematics), are seen as either positive or negative, and are grounded in experience (McLeod, 1992). Way and Relich (1993) commented that "although definitions of attitude vary, they generally include the idea that attitudes are learnt, manifest themselves in one's response to the object or situation concerned, and can be evaluated." A key attitudinal dimension is mathematical confidence (see Ernest, 1988; Stevens, Olivarez, Lan, & Tallent-Runnels, 2004), and it has been identified as critical to effective numeracy development (Wilkins, 2000).

## Mathematical Affective Views and Mathematics Performance

The relationship between and among beliefs, attitudes and feelings towards mathematics, and achievement in mathematics has been the focus of a number of studies. In general, these studies report that there is a correlation between affective views of mathematics and mathematical achievement. For example, Antonnen (1969) reported a strong positive correlation between mathematics attitude and mathematical achievement. Fennema and Sherman (1978) reported a positive correlation between perceived usefulness of mathematics and mathematical achievement, and more recently, Bouchey and Harter (2005) found that students' perceived confidence was a critical predictor of success in mathematics. In reviewing New Zealand's performance in TIMSS, Garden (1997) reported:

> While a majority of students have positive attitudes to learning mathematics ... it appears that from a fairly young age there is an increasing proportion of students having lost interest in the subject, with a concomitant decline in their achievement. (p. 252)

Although these studies and other similar ones have reported correlations between mathematical affect and mathematical achievement, the nature of the relationship between the two dimensions seems less straight-forward. It appears that there is a cyclical or reciprocal relationship between beliefs and attitudes, and success in learning mathematics (Ma, 1997; Spangler, 1992). While it is more complex than a simple relationship, in general terms, success in mathematical learning seems to lead to more positive affective views about mathematics, which then lead to greater success in learning mathematics, and so forth, with the converse also being the case (Marcou & Philippou, 1995). In this sense, the cycle is related to issues of motivation and self-efficacy (Barkatsas, 2005; Marcou & Philippou, 1995).

The literature suggests that there is an influential connection between affective mathematical views and performance in mathematics (Ai, 2002; Schreiber, 2002), and so this relationship requires exploration. Since much of the impetus to explore this area began with concerns about gender and mathematical achievement, we shall look first at what the literature says about this area and then lead onto what the literature tells us about the relationships between affect and socioeconomic status and between affect and ethnicity.

## Gender

Issues of gender have been a rich area, and probably initiated interest in research about affective factors and mathematics learning. Historically, the achievement of girls in mathematics, across a range of different contexts, was lower than that of the boys, and this was attributed to a variety of reasons including affective factors (Leder, 1992). In a meta-analysis of studies on "gender comparisons of mathematics attitudes and affect", Hyde, Fennema, Ryan, Frost, and Hopp (1990) found that, in general, female students held more negative attitudes to mathematics than male students, and these differences increased with age. They suggested that this was problematic because, "if females have more negative affect and attitudes about themselves and mathematics, they will ... learn less mathematics than males do" (p. 301).

Young-Loveridge (1992) explored the attitudes towards mathematics of nine-year-old children in New Zealand and found that boys generally liked mathematics more than girls. More specifically, the boys held more positive views about mathematics than the girls (74% cf. 46%), and a significantly higher proportion of the boys perceived themselves as being good at mathematics than the girls did (44% cf. 24%).

More recently, as part of a large Australian project, Rothman and McMillan (2003) examined the influences on Year 9 students' achievement in numeracy. Gender was shown to be a statistically significant influence with the achievement of females lower than that of the males. However, this result is at odds with the results of Australian students in PISA 2000 (Lokan, Greenwood, & Cresswell, 2001) and TIMMS (Mullins, Martin, Gonzalez, Gregory, Garden, O'Conner, Chrostowski, & Smith, 2000). While gender differences were statistically significant in the Rothman and McMillan study, they were not as prominent as the differences noted for socioeconomic status (SES).

## Socioeconomic Status

There has been a long-standing understanding that SES has a significant effect on achievement in mathematics education (Atweh, Meaney, McMurchy-Pilkington, Neyland, & Trinick, 2004). The Rothman and McMillan (2003) report noted that:

> [t]he effects of socioeconomic status on student achievement [in numeracy] were significant at two levels. There were small but significant effects of SES within schools, and there were larger significant effects of SES between schools. By far the greatest influence on between-school differences was the school's mean socioeconomic status. (p. 30)

Similarly, Peard (2002) quantitatively showed that SES has a prevailing influence on the mathematical achievement of school children. In short, the literature seems to be consistent in confirming that students who attend low SES schools achieve significantly lower than students who attend high SES schools. Furthermore, often SES is closely related to ethnic background (Atweh et al., 2004).

## Ethnicity

Research conducted in a range of countries has shown that the dominant ethnic group achieves better in mathematics than indigenous or minority groups (Bouchey & Harter, 2005; Demie, 2001; Ladson-Billings, 1997; Rothman & McMillan, 2004; Tate & D'Ambrosio, 1997). This pattern has also been reflected in New Zealand where Maori and Polynesian students had lower achievement levels in international studies compared with their European/Pakeha peers (Garden, 1997; Walker & Chamberlain, 1999). Furthermore, the data from a PISA study revealed that there was a large gap between the mathematical literacy of the relatively high achieving Pakeha group and the Maori and Pasifika students (May, 2003). These findings are also reflected in New Zealand studies where the same pattern of achievement is continually repeated (e.g., Crooks & Flockton, 2002).

## The Purpose of the Study

The literature reviewed above has identified that a range of factors, including affective/dispositional factors, are related to a student's mathematical performance. However, the studies reported herein have generally lacked rigorous quantitative analysis, and have been primarily either North American-based or have treated affective factors in isolation. In order to fill a void in this literature, the current study sought to investigate the influence of both affective factors and a set of background factors (viz., gender, school SES, and ethnicity) on New Zealand students' performance in mathematics. Specifically, the study explored correlations between students' mathematical beliefs/attitudes, and a performance rating from their teachers. Additionally, the study examined which combinations of these factors (affective and background) were able to appropriately classify student performance as either below average or above average (as rated by their teacher).

# Method

Participants were a sample of New Zealand students aged between 8 and 13 years (Mean = 10.6 years) and their mathematics teachers. The students and teachers were located in three types of educational setting, namely, primary (Year 1-6), intermediate (Year 7-8), and full primary (Year 1-8), and these settings were either categorised as government or non-government. Each school setting was positioned within a decile band that acted as a proxy for the SES of the students attending that particular school. Approximately 36% of the students attended schools in the lowest deciles (1-3), close to 43% of the sampled students fell in the middle deciles (4-6), and the remaining 21% of the students came from schools within the highest decile bands (7-10). The breakdown of gender and ethnicity (Pakeha and Maori/Pacific Islander only) for the sample is presented in Table 1.

Table 1
*Distribution of Sample by Gender and Two Main Ethnic Groupings*

| | | | Gender | | |
|---|---|---|---|---|---|
| | | | Female | Male | Total |
| | Pakeha | Count | 482 | 513 | 995 |
| | | % of Total | 30.5% | 32.5% | 63.0% |
| Ethnicity | Maori/Pacific | Count | 278 | 306 | 584 |
| | Islander | % of total | 17.6% | 19.4% | 37.0% |
| Total | | Count | 760 | 760 | 1,579 |
| | | % of total | 48.1% | 51.9% | 100.0% |

Although data were obtained from 1 880 students and 78 teachers, it needs to be noted that a number of these participants were unable to supply some data. To illustrate, several of the teachers involved in the initial phase of the study subsequently moved schools and, therefore were unavailable, when required, to match their rating of mathematical performance with their respective students. Given the relatively large size of the student sample, it was decided to eliminate cases with missing information rather than use substitution techniques to try to preserve the overall size of the dataset.

The students completed a questionnaire that was divided into three parts. Part 1 sought information of a background nature, including gender, ethnicity, and school year level. Part 2 consisted of a 25-item instrument that was designed to tap into 'Kids' Ideas about Maths' (KIM). These items asked respondents to indicate their agreement or disagreement with a statement, using a 5-point scale ranging from *strongly disagree* to *strongly agree*. The items comprising the KIM instrument were generated from the literature review, refined by an expert panel, and piloted. These processes are in accord with the suggestions made by de Vaus (2002) and Schloss and Smith (1999). The third part consisted of some open-ended questions that have not been included in this report.

Following a recoding, and an examination of the correlation matrix which resulted in the deletion of some of the items, the instrument was then interrogated by a principal components analysis with an oblique rotation (using SPSS, Version 14.0). The analysis identified four factors which were interpreted as *Positive View, Utilitarian Belief*, *Traditional Belief*, and *Maths Confidence*. These factors accounted for approximately 56% of the total variance in the analysis, and 18 of the 20 items were used to delineate the components. The two items eliminated, as a result of the factor analysis and subsequent testing of the subscales, were 'If I could avoid doing maths I would' and 'Maths is something you do by yourself'. The factor loadings for the items contributing to the factors are shown in Table 2.

Table 2
*Rotated Matrix and Factor Names*

| | Factors and Factor Loadings | | | |
|---|---|---|---|---|
| Item | Positive View | Utilitarian Belief | Traditional Belief | Maths Confidence |
| I like maths | **0.797** | -0.007 | -0.029 | 0.119 |
| I would like to be a mathematician | **0.594** | -0.018 | 0.194 | 0.018 |
| Maths is cool | **0.900** | 0.013 | -0.037 | 0.009 |
| Maths is fun | **0.869** | 0.033 | -0.032 | -0.018 |
| Maths is interesting and fascinating | **0.740** | -0.115 | 0.007 | -0.075 |
| Maths is boring | **0.792** | -0.041 | -0.130 | 0.119 |
| I need to do maths to get a good job | 0.064 | **0.604** | 0.109 | -0.072 |
| Maths is important | 0.205 | **0.666** | -0.122 | -0.108 |
| Maths is useful | 0.007 | **0.646** | -0.189 | -0.011 |
| Most people use maths everyday | -0.104 | **0.630** | 0.183 | 0.144 |
| Maths helps me in my life | 0.176 | **0.642** | -0.086 | -0.091 |
| If you are no good at maths then there is no point trying because you don't have a maths brain | -0.017 | -0.239 | **0.514** | 0.514 |
| Maths is something only smart people can do | -0.005 | -0.243 | **0.627** | 0.155 |
| The most important thing in maths is to get the right answer | 0.002 | 0.065 | **0.745** | 0.024 |
| Times-tables are the most important part of maths | 0.027 | 0.227 | **0.695** | 0.034 |
| I get uptight when I have to do maths | 0.011 | 0.137 | -0.048 | **0.684** |
| I worry about maths | -0.030 | -0.057 | -0.062 | **0.793** |
| Maths is a difficult subject | 0.201 | -0.162 | 0.049 | **0.647** |

Next, four subscales were derived (from the various factors) by adding the raw scores of each item substantially loading on a particular factor. These totals were then divided by the number of items in the subscale to obtain scores ranging from 1 to 5. The means, standard deviations, skewness and kurtosis values, and the reliability coefficients for the subscales are presented in Table 3. The skewness and kurtosis values indicate that the respective distributions of each subscale do not differ substantially from a normal distribution (Tabachnick & Fidell, 2001). It also needs to be noted that the reliability coefficients of the four subscales are deemed to be at an acceptable level. The *Maths Confidence* reliability coefficient (as measured by Cronbach's alpha) was the lowest but this is partly related, of course, to the small number of items forming this subscale. The results in Table 3 also reveal that the rating for *Maths Confidence* was substantially lower than the means for the other three subscales.

Table 3
*Means, Standard Deviations, Skewness and Kurtosis Values, and Alpha Coefficients of the Subscales*

| Measures | Subscales | | | |
|---|---|---|---|---|
| | Positive View | Utilitarian Belief | Traditional Belief | Maths Confidence |
| Mean | 3.246 | 3.379 | 4.130 | 2.273 |
| Standard Deviation | 0.932 | 0.776 | 0.649 | 0.809 |
| Skewness | -0.257 | -0.105 | -0.777 | 0.703 |
| Kurtosis | -0.526 | -0.318 | 0.526 | 0.180 |
| Cronbach's alpha | 0.89 | 0.69 | 0.61 | 0.58 |

Those teachers assigned to provide mathematical instruction for the various students indicated a rating of the students' recent mathematical performance. Table 4 contains a description of this measure, as well as the labels and descriptions of the other variables examined in, and forming the basis of, this study.

## Results

A correlation analysis was selected to explore the relationships among the predictor variables defined in the previous section and the teacher rating of mathematics performance. Because the predictor variables were either categorical or non-categorical, two separate analyses were carried out. The correlations involving gender and ethnicity were calculated using Spearman's rho; whereas, the correlations drawing on SES and the four dispositional variables were determined via the Pearson product-moment method. These analyses were performed using SPSS (Version 14.0) software and the results are

Table 4
*Description of Variables*

| Variable Label | Description |
|---|---|
| Gender | Gender: Dummy coded; 0 = Female and 1 = Male |
| Ethnicity | Ethnicity: Dummy coded; 0 = Pakeha and 1 = Maori/Pacific Islander |
| SES | Socioeconomic status: Scaled 1-10, with 1 signifying lowest decile |
| Positive View | Positive attitude about mathematics: 6 items, range 1-5 |
| Utilitarian Belief | Utilitarian belief towards mathematics: 5 items, range 1-5 |
| Traditional Belief | Traditional belief towards mathematics: 4 items, range 1-5 |
| Maths Confidence | Confidence in doing mathematics: 3 items, range 1-5 |
| Maths Performance | Teacher rating of mathematical performance: Scaled with values 1 = below average, 2 = average, and 3 = above average |

summarised in Table 5. An inspection of the correlation coefficients revealed that the direction of the measures was as anticipated, typically significant, but often of small magnitude. With one exception, the relationship of these measures with teacher rating of mathematics performance was significant ($p < 0.001$). That is, those students rated more highly on mathematics performance by their teachers were more likely to be male ($r = 0.107$), Pakeha ($r = 0.114$), indicate a liking for mathematics ($r = 0.361$), suggest confidence when doing mathematics ($r = 0.229$), be disposed to a utilitarian view of mathematics ($r = 0.203$), and not hold traditional beliefs about mathematics ($r = -0.190$). However, given the size of the sample some of the significant correlations still represent a relatively small proportion of the shared variance.

Since both gender and ethnicity were categorical variables, it was considered more instructive to examine further the relationship between these variables and mathematical performance by using an independent t-test. The results of this analysis showed that, in relation to gender, there was a significant difference ($t(1376) = -4.58$) between males and females. That is, males tended to be rated more highly in mathematical performance than their female counterparts (see Table 6). The results of the t-test with respect to ethnicity also yielded a significant difference ($t(1180) = 3.71$). Table 7 reports the results of this analysis and shows that Pakeha students were more likely to be rated at a higher level of mathematical performance compared with students from Maori/Pacific Islander backgrounds.

Table 5
*Correlation Matrix, Means, and Standard Deviations for Key the Variables*

| Variable Label | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1. Gender | 1.000 | | | | | | | |
| 2. Ethnicity | 0.008 *(1579)* | 1.000 | | | | | | |
| 3. SES | -0.032 *(1880)* | -0.155* *(1599)* | 1.000 | | | | | |
| 4. Positive View | 0.120* *(1805)* | 0.135* *(1534)* | 0.120* *(1837)* | 1.000 | | | | |
| 5. Utilitarian Belief | 0.098* *(1812)* | -0.009 *(1542)* | 0.035 *(1844)* | 0.394* *(1787)* | 1.000 | | | |
| 6. Traditional Belief | 0.021 *(1826)* | 0.114* *(1551)* | -0.098* *(1856)* | -0.108* *(1799)* | -0.148* *(1809)* | 1.000 | | |
| 7. Maths Confidence | 0.074* *(1850)* | -0.084* *(1576)* | 0.119* *(1884)* | 0.348* *(1816)* | 0.064 *(1822)* | -0.263* *(1833)* | 1.000 | |
| 8. Maths Performance | 0.107* (1378) | 0.114* (1182) | 0.056 (1398) | 0.361* (1346) | 0.203* (1346) | -0.190* (1357) | 0.229* (1372) | 1.000 |
| Mean | 0.53 | 0.37 | 4.89 | 3.24 | 3.38 | 4.13 | 2.27 | 2.03 |
| SD | 0.50 | 0.48 | 2.10 | 0.93 | 0.78 | 0.65 | 0.81 | 0.73 |

*Note*. The sample size for each correlation is identified in italics and these sample sizes vary because of missing values in some of the measures.

*p < 0.001. Because of the large number of separate measures being used to constitute the correlation matrix, it was necessary to reduce the occurrence of chance results. Thus, a stringent level of significance (p < 0.001) was used (Stevens, 1996).

In order to distinguish between students who perform below average (261 cases) and those who perform above average in mathematics (293 cases), a logistic regression analysis was performed using SPSS (Version 14.0) software. Logistic regression is an appropriate multivariate procedure for describing and testing relationships between a dichotomous outcome variable and a number of categorical and/or continuous variables (Peng, Lee, & Ingersoll, 2002). The results of this analysis revealed a significant relationship between the seven predictor variables and the outcome variable in the model. The omnibus test indicated an overall significant model ($\chi^2$ (7) = 192.545, $p$ < 0.001). Moreover, the analysis demonstrated that all seven variables were significantly related at the five per cent level to the outcome variable, namely, low/high mathematical performance (see Table 8). In other words, the three background and the four dispositional variables

Table 6
*Means and standard deviations for gender by teacher rating of maths performance*

| | Gender | *N* | Mean | Standard Deviation |
|---|---|---|---|---|
| Maths | Female | 671 | 1.23 | 0.42 |
| Performance | Male | 707 | 1.34 | 0.47 |

*Note.* $t(1376) = -4.58$, $p < .001$

Table 7
*Means and Standard Deviations for Ethnicity by Teacher Rating of Maths Performance*

| | Ethnicity | *N* | Mean | Standard Deviation |
|---|---|---|---|---|
| Maths | Pakeha | 753 | 1.30 | 0.46 |
| Performance | Maori/Pacific Islander | 429 | 1.20 | 0.40 |

Note. $t(1180) = 3.71$, $p < 0.001$

were predictive of differential mathematical performance. The Cox and Snell $R^2$ and the Nagelkerke $R^2$ values were 0.294 and 0.392 respectively. These pseudo-$R^2$ measures can be treated as "somewhat analogous to $R_2$ in linear regression" (McCoach & Siegle, 2003, p. 149). Interestingly, if the three background variables, namely, gender, ethnicity, and SES, were omitted from the logistic regression, the four remaining dispositional variables still yielded Cox and Snell $R^2$ and Nagelkerke $R^2$ values of 0.254 and 0.340 respectively.

Table 8
*Results of the Logistic Regression with All Seven Predictor Variables*

| Predictor Variable | B | *SE* | Wald's $\chi^2$ | *df* | *p* | Exp (B) |
|---|---|---|---|---|---|---|
| Gender | 0.53 | 0.21 | 6.56 | 1 | 0.010 | 1.7 |
| Ethnicity | -0.92 | 0.25 | 14.05 | 1 | 0.000 | 0.40 |
| SES | -0.125 | 0.05 | 6.49 | 1 | 0.011 | 0.88 |
| Positive View | 1.01 | 0.13 | 64.19 | 1 | 0.000 | 2.74 |
| Utilitarian Belief | 0.39 | 0.17 | 5.47 | 1 | 0.019 | 1.49 |
| Traditional Belief | -0.41 | 0.14 | 8.12 | 1 | 0.004 | 0.67 |
| Maths Confidence | 0.27 | 0.13 | 4.15 | 1 | 0.042 | 1.31 |
| Constant | -4.06 | 0.97 | 17.78 | 1 | 0.000 | 0.042 |

Logistic regression is a statistical procedure that is also used to predict (and classify) group membership from a combination of predictor variables (Tabachnick & Fidell, 2001). The results of the classification analysis are given in Table 9 and show that 79.5% of the group rated 'above average' in terms of mathematics performance were correctly classified; whereas, 26.4% of the group rated 'below average' by their teachers were misclassified. The percentage of 'grouped' cases correctly classified was 76.7%. When the background variables were dropped from the logistic regression, and consequent classification analysis, the percentage of 'grouped' cases correctly classified fell marginally to 75.3%.

Taken together, the classification results and the pseudo-$R^2$ measures suggest that the tested models were fit to the data well. Additional support for this claim can be found by inspecting the results of the Hosmer-Lemeshow (H-L) inferential goodness-of-fit test. This test, based on all seven predictor variables, yielded $\chi^2$ (8) = 10.393, $p$ = 0.239. According to Peng et al. (2002), an insignificant result of this magnitude is further evidence of overall model fit.

## Discussion

The current study complemented some of the previous studies by examining the potency of a number of background and affective factors on students' mathematical performance. This examination drew largely on both bivariate and multivariate analyses. The logistic regression analysis showed that the four affective factors, namely, Positive View, Utilitarian Belief, Traditional Belief, and Maths Confidence, were associated significantly with mathematical performance. Furthermore, these same factors plus SES were predictive of low/high mathematical performance. Two of the more significant predictors of differential mathematical performance were Traditional Belief and Maths Confidence. Strikingly, these factors in combination with merely two other affective/dispositional factors produced a model that fitted the data well and appropriately classified students who either were below average or above average with respect to mathematical performance.

Table 9
*Classification Results for Below-Average and Above-Average Mathematics Performers*

| | | Predicted | |
|---|---|---|---|
| Actual Group | *N* | Below-average Performers | Above-average Performers |
| Below-average Performers | 261 | 192 (73.6%) | 69 (26.4%) |
| Above-average Performers | 293 | 60 (20.5%) | 233 (79.5%) |

*Note*. Percentage of 'grouped' cases correctly classified (76.7%).

Broadly speaking, the order of importance of the four affective factors in relation to maths performance, as indicated by the correlations, is similar to that obtained in the logistic regression analysis predicting membership in low/high mathematical performance groups — the one exception being the changed order for Utilitarian Belief and Maths Confidence (see Exp [B] results in Table 8).

The findings of this study lend support to previous research findings with regard to gender differences. It had been previously reported that males often surpassed females in the performance of mathematical tasks and that this finding was consistent across different Western contexts (see Rothman & McMillan, 2003). However, the results of other Australasian studies published by Lokan et al. (2001) and Mullins et al. (2000) have not shown significant gender differences in relation to mathematical achievement. The present study found that those students who were rated more highly on mathematics performance by their teachers tended to be male. Being either classified as 'above average' or 'below average' in terms of mathematical performance was influenced significantly by gender. That is, males were more prone to be members of the above-average performance group.

The results relating to the effect of ethnicity are in many ways predictable in that the Pakeha students, when compared with their Maori/Pacific Islander counterparts, were more likely to reach higher performance levels in mathematics and be categorised as above average performers. These findings are in accord with those findings reported by Garden (1997), Walker and Chamberlain (1999), and May (2003).

Surprisingly, the results of the correlation analysis indicated that SES was not significantly related to teacher rating of mathematical performance. However, SES was correlated significantly with ethnicity. Such a relationship is a relatively common one reported in the literature and has been highlighted by researchers such as Atweh and his colleagues (2004). Moreover, when SES was used in conjunction with other measures to predict below- and above-average group membership, it had a significant impact.

Results from the present study imply a need for more investigation concentrating on affective factors and mathematical performance. It is anticipated that the present study marks the beginning of a series of future studies exploring the importance of affective factors, as measured by the KIM instrument within other primary and secondary school contexts. Causal analyses linking previous achievement with both affective and background factors would seem to be a most likely progression. With respect to the KIM instrument, it could be refined by adding several items to boost the Traditional Belief and Maths Confidence subscales. Even though these two subscales were strongly predictive of differential mathematical performance, their respective reliability coefficients were relatively low. As the number of items in each subscale was quite small, developing new items would be one way of possibly improving overall reliability. However despite this flaw, the KIM instrument is a worthy addition to the research literature as it embraces four discrete but broadly-defined areas of mathematical affect.

Despite this study contributing very worthwhile information about factors impacting on mathematical performance, there are nevertheless certain limitations inherent in the study. First, the study was exploratory in that the KIM instrument was used for the first time in this type of research about mathematical performance. Obviously, it would be prudent to validate this measure in a similar setting and across a range of contexts before firm conclusions about its usefulness can be drawn. Second, the reliance on self-reporting measures can be problematic and consequently greater attention should be paid to the relationship between the affective factors and content/procedural knowledge (see Tovey, 1999). That is, consideration needs to be given to further interrogate and understand these factors from a practical perspective. Third, the use of a school decile rank to act as a proxy for a student's SES posed some questions which could not be fully answered. Perhaps another measure might have been more suitable and potent. Fourth, although the four affective factors had considerable explanatory and predictive power, it would have been useful to have included a measure of prior mathematical achievement or even general academic ability given that these types of measures have been shown to relate strongly with mathematical performance (see Eaves, Williams, Winchester, & Darch, 1994; Kabiri & Kiamanesh, 2004). Unfortunately, information about previous achievement and/or standardised test results, for example, IQ, was not able to be supplied by the participating schools' administrators. Fifth and last, despite the fact that differences in mathematical performance were evident between Pakeha and Maori/Pacific Islander students, the study could not explore these differences in any meaningful way. A concentrated focus on the school experience for the latter group of students is warranted to ascertain how dispositions towards mathematics are being formed and whether or not certain dispositions can be changed.

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