Ethnicity and school achievement in New Zealand: Some data to supplement the Biddulph *et al* (2003) Best Evidence Synthesis.

Richard Harker
College of Education
Massey University

Report to the Ministry of Education
31 July, 2006

As per: Schedule 1 of:
An agreement for the provision of services for the Ministry of Education in relation to effects of ethnicity on output criteria used in selected research studies. 28 June, 2006

Summary

This paper looks specifically at the section of the BES (Biddulph *et al,* 2003, pp. 53-61 in particular) that deals with the relative contribution to achievement outcomes that is attributable to socio-economic status (SES) and to membership of ethnic groups. The BES relies on a small number of longitudinal studies which have some external validity problems with regard to ethnicity. The "Smithfield" (Lauder & Hughes, 1999) and "Progress at School" (Nash & Harker, 1998) studies have large representative samples with substantial sample sizes with regard to ethnic group membership. These data are analysed in a variety of ways, based around single level and multi-level regression analysis. The data is supplemented by reference to some secondary analyses that have been undertaken using data generated by New Zealand's participation in international educational achievement surveys – particularly PIRLS (Nash, 2004).

The data indicates that "ethnicity" as a quantitative variable used in a multi-variate "explanatory" model acts as something of a residual category, sweeping-up otherwise un-accounted for variance. The more the explanatory model contains variables that relate to family practices, values and attitudes (particularly as they relate to basic matters of literacy such as reading practices and resources), the smaller the direct part played by ethnicity as an explanatory factor of achievement outcomes. It is clear that relatively crude measures of socio-economic status such as family income or parent occupation, considered along with ethnicity, can account for some of the variance found in an ethnicity-only explanatory model. However much remains to be accounted for. The addition of more educationally relevant variables (such as level of parents' education (Wylie, 2001), literacy related practices within families and communities (Nash, 2004)) reduces the explanatory power of ethnicity as a direct effect to very low levels or eliminates it entirely.

Further research (both quantitative and qualitative) is required to unpack the interaction effects between the family based practices and those of the schools, at all levels of the compulsory sector.

Ethnicity and school achievement in New Zealand: Some data to supplement the Biddulph *et al* (2003) Best Evidence Synthesis.

Richard Harker
College of Education
Massey University

1. Introduction

This paper looks specifically at the section of the BES (Biddulph *et al,* 2003, pp. 53-61 in particular) that deals with the relative contribution to achievement outcomes that is attributable to socio-economic status (SES) and to membership of ethnic groups. The authors note in their conclusions that:

> The achievement of Maori and Pasifika children is significantly below that of other children in New Zealand, but that this may be partly accounted for by assessment procedures that tend not to reflect Māori/Pasifika contexts for learning, and partly accounted for by the fact that most of these children live in low SES families, with associated issues of family stress, health problems and lack of resources. (p.178)

This quotation captures the two different sources, or "causes" that are frequently advanced to explain difference between groups:

- the assessment procedures, here standing in for a number of practices and values that are part of the school culture; and
- aspects of the context (social, cultural) which the students bring with them through the school gate, and which shape their non-school lives.

The complexities of this issue are well canvassed in the BES and the authors are clearly frustrated by the lack of any clear evidence to provide some clarification. Indeed, they argue that "there is an obvious need to explore these 'other factors' and their inter-relationships in more depth" (p. 61). These other contextual factors or variables are things that are associated

with both ethnic group membership *and* achievement (such as family income, values, attitudes, aspirations etc.).

The research that they review consists of two basic data-generating studies: the "Competent Children" study (Wylie et al, 1996, 2001); and the Christchurch based longitudinal study (Barker & Moloney, 2000); both of which have considerable drawbacks with regard to the representativeness of their Maori (and Pasifika) participants. The BES also cites two review publications (Chapple et al, 1997; and Nechyba et al, 1999), both of which rely on the two data-generating studies noted above. The general conclusion of the reviews is that far too much emphasis has been placed on the cultural differences that exist between family cultures and the culture of the schools, and that most (if not all) of the variance in academic outcomes is accounted for by the kinds of family resource differences which SES encapsulates and acts as a proxy for. For example, the Competent Children study is cited:

> While we found some differences in mathematics and literacy scores for children who came from different ethnic groups, most of these differences were reduced or were no longer significant once we took family income and maternal qualification into account. In other words, it is the resources available to children which matter to their progress, not their culture or ethnicity. (Wylie, 2001, cited in Biddulph et al, 2003: 53)

Both of the data gathering studies have sampling drawbacks with regard to ethnic differences in achievement. The "Competent Children" study has a relatively small sample, with a very small (and unrepresentative) number of Maori within it. Hence, in addition to questions of representativeness, the power of the study to detect any small differences that remain after a range of family circumstances are controlled will be quite small. The authors of the Christchurch study also acknowledge the drawbacks of reading too much into their findings on ethnicity, since they are aware of the unrepresentativeness of their sample in this regard.

The Biddulph BES study is aware of these limitations (though their *caveats* are often ignored). It is unfortunate that the BES did not look at the results from two other data generating studies which have sizeable samples and background data on the students involved. These are the "Smithfield" project (Lauder & Hughes, 1999) and the "Progress at School" project (Nash

& Harker, 1998). Both of these datasets have data on large samples of individual students, and data aggregated at the level of the schools which they attend. Using multilevel modelling techniques, the variability in outcomes can be partitioned between individuals and schools. The two projects were recently summarised in relation to compositional effects (Harker, 2004), and the data can be explored further to look at ethnic effects in detail.

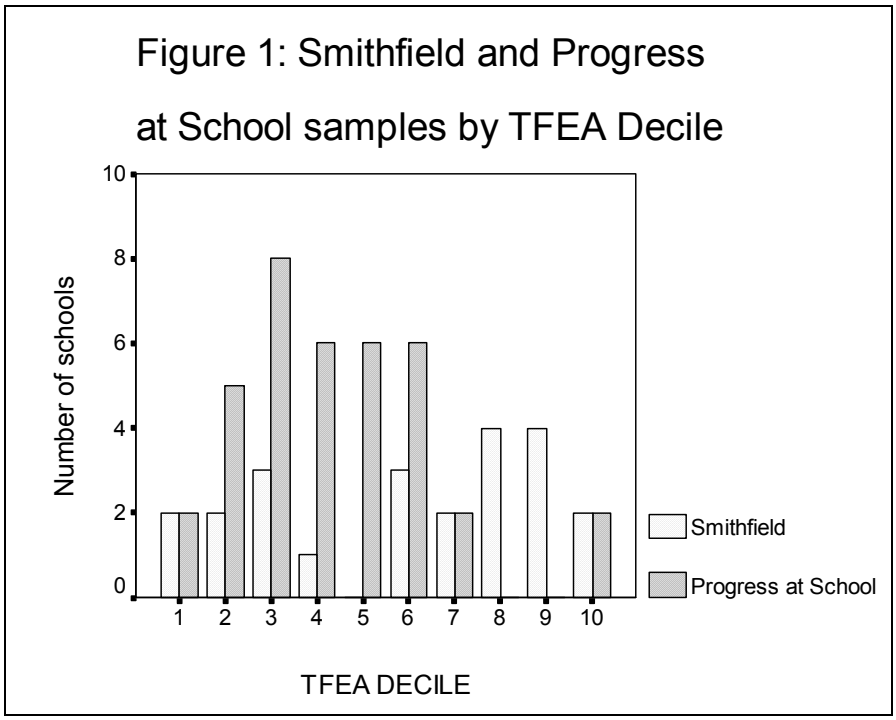
To do this, three different models are examined in relation to the generation of regression coefficients in relation to three academic outcome criteria: School Certificate marks awarded in Mathematics, English and Science. The models are run with both the Smithfield and Progress at School data separately as a form of cross study validation (replication).

1.1 The "Smithfield" data

This study consisted of 3,320 students who commenced secondary school (Year 9) in 1994 at 23 schools. The effective sample was 76% of the relevant cohort at these schools, 24% declining to participate. The primary aim of the project was to examine the long term effects of the changes made to the governance and management of New Zealand schools introduced in 1989. Particular interest was in the marketisation process involving parental choice of school for their offspring. Consequently, the sample was designed to facilitate this objective, and consisted (with one exception) of urban schools from two large cities and their suburbs in order to examine the characteristics of the schools (and the students attending them) amongst which families in these two cities could realistically choose. This design feature has had an impact on the SES distribution of the schools in the sample (see Figure 1). Prior attainment data were collected from contributing schools during 1993, and further data between 1994 and 1996, when the students were eligible to sit the School Certificate examinations, the results of which (in English, Mathematics and Science) are used here.

1.2 The "Progress at School" Project (PatS)

This study consisted of a cohort of 5,300 students who commenced their secondary schooling (Year 9) in 1991 at 37 schools. The sample of schools covered all types of community (but had only three South Island schools) with 14 urban and suburban schools, 8 in regional centres, and 15 in country towns. All Year 9 students were included in the sample. The SES distribution of the schools was quite different from the Smithfield sample (see Figure 1). Attainment data were collected at the beginning of Year 9. Data were collected from the schools on their Examination enrolments and results in Years 11, 12 and 13.



Unfortunately there is very little overlap between the two projects with regard to common variables (and their measurement), and even the outcome variables were utilised in different ways, hence it is not possible to merge the two data sets, as much would be lost or unacceptably distorted in the process. However, a great deal of interest can be gleaned from a careful examination and comparison of the quantitative data in regard to ethnicity and SES effects

on attainment scores. It should also be noted that there was a three year gap between the cohorts in the two studies.

2. The analytic models

As a first step, multi-level regression is used (where two sets of data are employed: a dataset at the individual student level; and a second dataset where data is aggregated to the school level), using software specifically designed for the purpose (HLM – see Bryk & Raudenbush, 1992).

Model 1

The first model examines each output with three dummy variables for each of Maori, Pasifika, and Other. In both studies "other" consisted almost entirely of Asian students. With this model, the intercept score ($ß_{0j}$) will be the average score for Pakeha students and the coefficients for each of the ethnic groups will show what needs to be added or subtracted to arrive at the average for each ethnic group. No explanatory variables were entered at the school level except in Model 3.

The models illustrated here using the Maths score as output were applied in the same way to English and Science scores.

Level-1: $Maths_{ij} = ß_{0j} + \gamma_{10}Maori_{ij} + \gamma_{20}Pasifika_{ij} + \gamma_{30}Other_{ij} + r_{ij}$

Level-2: $ß_{0j} = \gamma_{00} + \upsilon_{0j}$

Model 2

Model 2 added family SES (based on caregiver occupation) to the individual level model. If the hypothesis is that most of the differences between ethnic groups are due to SES factors, then this model should produce smaller coefficients (and effect sizes) for the three ethnic variables. If the ethnic differences are entirely due to SES factors, then the ethnic coefficients and effect sizes should reduce to such an extent that they are no longer significantly different from zero.

Level-1: $Maths_{ij} = ß_{0j} + \gamma_{10}Maori_{ij} + \gamma_{20}Pasifika_{ij} + \gamma_{30}Other_{ij} + \gamma_{40}SES_{ij} + r_{ij}$

Level-2: $ß_{0j} = \gamma_{00} + \upsilon_{0j}$

Model 3

Model 3 adds to model 2 the school average SES (SESAGG, based on the individual family SES classifications of the entire cohort at each school) as a school level variable to estimate the effect of the school SES-mix (over-and-above the effect of SES at the individual level – compositional effect) on the ethnic coefficient estimates in relation to the mean scores.

Level-1: $Maths_{ij} = ß_{0j} + \gamma_{10} Maori_{ij} + \gamma_{20} Pasifika_{ij} + \gamma_{30} Other_{ij} + \gamma_{40} SES_{ij} + r_{ij}$

Level-2: $ß_{0j} = \gamma_{00} + \gamma_{01} SESAGG_{.j} + \upsilon_{0j}$

3. Results

The detailed data are reported in Appendix 1 and a summary is reported in Table 1 as effect sizes. These have been calculated by dividing the model coefficients by the overall standard deviation of the individual scores generated by each model for each output. An effect size of 1.00 would indicate that the scores for a group are 1 standard deviation above the reference group – in this case Pakeha students. If the sign is negative, then they would be 1 standard deviation below.

Table 1: Effect sizes for ethnicity before and after controlling for SES

Ethnic group	***Output***	***Model 1***		***Model 2***		***Model 3***	
		PAS	Smith	PAS	Smith	PAS	Smith
Maori	Maths	-0.55	-0.60	-0.46	-0.48	-0.45	-0.48
	English	-0.52	-0.55	-0.42	-0.44	-0.41	-0.43
	Science	-0.62	-0.73	-0.52	-0.61	-0.52	-0.60
Pasifika	Maths	-0.83	-0.72	-0.68	-0.56	-0.67	-0.57
	English	-0.88	-0.37	-0.73	-0.17	-0.72	-0.17
	Science	-1.02	-0.71	-0.88	-0.52	-0.87	-0.52
Asian	Maths	0.11	0.00	0.20	0.16	0.18	0.14
	English	-0.19	-0.16	-0.11	0.03	-0.11	0.02
	Science	0.06	-0.18	0.12	-0.03	0.11	-0.05

Note: The data for these effect sizes can be seen in Appendix 1.

As can be seen from an inspection of Table 1, there is substantial agreement between the two studies in terms of the magnitude of the effect sizes generated by Model 1. For Maori, the effect size indicates an average exam mark just over half a standard deviation below that for the reference group. There is some divergence between the two studies for the Pasifika group, particularly in English, and somewhat less in Science and Maths, though they tend to be larger than those for Maori. In this regard the two studies are not comparable due to the absence of students from Auckland schools in the Smithfield sample. Since the majority of Pasifika students are in the greater Auckland area, the Smithfield data are less reliable for this group. The effect size for Asian students is small (but positive) in Maths, close to zero (though slightly negative) in English, and small (but mixed) in Science.

For both studies there is a small but consistent drop when an SES variable is added at the individual level (Model 2). Adding the SES mix of the school (Model 3) does not have any further effect in reducing the ethnic effect sizes.

With regard to the three academic outcome variables used in these two studies, the hypothesis that some of the variance between groups can be accounted for by the differential distribution of ethnic groups across the socio-economic spectrum is supported and can be quantified by the percentage drop in the effect size between Models 1 and 2:

- between 15 and 20 % for Maori and Pasifika students;
- no effect for Asian students – with some indication that the effect of controlling for SES actually increases the ethnic effect for the Asian students, particularly in Maths and Science.

Overall, most of the variability in these exam scores between Maori and Pasifika students on the one hand, and Pakeha students on the other, remains to be accounted for. As reference to Appendix 1 indicates, the difference between Maori and Pakeha students, after controlling for SES amounts to around 8 percentage points – slightly under half a standard deviation in Maths and English, slightly over half for Science. For Pasifika students the difference ranges up to three-quarters of a standard deviation.

This rather small drop may come as a surprise to many given the consistent relationship that has been established in research around the world, between SES indices (such as the Elley-Irving scale used in New Zealand) and measures of school attainments (correlations around 0.3 are typical in developed countries). However, the relationship has been established in the literature almost entirely from samples drawn from western, developed nations with populations largely of European origins and culture. To be substantively effective as an explanation for inter-ethnic differences, the SES variable would need to function in a very similar way within each of the ethnic groups involved in the comparison. A simple hypothesis to check would be:

that the relationship between a measure of SES and school examination results will be the same for Maori, Pasifika, Asian and Pakeha students.

Table 2: Correlation coefficients between SES and school attainments, by ethnic group.

Ethnic group	Output	Correlation	N
Maori	Maths	**0.16**	494
	English	**0.18**	632
	Science	**0.22**	488
Pasifika	Maths	0.12	193
	English	0.12	255
	Science	0.08	191
Asian	Maths	**0.46**	136
	English	**0.35**	139
	Science	**0.28**	131
Pakeha	Maths	**0.31**	2362
	English	**0.25**	2679
	Science	**0.25**	2412

Note: the coefficients in **bold** are significantly different from zero, $p<0.01$.

Since there is no interest in looking for school effects in this analysis, the original (single level) raw data from the Progress at School project[1] can be used to examine this by correlating the scores for each ethnic group separately. The results are reported in Table 2 and show clearly that the hypothesis stated above cannot be sustained. For the Pasifika students there is no relationship between any of the output criteria and the SES measure (based on occupation of parent/caregiver) used in the study. For Maori students the relationship is statistically significant (i.e., unlikely to be due to sampling error), but quite weak. The strongest correlation is with Science (0.22), which accounts for only 4.8% of the variance in the scores obtained by the Maori students. This raises an issue as to whether any contextual variables other than the SES measure used above, might help "explain" the differences in scores between the ethnic groups.

A number of possibilities exist within the Progress at School and Smithfield multi-level databases. Prior achievement (based on reading comprehension and scholastic aptitude data collected at the beginning of their secondary schooling, Year 9) is recognised as perhaps the most powerful predictor of future attainments. Substituting prior achievement for SES in the models above produces a much stronger effect on the ethnic effect sizes reported in Table 1. The effect sizes for running model 2 using prior achievement instead of SES are shown in Table 3.

For Maori and Pasifika students these are considerably smaller than those for SES shown in Table 1, and no improvement occurs by adding the school aggregate prior achievement to the model at the school level. However, as with SES, there are still substantial differences between the ethnic groups after controlling for prior achievement.

This raises the question whether the relationship between prior achievement and academic attainments are the same in each of the ethnic groups. Running the correlations for each ethnic group shows, unlike the SES data, no substantive difference between the groups in this regard.

[1] I do not have access to the original raw data for the Smithfield Project.

Table 3: Ethnic effects controlling for prior achievement.

Ethnic group	*Output*	*Model 2*	
		PAS	Smith
Maori	Maths	-0.33	-0.37
	English	-0.27	-0.36
	Science	-0.42	-0.64
Pasifika	Maths	-0.28	-0.30
	English	-0.29	-0.25
	Science	-0.46	-0.18
Asian	Maths	0.56	0.24
	English	-0.18	0.19
	Science	0.51	-0.06

In summary, controlling for both SES and prior attainment reduces, but does not eliminate significant differences between the four ethnic groups studied in the Progress at School and Smithfield projects.

Running single level regression analyses with the Progress at School data allows for the examination of some other variables as well, such as academic self-concept, reading practices, sex, and number of books in the home, all of which are often noted as explanations of differential academic performance.[2] Initially the academic outcomes are regressed against the three ethnic dummy variables to generate the gross differential as a baseline for comparative purposes (Baseline Model). This baseline model actually explains between 8 and 10 percent of the variance in the output criteria, hence is not particularly effective as a predictor. Having established a baseline, in Model 1 the ethnic variables are deleted and both SES and prior achievement are entered as a block. These prove much more effective in accounting for the variability of scores; just over 40 percent for all three exams. In Model 2, student sex, the number of books, academic self concept and reading practices are added as a second block to see if these additional

[2] Nash and Harker (1998) discuss these variables in detail, and the issue is addressed more extensively in Appendix C, pp. 185-190 of that book, and also in Nash (2001), where Sixth Form Certificate and Bursary data are also examined in detail.

variables account for any more of the variability. They have a very small effect on the amount of variance accounted for over and above SES and prior achievement. Finally in Model 3 the ethnic variables are re-entered to see to what extent they make any further, unique contribution to the variance accounted for, and to see to what extent the coefficients are reduced after taking into account all the variables used in Model 2.

The results are shown in detail in Appendix 2, and summarised in Table 4, where it can be seen that the addition of the ethnicity variables in Model 3 does very little to further account for the variability between students, over and above the variables in Model 2. However the regression coefficients for each of the ethnic variables remain significantly different from zero, and indicate that with all the contextual variables used in the model held constant, ethnicity still makes a difference to the total score achieved by students. The additional contextual variables in Model 2 have not had much of an effect, and the question could be asked (as with SES and prior achievement) as to the effects of these four variables within each of the ethnic groups. Appendix 3 shows in detail the relevant data, which can be summarised as follows.

Academic self concept – a factor score. Appendix A3.1 shows that it has a moderate relationship (c.0.34) with exam scores for Pakeha and Asian students, and a weaker relationship (c.0.23) for Maori and Pasifika students.

Reading practices – a factor score. A3.1 shows that there is a weak to moderate relationship between reading practices and exam scores for Pakeha and Maori students, and (with the exception of the English exam for Pasifika students) no relationship for Pasifika and Asian students.

Sex of students. Appendix A3.2 shows that in English, there is a similar gap of around 4 % in favour of girls for Pakeha and Maori students, and a slightly larger gap (c. 6-7 %) in favour of girls for Asian and Pasifika students. In Maths the gap in favour of boys is about 6 % for Maori and Pakeha students, half that for Asian students, and there is no difference between Pasifika boys and girls. In Science the differences are quite small for all groups.

Number of books in the home. A3.3 shows that there is a weak linear relationship between this variable and exam marks for Asian, Pakeha and Maori students, but no consistent pattern for Pasifika students.

Together, the reading practices and number of books data suggest that family language patterns may well be involved and would repay investigation in relation to other types of school achievement outcomes.

Table 4: Academic outcomes for ethnic groups, controlling for contextual variables.

Data for the sample		Mean	St.dev.	N		
	Maths	54.42	20.83	2633		
	English	54.14	15.07	3019		
	Science	55.42	17.89	2669		
Data for the Models						
	Output	Baseline Model		Model 1	Model 2	Model 3
R^2	Maths	**0.08**		**0.41**	**0.43**	**0.45**
	English	**0.08**		**0.42**	**0.47**	**0.48**
	Science	**0.10**		**0.42**	**0.44**	**0.46**
		Coeff.	Effect size		Coeff	Effect size
Maori	Maths	**-12.61**	-0.61		**-4.37**	-0.22
	English	**-8.53**	-0.57		**-2.95**	-0.22
	Science	**-11.47**	-0.64		**-5.03**	-0.28
Pasifika	Maths	**-19.34**	-0.96		**-3.97**	-0.20
	English	**-14.68**	-0.97		**-3.68**	-0.26
	Science	**-19.55**	-1.13		**-7.04**	-0.41
Asian	Maths	2.43	0.16		**9.10**	0.45
	English	**-3.59**	-0.30		0.90	0.06
	Science	0.27	0.01		**5.46**	0.33

Note: coefficients in **bold, p. <0.01**

To return to the regression analysis: re-inserting the ethnic variables in Model 3 raises the variance accounted for by a very small amount as is shown in the R^2 panel of Table 4, and allows for the recalculation of the ethnic coefficients. It is interesting to note that the Nash study of the PIRLS data (2004: 289-290) [3], using a much more fine-grained set of independent contextual variables, generates a very similar R^2 statistic (0.45). As can be seen, the effect sizes for the Maori and Pasifika ethnic groups are reduced

[3] Progress in International Reading Literacy Study. The New Zealand data set included 2504 students in 172 schools.

considerably (by more than half) from those shown in the multi-level analysis, but by no means do they disappear. The addition of the four contextual variables has “soaked-up” a significant amount of the variance attributable to ethnic group membership for Maori and Pasifika students. For Asian students, the positive differential between themselves and Pakeha students increases considerably in Maths and Science after controlling for the variables in Model 2, and is similar to the Pakeha students in English.

There is, however, for Maori and Pasifika students a remaining negative variance to be accounted for. For Asian students there is a significant and substantial positive gain over Pakeha students which increases with the addition of the contextual variables. Any explanation for these residual ethnic differences has to deal with the fact that controlling for the contextual variables has the opposite effect on the scores of Asian students on the one hand, and Maori and Pasifika students on the other.

The aggregated drop in effect size is between 56 and 64 percent for Maori, between 64 and 79 percent for Pasifika, and reverses direction and increases substantially for Asian students. It should also be noted that in the PIRLS study (Nash, 2004), while the amount of variance accounted for is very similar to the “Progress at School” data, his independent variables included not only the kind of index variables usually associated with measures of SES, but also measures of actual practices and attitudes related to literacy activities, and the effect size of ethnicity was reduced to non-significance for Maori, and a very small effect for Pasifika students.

This raises the issue of just what is being “measured” when students are classified into ethnic groups. Ethnicity is not so much a variable as a classification, within which students can vary as much as they do between groups. In a sense then, ethnicity can be seen as a residual category that will “soak-up” any variance left over in the model – the poorer the model specification, the larger the “ethnic” effect. It is notable that an analysis of the large PIRLS study (Nash, 2004) does reduce the Maori-Pakeha differential to zero, and it is the one study which has measures of actual family practices and attitudes related to literacy activities, which have a direct effect on the literacy measures used in the study.

4. Conclusion

The Biddulph *et* al (2003) BES has a section entitled “The complexity of links between ethnicity, family resources and achievement” (pp. 53-59) in which a variety of explanations is reviewed. It is clear from the data presented here that any uni-causal explanation based on socio-economic circumstances is inadequate to explain ethnic differences, thus supporting the caution expressed in the Biddulph BES. The most likely explanation would seem to lie in the interaction between school environments and the values, attitudes, motivations that under-pin the school “culture”, and the culture of home and community environments and the values, attitudes and motivations on which they are based. That is to say, while it is important (even necessary) for the family and community culture of the students to be understood and supported by schools, it is also important (even necessary) for the culture of the school to be understood and supported by families and communities, if progress is to be made in terms of the outputs analysed above. The “two-way-street” nature of this argument is put forward in the Chapple *et al* (1997) report which states:

> The notion that there is an interaction effect between school barriers and secondary cultural characteristics of Maori as an involuntary minority is a substantially stronger argument logically and empirically than a simple school barriers argument. (p.121)

Further, Nash (2004) argues on the basis of his analysis of the PIRLS New Zealand data that it is literacy practices within families and their communities which are closely related to attainment levels of the 10 year-olds involved in the study, and that these practices are found differentially distributed in *all* ethnic groups. Classifying students into any particular “ethnic” category does not produce independent, non-overlapping categories, in that there will be a similar range of related family and community contextual variables within each ethnic category as there is between ethnic categories (though relative distributions on these co-related variables will probably differ). As Hohepa, McNaughton and Jenkins (1996: 39) remind us, “dichotomised and homogeneous descriptions of cultural identity may lead to simplistic judgments of educational processes, including assumptions of pedagogical preferences being ‘equally’ present for all Maori children, and limited to, or

always present in, sites those children occupy." Thus it is difficult to know just what the ethnic classification is telling us about the students, and about the relationship of such students to measures of achievement in schools. Studies have shown that the more one includes other contextual variables in the analysis (such as level of parental education, reading and other educational related practices of the home, attitudes to school, motivation etc.) the direct effect of ethnicity as a category related with achievement indicators declines significantly, in favour of the indirect effects through association with the covariates in the model.

The data reviewed here support the conclusions in the Biddulph *et al* (2003) review of the role of family resources in children's achievement throughout their school trajectory (pp. 89 – 96). "There is overwhelming evidence" they say, "that literacy resources in the home, both material and experiences, are crucial for children's literacy development and achievement" (pp. 93). Thus it is important to differentiate ethnic effects into "direct" and "indirect" components, since being able to make the ethnic factor shrink (or even disappear) in a sophisticated statistical analysis, does not make it "go away". What it does show is that some (or all) of the ethnic effect is indirectly related to school achievement through the co-association of ethnicity with such things as "level of parents education", "family resources", "health factors" and so on. Schools are not accountable for many of these co-associations, but often have to deal with the consequences for the student's learning. Any explanation of the differences between ethnic groups that would place the "blame" solely on schools, is obliged to show that their remains a significant direct effect of ethnicity on achievement measures after all other relevant contextual variables have been taken into consideration. The results reported above for the Asian students further indicate that a simple "mono-cultural school" argument is inadequate to explain ethnic effects.

While such quantitative data can provide some pointers, this is an area where "nothing of any value can be known without fine-grained observational research" (Nash, 2004, p. 295). Careful, long-term research (both qualitative and quantitative, with adequate, representative samples) is required to untangle such complex issues. After all, we may well be dealing with a "mode of assessment" issue here, which may be interacting with the contextual

variables as well as the ethnic one. The output criteria used in the "Progress at School" and "Smithfield" projects were generated by very traditional, 3-hour, "paper-and-pencil", public examinations, which do not suit everyone equally. With the change in assessment embodied in the new NCEA qualifications regime, which has had a considerable impact on school cultures, things may well be different. Nash's (2004) study of the PIRLS data is instructive in this regard.

5. Further research

The Biddulph *et al* (2003) BES makes a strong case for further research, and concludes:

> Given…the complexities surrounding ethnicity and achievement, and the range of other factors which are strongly associated with children's achievement, there is an obvious need to explore these 'other factors' and their inter-relationships in more depth, so that efforts to ensure high achievement for all New Zealand children, regardless of their ethnic backgrounds, can be more fully informed. (p. 61)

Neither of the projects used at the beginning of the analysis presented in this paper were specifically designed to explore the issues being discussed. However each was of sufficient size and scope to generate reliable and robust estimates, which together with the PIRLS data, constitute a departure point for analyses that look at other levels of schooling, and with rather more recent data, and to provide a baseline for more intensive qualitative studies of the practices (in school and family/community contexts) involved. Both of the original projects were studies of the performance of students sitting three hour "paper-and-pencil" examinations at the end of Year 11 in the mid 90s, in order, amongst other things, to look for, so-called, "school effects". As pointed out above, a lot has changed since then, including the nature of the assessment process to which students are now subject (NCEA). The current analysis shows that:

- ethnicity continues to make a significant direct contribution to variance explanation after controlling for a number of structural contextual variables, such as prior achievement and SES;

- ethnicity ceases to be a significant direct factor when a more sophisticated set of family-based practices and attitude variables are added to the model.

This would seem to indicate that ethnicity is not a “single-point-in-time” effect on achievement, hence is not susceptible to a “quick-fix”, “single-shot” solution. The way effect sizes respond to the nature of the explanatory model used in the analysis, indicates a complex situation that needs to be addressed on a comprehensive, system-wide basis.

It would be important to follow up with a database (such as Asttle) that covers a wider range of school years, and is of sufficient size to contain adequate sample sizes for each ethnic group at each year level, in order to check whether the patterns identified above can also be found with students at all stages of schooling. This would help in establishing whether the baseline “gap” in achievement levels is getting wider, staying the same or getting smaller as children pass through the school system. Nash (2004: 292-3) shows that the raw effect size (the “gap” between Maori and Pakeha in standard deviation terms) is 0.75 for the New Zealand PIRLS 10 year-olds, and 0.66 for the New Zealand PISA sample of 15 year-olds.

There are a number of national level databases generated by New Zealand’s participation in International educational achievement studies (such as PIRLS, PISA, TIMSS) which provide good cross-sectional data “snapshots” on a variety of outcomes, at particular age levels. The secondary analysis of these data would be an effective use of scarce research resources, and the facilitation of such analysis should be one of the criteria used in setting up the sampling frames for these studies. As with all such studies, the requirement is for a comprehensive data set with a rich collection of “contextual” as well as attainment data for the individual students at all levels of the school system. The database collected by the Asttle team in order to “benchmark” the battery of test items that have been developed, could provide the basis for such an analysis. A very large sample of data has been collected, across years 5 to 12 of the school system, in a number of attainment domains. An analysis of these data would provide a more up-to-date evaluation of the questions that arise from the work summarised above – always provided that sufficient, and fine-grained, contextual data has been collected along with the achievement data.

Such studies should be in addition to studies of a qualitative nature which explore the complex territory surrounding the inter-face between schools, families and communities, which can give us the greatest insight into the actual practices that occur in schools and homes, and how they interact with each other. After all we must remember that statistical associations may describe some phenomena, but do not, in-and-of-themselves *explain* anything much, unless the problems of co-linearity have been carefully worked out. They can, however, give us some strong indications of where to look, and where resources might be effectively applied. Hence the two types of data are complementary, since they provide answers to different sorts of questions, rather than providing alternative "explanations".

6. References

Barker, G. & Moloney, T. (2000) *Final regression results on the cognitive achievement of children in the Christchurch health and development study with corrections for attrition from this longitudinal study.* Wellington: Treasury Working Paper 00/6.

Biddulph, F., Biddulph, J., & Biddulph, C. (2003). *The complexity of community and family influences on children's achievement in New Zealand: Best evidence synthesis.* Wellington: Ministry of Education.

Bryk, A.S., & Raudenbush, S.W. (1992) *Hierarchical linear models.* Newbury Park: Sage.

Chapple, S., Jefferies, R., & Walker, R. (1997) *Maori participation and performance in education - A literature review and research programme.* A report for the Ministry of Education. Wellington: NZ Institute of Economic Research

Harker, R. (2004). Compositional effects in New Zealand schools. *New Zealand Journal of Educational Studies, 39*(2), pp. 303 - 319.

Hohepa, M., McNaughton, S. & Jenkins, K. (1996). Maori pedagogies and the roles of the individual. *New Zealand Journal of Educational Studies, 31*(1), pp. 29 - 40.

Lauder, H., & Hughes, D. (1999). *Trading in futures: Why markets in education don't work.* Milton Keynes: Open University Press.

Nash, R. (2001) Models of Māori educational attainment: Beyond the “class” and “ethnicity” debate. *Waikato Journal of Education, 7*, pp. 23 – 36.

Nash, R. (2004) The explanation of social differences in reading attainment: An inspection of the PIRLS New Zealand data. *Waikato Journal of Education, 10*, pp. 283 – 297.

Nash, R., & Harker, R. K. (1998) *Making progress: “Adding value” in secondary education.* Palmerston North: ERDC Press, Massey University.

Nechyba, T., McEwan, P. & Older-Aguilar, D. (1999). *The impact of family and community resources on student outcomes.* Wellington: Ministry of Education.

Wylie, C. (2001) *Ten years old & competent - the fourth stage of the Competent Children Project: A summary of the main findings.* Wellington: New Zealand Council for Educational Research.

Wylie, C., Thompson, J. & Hendricks, A.K. (1996). *Competent children at 5: Families and early education*. Wellington: New Zealand Council for Educational Research.

Appendix 1: HLM regression coefficients

Variable	Output	Model 1		Model 2		Model 3	
		PAS	Smith	PAS	Smith	PAS	Smith
Mean score	Maths	54.85	58.29	54.59	58.28	54.50	58.19
	English	55.01	55.79	54.70	55.78	54.67	55.67
	Science	56.73	57.24	56.49	57.25	56.43	57.08
Std. Dev.	Maths	18.85	17.64	18.47	17.01	18.48	17.01
	English	14.12	15.49	13.84	15.00	13.84	15.00
	Science	16.62	15.31	16.30	14.71	16.30	14.71
Maori	Maths	**-10.33**	**-10.67**	**-8.46**	**-8.10**	**-8.37**	**-8.09**
	English	**-7.29**	**-8.46**	**-5.76**	**-6.54**	**-5.72**	**-6.44**
	Science	**-10.24**	**-11.19**	**-8.51**	**-8.92**	**-8.45**	**-8.92**
Pasifika	Maths	**-15.60**	**-12.72**	**-12.52**	**-9.59**	**-12.36**	**-9.75**
	English	**-12.40**	**-5.75**	**-10.11**	-2.55	**-10.03**	-2.95
	Science	**-17.03**	**-10.92**	**-14.28**	**-7.68**	**-14.16**	**-7.62**
Other (Asian)	Maths	2.12	0.01	**3.66**	2.67	*3.40*	2.41
	English	*-2.67*	-2.44	-1.51	0.46	-1.54	0.25
	Science	0.97	*2.83*	2.00	-0.47	1.86	-0.69
SES (indiv)	Maths			**2.07**	**5.08**	*2.08*	**4.84**
	English			**1.57**	**4.15**	**1.54**	**3.90**
	Science			**1.87**	**4.65**	**1.81**	**4.37**
SES (aggr.)	Maths.					**5.00**	**11.43**
	English					*1.96*	**7.36**
	Science					**1.98**	**7.30**
Model	Maths	27562	11925	27428	11816	27412	11795
deviance	English	29917	11542	29770	11445	29765	11429
	Science	27089	11270	26956	11153	26959	11136

Note: coefficients in **bold**, p<0.01; in *italics*, p<0.05

Appendix 2 – Regression analyses from Progress at School

A2.1: School Certificate English examination results

Regression coefficients from the English exam - n=3019[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	47.304	.648		73.001	.000
	SES	.730	.110	.097	6.646	.000
	prior achievement	10.301	.246	.611	41.799	.000
2	(Constant)	50.001	.861		58.082	.000
	SES	.868	.106	.116	8.231	.000
	prior achievement	9.333	.265	.554	35.159	.000
	sex	-5.378	.418	-.178	-12.857	.000
	bookown	-.228	.191	-.021	-1.197	.231
	Reading practices	1.534	.291	.100	5.275	.000
	Academic self concept	2.078	.278	.105	7.477	.000
3	(Constant)	51.789	.913		56.705	.000
	SES	.752	.107	.100	7.062	.000
	prior achievement	8.987	.274	.533	32.849	.000
	sex	-5.433	.417	-.180	-13.043	.000
	bookown	-.330	.191	-.030	-1.726	.084
	Reading practices	1.591	.292	.103	5.450	.000
	Academic self concept	2.172	.277	.110	7.849	.000
	Maori	-2.953	.558	-.073	-5.297	.000
	Pacifica	-3.680	.928	-.056	-3.965	.000
	Asian	.898	1.061	.011	.846	.398

a. Dependent Variable: scengl

Baseline coefficients	**Maori**	**-8.334 ****	**effect size**	**-0.55**
	Pasifika	**-14.681 ****		**-0.97**
	Asian	**-3.592 ****		**-0.24**

Mean score	**54.14**
Standard Deviation	**15.10**
N	**3019**

R^2	**Baseline**	**0.08**
	Model 1	**0.42**
	Model 2	**0.47**
	Model 3	**0.48**

Model 3 effect sizes for ethnic group membership (coefficient divided by the standard deviation):

Maori	-0.19
Pasifika	-0.24
Asian	0.06

A2.2 School Certificate Mathematics exam results

Regression coefficients from the Maths exam - n = 2633

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	39.029	.994		39.251	.000
	SES	1.815	.167	.172	10.854	.000
	Prior achievement	13.366	.375	.563	35.598	.000
2	(Constant)	39.771	1.350		29.461	.000
	SES	1.707	.165	.161	10.361	.000
	Prior achievement	12.410	.408	.522	30.419	.000
	sex	4.365	.642	.104	6.797	.000
	bookown	-.808	.297	-.053	-2.724	.006
	Reading practices	1.022	.449	.047	2.274	.023
	Academic self concept	3.615	.445	.125	8.120	.000
3	(Constant)	41.509	1.420		29.230	.000
	SES	1.561	.165	.147	9.473	.000
	Prior achievement	12.186	.417	.513	29.257	.000
	sex	4.154	.635	.099	6.540	.000
	bookown	-.859	.296	-.056	-2.902	.004
	Reading practices	.919	.448	.042	2.052	.040
	Academic self concept	3.727	.440	.129	8.472	.000
	Maori	-4.374	.872	-.076	-5.019	.000
	Pacifica	-3.973	1.495	-.041	-2.658	.008
	Asian	9.099	1.567	.085	5.807	.000

a. Dependent Variable: scmath

Baseline coefficients	**Maori**	**-12.607 ****	**effect size**	**-0.61**
	Pasifika	**-19.340 ****		**-0.96**
	Asian	**2.436 ^{ns}**		**0.16**

Mean	**54.42**
Standard deviation	**20.83**
N	**2633**

R^2	**Baseline**	**0.08**
	Model 1	**0.41**
	Model 2	**0.43**
	Model 3	**0.45**

Model 3 effect sizes for ethnic group membership (coefficient divided by the standard deviation):

Maori	-0.21
Pasifika	-0.19
Asian	0.44

A2.3 School Certificate Science exam results.

Regression coefficients from the Science exam - n = 2669

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	45.390	.820		55.334	.000
	SES	1.049	.138	.117	7.585	.000
	Prior achievement	12.247	.312	.606	39.259	.000
2	(Constant)	46.015	1.144		40.218	.000
	SES	1.024	.137	.114	7.453	.000
	Prior achievement	11.185	.348	.553	32.154	.000
	sex	.254	.547	.007	.465	.642
	bookown	-.206	.252	-.016	-.819	.413
	Reading practices	.839	.382	.046	2.193	.028
	Academic self concept	2.873	.365	.121	7.863	.000
3	(Constant)	48.849	1.195		40.879	.000
	SES	.816	.137	.091	5.953	.000
	Prior achievement	10.661	.354	.528	30.131	.000
	sex	.214	.538	.006	.397	.691
	bookown	-.365	.250	-.028	-1.461	.144
	Reading practices	.938	.380	.051	2.467	.014
	Academic self concept	3.043	.360	.128	8.457	.000
	Maori	-5.027	.739	-.102	-6.803	.000
	Pacifica	-7.036	1.247	-.085	-5.644	.000
	Asian	5.465	1.341	.059	4.074	.000

a. Dependent Variable: scscnc

Baseline coefficients	**Maori**	**-11.472 ****	**effect size**	**-0.64**
	Pasifika	**-19.545 ****		**-1.09**
	Asian	**0.274 ^{ns}**		**0.01**

Mean		**55.42**
Standard deviation		**17.90**
N		**2669**
R^2	**Baseline**	**0.10**
	Model 1	**0.42**
	Model 2	**0.44**
	Model 3	**0.46**

Model 3 effect sizes for ethnic group membership (coefficient divided by the standard deviation):

Maori	-0.28
Pasifika	-0.39
Asian	0.30

Appendix 3: Explanatory variables within ethnic groups

A3.1 Interval factor scores (Reading practices, and academic self concept).

Correlation coefficients with English, Maths and Science within ethnic groups.

Factor	*Group*	*English*	*n*	*Maths*	*n*	*Science*	*n*
	Pakeha	**.37**	2280	**.24**	2025	**.30**	2061
Reading	Maori	**.35**	540	**.16**	434	**.30**	437
Practices	Pasifika	**.29**	183	.07	140	.03	143
	Asian	.15	122	.17	114	*.22*	112
	Pakeha	**.29**	2308	**.33**	2050	**.34**	2087
Academic	Maori	**.26**	551	**.19**	438	**.20**	446
Self-	Pasifika	**.25**	187	*.20*	142	**.23**	147
concept	Asian	**.40**	123	**.30**	116	**.36**	113

A3.2 Mean exam marks, by sex, within ethnic groups.

Group	*Group*	*English*	*n*	*Maths*	*n*	*Science*	*n*
Pakeha	Female	**58.0**	1317	**53.2**	1094	**56.8**	1142
	Male	**53.6**	1445	**59.4**	1332	**57.9**	1340
Maori	Female	**49.5**	384	**41.8**	296	**44.8**	280
	Male	**45.5**	305	**47.6**	239	**47.2**	253
Pasifika	Female	**43.4**	146	**36.5**	106	**38.0**	107
	Male	**37.1**	132	**36.9**	103	**39.0**	98
Asian	Female	**55.2**	70	**55.0**	68	**56.9**	69
	Male	**48.4**	82	**58.1**	79	**58.2**	74

A3.3 Mean exam marks, by books in the home, within ethnic groups.

Group	*N*	*Number of books in the home*									
		0-5	n	6-10	n	11-20	n	21-50	n	>50	n
English											
Pakeha	2307	**49.8**	260	**53.1**	237	**54.5**	399	**58.8**	658	**58.4**	753
Maori	550	**43.3**	111	**46.0**	81	**46.5**	104	**51.3**	130	**49.8**	124
Pasifika	184	**38.4**	53	**43.5**	32	**42.2**	32	**43.7**	35	**43.5**	32
Asian	124	**46.3**	24	**52.2**	23	**51.1**	10	**52.0**	29	**56.0**	38
Maths											
Pakeha	2049	**50.8**	212	**54.5**	206	**55.4**	358	**58.0**	606	**60.0**	667
Maori	439	**42.8**	86	**42.0**	68	**41.7**	70	**46.0**	115	**47.6**	100
Pasifika	141	**37.3**	42	**35.8**	28	**44.0**	21	**39.0**	27	**37.3**	23
Asian	117	**51.7**	21	**59.9**	24	**54.4**	11	**56.8**	24	**64.8**	37
Science											
Pakeha	2086	**51.2**	217	**55.4**	213	**56.1**	365	**59.7**	602	**60.5**	689
Maori	444	**42.2**	88	**42.2**	67	**44.5**	77	**49.1**	118	**49.9**	94
Pasifika	144	**38.8**	36	**39.3**	23	**38.4**	29	**41.5**	28	**35.3**	28
Asian	114	**49.8**	23	**61.3**	20	**63.3**	9	**56.9**	26	**61.6**	36