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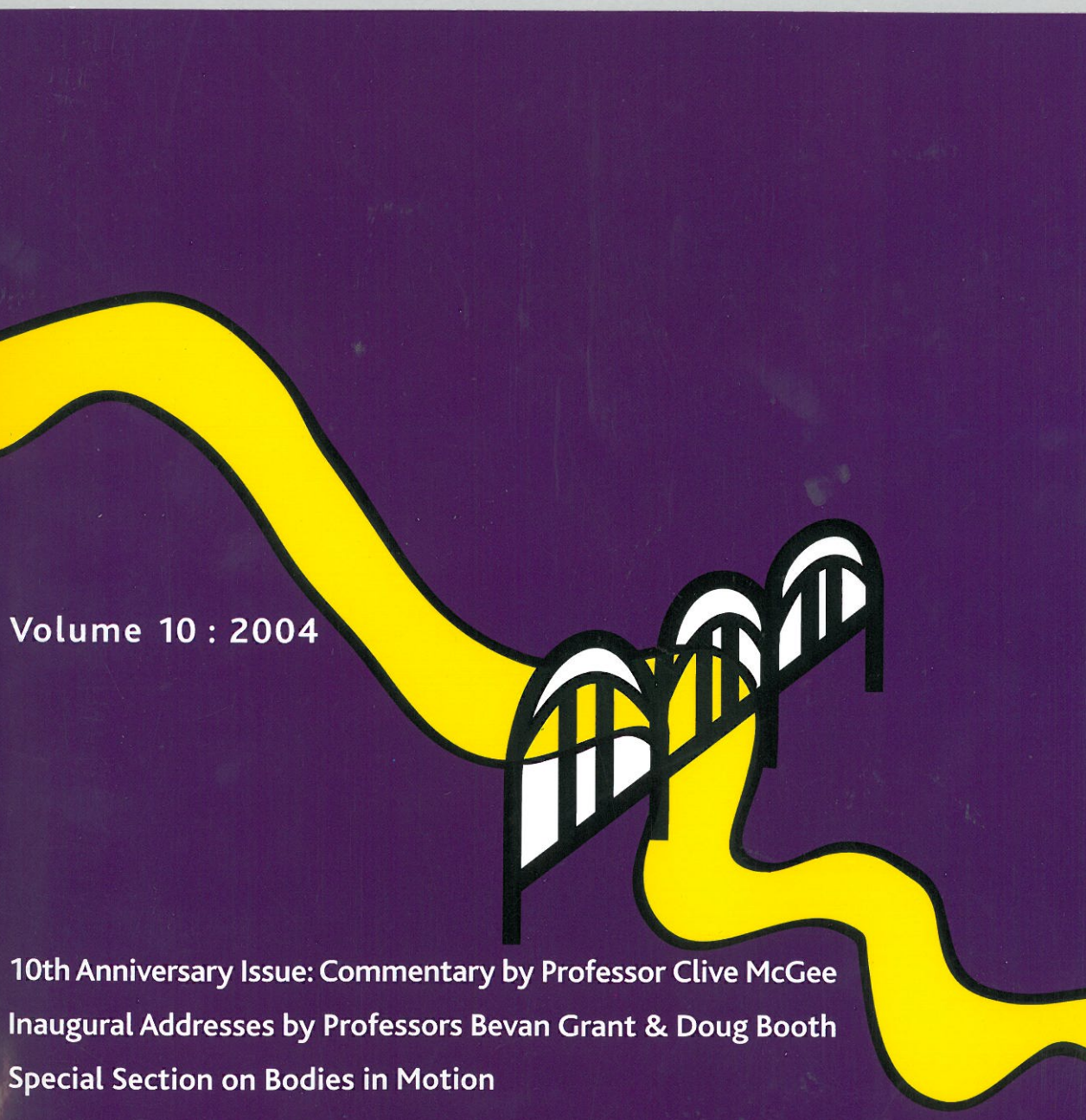

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THE EXPLANATION OF SOCIAL DIFFERENCES IN READING ATTAINMENT: AN INSPECTION OF THE PIRLS NEW ZEALAND DATA

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ABSTRACT *The newly released PIRLS data allow secondary analyses of group disparities in reading attainment to be conducted with a representative national sample of 10-year-old students. It is found that reading attainment is markedly associated with social class and ethnic origin. A standard regression model suggests that the most powerful indicators are those pointing to the family rather than the school. The argument is, however, critical of the positivist assumptions of statistical modelling and gives considerable space to a discussion of how such empirical findings can contribute to a realist explanation of social differences in reading.*

INTRODUCTION

The explanation of group differences in educational attainment is by no means the straightforward matter many advocates of social justice, rightly concerned with such apparent inequalities, often appear to believe is the case. What practices, by what people, in what social organizations, make what contribution to the variance in educational attainment associated with social class and ethnic origin? How do the actions of parents, with different financial, intellectual, and social resources; of teachers, in schools variously staffed and equipped; and of students, with their different abilities and interests, come to "make the difference" (Connell, Ashenden, Kessler & Dowsett, 1982)? Realistic answers to these questions are fundamental to the development and implementation of policies designed to eliminate social disparities in educational attainment. But in order to answer these questions it is necessary to provide an explanation of this inequality/difference with a set of methods able to describe the effective mechanisms of its generation (Nash, forthcoming). The emphasis in this paper is thus placed on *explanation* rather than on *theory*, for this is a field in which there are more bad theories than good explanations, and as this remark is likely to be provocative it will be useful to review briefly the nature of the difficulties involved.

Many respected theories of social disparity in education are, in fact, empty of content by virtue of being circular. Mainstream sociology of education is actually founded on Coleman's (1983) assumption that inequality of educational opportunity is demonstrated by the existence of social disparities in educational attainment. Coleman always accepted that children entered school with effective cognitive and non-cognitive abilities developed differentially in variable family environments, but maintained as a matter of principle that educational systems have the capacity – given a level of provision he admitted would never be realized in the US – to achieve similar results for students of all social and cultural origins, and supported on those grounds the doctrine of equality of educational opportunity. Coleman, an advocate for social equality and a well-informed

sociologist, struggled to reconcile his optimistic faith in the democratic potential of the educational system with his pessimistic assessment of the likelihood, in a society based on the unequal distribution of productive capital, of the collective political will to make real equality possible. But Coleman gives us the thesis that inequality of educational opportunity (actually provision) is a concept to be measured by the extent to which equality of educational opportunity (actually outcome) is demonstrated to be the case (Nash, 2004).

The circularity of this conventional argument, however, has long been a source of confusion. It will not do to declare, for example, as has become commonplace in New Zealand, that the educational system fails Maori students because Maori students fail in the educational system, and to suppose that this is actually an explanation of why Maori students do fail. Yet a group of "medical colleagues" (Mills *et al.*, 2004) defending Maori student quotas in a letter to the editor of the *Dominion Post,* allow themselves to argue that, "the quota system … compensates, to some extent, for the education system's failure to serve the needs of Maori students, as demonstrated by overall lower academic success rates of Maori in school". In other words, Maori students have a lower success rate in the educational system because the educational system fails to meet their needs, which is proved by the fact that Maori students have a lower success rate. Imagine arguing in a medical school that people get sick because they are bewitched, and that we know they are bewitched because they are sick. It seems needless to labour the point, and students have no difficulty in recognising this example, but circular arguments are not always so easy to detect. It is little more than a tautology to say that the educational system fails Maori students because Maori students fail in the educational system. One might as well say that a house leaks because it lets in water. What a builder wants to know is how the water gets in and how to fix it. This theory, that the educational system fails Maori students, if it implies that the effective mechanisms are located within its formal organizations, might mean, for example, that the school offers an unsuitable curriculum, uses ineffective teaching methods, and adopts inappropriate evaluation practices, and it is important to discover which of these are the most important. It is even more important to discover whether there is anything in the theory at all. A non-tautological theory of social disparity in education requires an analysis of the educational system that will show where the "holes" are and suggest a way to repair them.

The question that has been posed – what actions by what agents at what sites generate inequality/difference? – is one that calls for a quantified explanatory narrative. The answer must have the form: if parents do this, and teachers do that, then, under these conditions, the following consequences are, to this extent, likely to follow. And so this core problem for the sociology of education requires an explanation that might be enhanced, to put the matter no more forcefully, by quantitative methods. Statistical modeling, however, is a highly technical business and operates within a framework of ideas about the nature of social reality and the conduct of science that many educationists find deeply problematic and should, in fact, not be taken for granted (King, 1986).

This paper may, therefore, be found unusual in its approach. It argues, but within a realist theory critical of the positivist assumptions normalized in the discourse of statistics, that quantitative modeling is an essential tool of research into the origins of social differences in educational attainment. The goal of scientific realism is to explain the causes of social events, the operation of processes, and the origins of states of affairs, by discovering the effective mechanisms of social causality in the emergent properties of social organizations,

the social dispositions of agents, and the practices they adopt (Bunge, 1998). The argument is addressed not so much to those familiar with statistical analyses as to those who are skeptical of their value and substance in the explanation of social and cultural disparities in educational attainment.

What can be learned about the differences between students from middle-class and working-class students, and between European and Maori students, from statistical models? There are now several extensive public datasets that offer an opportunity to answer that question, insofar as it can be answered, at virtually no cost. The following analyses use the recently released PIRLS (Progress in International Reading Literacy Study) dataset for New Zealand.

A FIRST LOOK AT PIRLS

The PIRLS was carried out in 35 countries, including New Zealand, by the IEA (International Association for the Evaluation of Educational Achievement) in 2001 (Gonzalez & Kennedy, 2003). It provides information on the reading attainments of a nationally representative sample of students aged about 10 years. The study is particularly useful because the data, collected from students, teachers, principals, and parents by questionnaires, are freely available for secondary analysis. The New Zealand dataset includes 2504 students in 172 schools. Students were tested in complete classes, but there are often very few students with the same class identification, particularly in low decile schools, and this may largely be due to the exclusion of students with little understanding of English. There are only 6 classes in decile 1-3 schools, compared with 19 in decile 8-10, with 20 or more students. Attainment in reading was assessed using instruments in separate blocks designed to cover several domains of reading literacy, and a number of values are provided for analysis. The most appropriate score for the purposes of the study reported here, which does not involve international comparisons, is the "average score on all blocks" (PIRLS variable *asrearsc*). This nominal mean and standard deviation of this score are, respectively, 150 and 10: the actual New Zealand values are 150.1 and 9.3.

Our interest is in social and ethnic differences. Some basic data on the relationship between reading attainment and household income are presented in Table 1.

Table 1. Reading Attainment, Household Income and Ethnic Origin

	European		Maori		Pasifika	
Household income, $000s	Reading Mean	N.	Reading Mean	N.	Reading Mean	N.
55+	154.7	616	148.6	105	151.4	27
45-54	152.8	146	147.5	45	148.8	9
35-44	151.6	153	146.4	59	147.4	19
25-34	150.7	128	142.5	60	146.0	22
15-24	150.6	112	144.9	67	145.2	20
-15	146.7	45	143.6	45	144.1	18
Total	152.7	1201	145.9	381	146.1	171

The overall difference between European and Maori students is 6.8 score points, nominally 0.68 standard deviations (s.d.), but actually 0.73 s.d. Household income, from the parent questionnaire, is probably the best of the indicators available for this purpose, but it should be noted that 18.7% of parents did not respond to the questionnaire and that the mean scores of their children are below average; European 149.8 (n. 211), and Maori 141.3 (n. 155). There is some evidence that low-income families were less likely to respond than high-income families (an index of family wealth can be constructed from students' responses to questions about possessions in the home and 21.4% of those in the lowest fifth of this scale, compared with 17.6% in the highest fifth, were from non-response homes), and what this indicates about these families' level of engagement with the educational system can only be a matter of speculation.

Reading scores are associated with household income in all ethnic groups but it is readily apparent that within each income category the scores of European students are always higher than those of Maori and Pasifika students. Maori students from households earning $35-44,999 have scores equal to those of European students from households earning less than $15,000. The reasons for this disparity are not self-evident and, outside the nominalist conventions of statistical modelling, are not explained by ethnicity.

Reading attainment is associated not only with household income but also with the Ministry of Education's school TFEA (Targeted Funding for Educational Achievement) decile ranking. This could hardly be otherwise, of course, as measure of household income in a district is included in the formula used to allocate school decile. There is considerable interest in the performance of students in high and low ranked schools, particularly as Maori and Pasifika students with poor attainments tend to be concentrated in low decile institutions. Coleman suggests that this is evidence itself of the fact that these schools do not provide equality of educational opportunity and it seems almost natural then to argue, although he did not, that the causes must lie in the schools (Taskforce for Improving Participation in Tertiary Education, 1999). It is for this reason that Table 2 includes the proportion of students reported by their parents to live in homes with more than 100 children's books. It may be that students at low and high decile schools are dissimilar in respect of certain properties of their families as well as the schools they attend.

Table 2. Reading Attainment, School Decile and Ethnic Group

	European			Maori			Pasifika		
School Decile	Reading Mean	N.	% More than 100 children's books	Reading Mean	N.	% More than 100 children's books	Reading Mean	N.	% More than 100 children's books
1-3	148.6	227	34	143.1	390	13	144.2	87	10
4-7	151.6	611	37	146.8	124	16	147.8	60	18
8-10	154.2	682	50	158.3	50	43	148.9	24	19
Total	152.3	1550	42	144.8	564	17	146.1	171	14

Table 2 shows that students from all origins do have a higher mean reading score when they attend high decile schools. The information reveals that 14.6% of European students are in low decile schools and that 44% are in high decile schools. The comparative figures for Maori (and Pasifika) students are: 69% (50.9%) in low decile schools, and 8.9% (14.0%) in high decile schools. Maori and Pasifika students usually perform less well than European students even when they attend schools in the same decile group. Table 2 also indicates, however, that students from different ethnic origins at low decile schools are not from families with similar levels of educational resources. The proportion of European students at low decile schools from homes with more than 100 children's books is two or three times higher than that of Maori students. This is a matter that should perhaps be taken into account in any analysis of the causes of disparities between students of different social class and ethnic origin. It is particularly interesting in this respect to note that Maori students at high decile schools actually have a higher mean reading score than their European counterparts and are also from homes with more children's books than Maori students at other schools. Here is clear evidence, should it be needed, that students attending high and low decile schools are not identical, even within ethnic groups, with respect to the literacy resources of their homes. These facts may seem unremarkable, they are mentioned here only because they counter the thesis that low decile schools are particularly to open to criticism for their failure to generate results equal to those of high decile schools, and nothing more than that hangs on the argument. It seems more than likely that students from homes that give particular attention to the early development of literacy will enter school with basic skills that will provide a foundation for subsequent progress. The evidence presented from the PIRLS dataset suggests that this is so.

The majority of parents appear to be satisfied with their children's literacy-related abilities when they entered school. Analysis of a parental estimate of children's early literacy skills reveals that 9% had "no skills at all"; 29% had skills "not very well developed"; 40% had "moderately well developed" skills, and 22% had "very well developed" skills. These estimates, based on responses to a brief item set, and made with respect to abilities five years in the past, should not be treated as if they were derived from standardised test scores administered at age 5, but the data do provide an opportunity to explore the contexts of progress at school that may be worth pursuing. Table 3 indicates that students who enter school with good literacy skills do tend to make more progress in reading than those who do not. The mean reading score of all students estimated to have good skills (151.8) is significantly higher than those with poor skills (149.3). The relationship is similar for European and Maori students, and it should be noted that implied levels of relative progress or decline associated with early learning skills are much the same in low and high decile schools. The small cell sizes for Maori students in decile 8-10 schools suggest that these data must be treated with caution.

Table 3. Reading Attainment and Early Learning Skills

	Good	Skills			Poor	Skills			All	
	European		Maori		European		Maori		European	Maori
School Decile	Reading Mean	N.	Reading Mean	N.	Reading Mean	N.	Reading Mean	N.	Reading Mean	Reading Mean
1-3	150.5	122	145.3	181	146.6	66	142.2	112	143.1	148.6
4-7	153.0	336	148.5	57	150.0	204	146.1	34	146.8	151.6
8-10	155.3	359	156.5	29	153.2	246	148.8	13	153.3	154.2
Total	153.6	817	147.2	267	151.1	516	143.6	159	1333	426

Note: A parental estimate of children's early learning skills is grouped into two sets: "Good Skills" includes those in the "very well" and "moderately well" developed skills category, and "Poor Skills" includes those in the "not very well" developed and "no skills all" categories.

These tables have an important function in setting the scene. They cannot, of course, provide much information about the interaction between the several variables involved, and it is here that statistical models make their special contribution. Is there anything to be learned, for example, about the reasons for the ethnic differences in attainment within income categories? The following section presents a regression model of the type developed to answer such questions.

A REGRESSION MODEL OF READING ATTAINMENT

The variables in the model are derived from the PIRLS dataset and are fully described in the user manual (IEA, 2003): they are all constructed from questionnaire responses made by parents, students, teachers, and principals. The names of the PIRLS variables are given in order that interested readers may replicate the analyses. Variables have been entered as blocks in an order guided by the theoretical interests of the analysis. Block 1 estimates the material resources of households, Block 2 reflects family literate resources and practices, Block 3 estimates the attitudes to reading and reading self-concepts of students, and Block 4 is an aggregate variable being the mean reading score of the class. It will be necessary to give a brief account of the variables included in these blocks.

Block 1 is a principal component factor score expressing the common variance of five indicators of material resources in students' homes: household income, self-rated on a six-point scale (PIRLS variable *asbhincm*); whether the family is well-off relative to others (*asbhwell*); highest level of parental education (*asdhedup*); father's socio-economic status (all from the parent questionnaire); and an index of home possessions (*asdgps*), from the student questionnaire. Socio-economic status was constructed from the PIRLS variable (*asbhmjf*) which gives father's occupation in 11 broad categories of occupation, including never worked outside the home for pay (*asbhmjf*), and these categories have been recoded, as closely as possible, to the Elley-Irving socio-economic index (Elley & Irving, 2003).

Block 2 is a principal component factor score from parents' attitude to reading (*asdhpatr*); the number of children's books reported by parents (*asbhchbk*); an index of children's early home literacy activities, constructed from parents' responses to

questions about such practices as reading books, telling stories, singing songs, and playing word games (*asdhhla*); and the number of books in the home reported by students (*asbgps3*).

Block 3 is a principal component factor score from an estimate of parents' estimate of literacy abilities at school entry (*asdhabi*); students' attitude to reading (*asdgsatr*); and students' reading self-concept (*asdgself*).

Block 4 contains the aggregate mean reading score for each class. Variables of this kind are frequently used to indicate a collective property of a level within an institution, such as a class, and have become essential in the quantitative analysis of composition or "mix" effects.

Indicator variables for Maori and Pasifika ethnic identity, from a designation made by the school, were provided by the New Zealand Ministry of Education. A dummy variable to indicate non-response to the parental questionnaire was also constructed. There is likely to be something in common about families that chose not reply to the PIRLS questionnaire: their children certainly have lower reading scores, 146.1 compared with the 151.0 observed for those with more co-operative parents, and the thought that non-response hints at a sense of disaffection with the educational system seems reasonable.

The theoretical assumptions of the model should be made explicit. It is argued that families are located in the class structure; that as a consequence they possess different material and symbolic resources; that these resources are used to support literate practices to different levels; and that the immediate effective causes of social disparity in education should be sought at this level. The model also assumes that ethnic origin may be linked to practices, not entirely captured by indicators of social class, which facilitate educational success. The effect found to be associated with aggregate reading score is subject to discussion.

A Regression Model of the Sources of Variation in PIRLS Reading Attainment

Block 1
Principal component score factor from:

- Parents' highest educational level
- Father's socio-economic status
- Household income
- Index of home possessions
- Well-off family financially

Multiple correlation .342, Adjusted R Square .116

Block 2
Principal component score extracted from:

- Parents' attitude to reading
- Number of books in home (student estimate)
- Number of children's books in home
- Index of early home literacy activities

Multiple correlation .458, Adjusted R Square .208

Block 3
Principal component score extracted from:

Parents' estimate of child's early literacy skills
Index of student's attitude to reading
Index of student's reading self-concept

Multiple correlation .536, Adjusted R Square .288

Block 4
Aggregate class reading score

Multiple Correlation .673, Adjusted R Square .452

The adjusted R squared statistic for the full model is .452 and thus accounts for 45% of the variance in the PIRLS reading scores. The addition of a dummy variable to indicate Maori ethnic status has a non-significant effect. Adding Pasifika ethnic status generates a very minor effect (significant at the 0.05 level), raising the multiple correlation (MR) to .674 and the adjusted R Squared statistic (ARS) to .453. It is interesting to note that a dummy variable to indicate non-response to the parent questionnaire also has a significant effect: MR .682 (ARS .463).

The model supports the assumptions on which it is based. The amount of variance explained rises steadily as the blocks are entered successively. Almost 12% of the variance is accounted for by material properties of the family, a further significant proportion by indicators of parents' reading, and an almost equal amount, making a total of 29%, by students' own interest in reading. Aggregate class reading score adds a further significant amount to the multiple correlation, bringing the total proportion of variance accounted for to about half. Many commentators are unconvinced by the results of quantitative modelling and it may be useful to defend the findings reported here and the substantive interpretation offered.

TEACHERS' EXPECTATIONS AND RELATED THEORIES

The significant composition effect associated with aggregate reading score merits some discussion. This variable is associated with school decile (correlation .315). It is also associated with several other variables derived from principals' responses, notably the percentage of disadvantaged students enrolled (-.543), an index of school climate (-.396), and an index of school safety (-.336). The percentage of disadvantaged pupils is an indicator that points, by definition to an aggregate property of the school, but whether it points to generative practices located in the institution or elsewhere is by no means established. "School climate", for example, is not necessarily an emergent property of the school, but may point to characteristics of the locality it serves. A deep faith in nominalism is required to accept that a variable "measures" the concept it names. And an equally deep faith in positivism is required to accept that an independent variable is, therefore, a cause of any effects associated with it. As the PIRLS data are not longitudinal there is nothing to suggest that this variable is associated with students' relative progress and in that sense it should not be regarded as evidence of a composition effect in the accepted sense. Nevertheless, somewhere, at home, at school, or in the peer group, something is going on in such a way that inequality/difference is generated in contexts pointed to by such indicators. In a model of this kind, an aggregate attainment variable, in effect, introduces an indicator of ability and

accounts for much of the variance that would be allocated to prior ability were such an indicator available. If each student in the class has the average score of the whole class, then the more homogenous the class is in this respect the more will that score predict the academic performance of individual students and act as a proxy for prior ability. The generative mechanisms, therefore, may not lie predominantly in the school, and theories that suppose that students attending low decile schools are affected by teachers' low expectations in such a way that they become disaffected and reluctant to learn, are not supported by the PIRLS evidence.

Most students of this age appear to be content with their experience at school. The responses to items designed to tap students' perceptions of the school environment and teachers' attitudes towards them are given overwhelming endorsement. The percentages of European (and Maori) students who answer "a lot" (the highest on a four point scale) to some key items will support this statement: *I feel safe when I am at school*, 60% (67%); *I like being in school*, 42% (60%); *I think that teachers in my school care about me*, 61% (66%); and *I think that teachers in my school want students to work hard*, 91% (87%). It is worth noting, perhaps, that students in low decile 1-3 schools are rather more prone than others to indicate that they *like being in school*, 52% (64%) compared with 40% (60%) in high decile schools, and agree that *teachers in my school care about me*, 67% (68%) in low decile schools, compared with 62% (62%) in high decile schools. These findings suggest that primary school students, both European and Maori, are generally happy at school and, if anything, rather more so at low decile schools than at high decile schools. It would be difficult to interpret these results as evidence in support of the hypothesis that teachers' in low decile schools hold poor expectations for their students whether they are Maori or non-Maori.

This interpretation appears to be supported by an analysis of teachers' own expectations, which seem generally high. When asked how many students in the target class they expected to grow up to be good readers, more than half checked the response "all or almost all" and fewer than 10% indicated that it might be "about half" or "less than half". Teachers in low decile schools may be somewhat more likely to hold lower expectations: in low decile schools (21%) of students are taught by teachers with lower expectations than those in high decile schools (3%), and there is a tendency for more Maori (16%) than European students (8%) to be in classes where teachers express lower expectations. Nevertheless, it should be pointed out that half of all students in low decile schools, and 51% of all Maori students, are taught in classes where teachers believe that "all or almost all" students can become good readers, and it seems implausible to suppose on the basis of the evidence that this characteristic of teachers can have a large independent effect on student attainment. There are so few PIRLS students in some "classes" that one could not, in any case, assume that those a teacher with "low expectations" believes are unlikely to become average readers were even included in the PIRLS assessment. In some classes it must be supposed that most students have been excluded: new learners of English are necessarily excluded, as are those simply absent, but in some cases, particularly as school inclusion is standard practice, their non-participation may actually be for reason of intellectual disability.

READING ATTAINMENT AND ETHNIC ORIGIN

An indicator of ethnic origin points to a nominal category that signifies aspects of an individual's being that, if they are to have effects on educational attainment, must be considered as a direct or indirect source of material and symbolic provisions. As a consequence of their ethnic origin people must hold resources, maintain dispositions, and adopt practices that affect their educational attainment in ways that contribute to the variance associated with the categorical indicator. The paradigm case is provided by the active discrimination of the educational system against students because of their racial or ethnic origin. The theory that teachers hold low expectations for Maori students, that the school does not recognize the "oral culture" of Maori communities, that Maori students are disadvantaged by the competitive individualism of the school, are all theories of this kind. But if it is argued that Maori students enter schools with the levels of literacy that might be expected, more or less, given their social class position, there is no reason to suppose that resources and practices associated other than contingently with ethnicity are the cause. It is one thing to concede that Maori are, disproportionately and unjustly, located in the working-class as a consequence of historical racism, and quite another to argue that, consequently, practices common to a class and supported by class resources should be defined as ethnic practices. Nothing substantive about the nature of a practice and its effects is in any respect changed by such a manoeuvre. The most convincing way to show that the relative underachievement of Maori students has its origins in the structures of the educational system would be to demonstrate that an alternative system, or significant modifications of practice within the existing system, would effect a marked improvement in their level of attainment.

The difference between European and Maori mean reading scores of .75 standard deviations (s.d.) is reduced to .37 s.d., when the statistical effect of variables in a model including Blocks 1-3 are taken into account. This does not mean, of course, that ethnic origin is responsible for the proportion that remains, and it is clear that there are other matters to be considered.

The logic involved in analyses of this kind, which are standard in the literature, is rarely defended (Fergusson, Lloyd & Harwood, 1991). It is assumed that practices associated with social class are equally likely to be adopted by European and Maori families with the same position, but that is more often than not proved unfounded when put to the test. Social class does not account for all the variance in reading scores observed between ethnic groups and, therefore, it is tempting to argue that the residual must be due to ethnicity. The fact is, however, that European and Maori families differ within class categories in ways likely to have a causal connection with children's reading attainment. It is significant, for example, that when manual working-class European and Maori fathers respond to the statement *I only read if I have to* only 15% of the former but 41% of the latter indicate their agreement. This disparity is an ethnic effect by definition, but that it can be regarded as an expression of Maori culture is open to dispute, and it certainly does not suggest that any possible effects of this difference on attainment lie outside the home. It is also relevant to note, when considering the possibility of selective bias, that these responses were available in respect of 83% of European and only 54% of Maori students.

The disparity between the reading scores of European and Maori students is actually higher for the 10-year-olds in PIRLS study than for the 15-year-olds in the PISA study (OECD, 2001). The standard deviation gap is, respectively, 0.75 and

0.66 (using the PISA Warm estimate), and this does not support the hypothesis that a progressive disaffection with school is responsible for a progressive decline in the educational attainments of Maori students relative to that of European students. On the contrary, there appears to be no such decline, and it may be supposed on this evidence, although it is not really enough to support such a conclusion, that Maori students actually improve their position at secondary school.

EXPLANATIONS, MODELS AND CORRELATIONS

An explanation provides an answer to a question about why some event took place, why some process occurs, or why some state of affairs is the case, by revealing the mechanisms that made it happen, caused it to occur, or brought it into being. A model is an explanatory tool in as much that it simplifies, actually or conceptually, an aspect of reality and its conditions of being that need to be known (Harré, 2002). A computer model of the effects of a 10-metre flood on a river plain thus explains why in an actual flood the water will reach a certain point on the ground. A statistical model explains insofar as it reflects the reality it is designed to represent and the accuracy of that match can only be made, therefore, given an adequate knowledge of what is actually the case. This is important: because a model explains in as much as it reflects the reality it simulates, it follows that knowledge of that reality, independent of the model, is necessary to its interpretation. Statistical models in education are almost never tested in this way, and the question of what kind of explanation they give, if any at all, can be a little embarrassing. The form of explanation provided by statistical models, although taken-for-granted in the standard literature, is therefore worth some reflection (Gasper, 1990).

A scientific model of the most powerful kind is designed to provide estimates of the discrete contribution made by specific properties of the world that affect processes under investigation in a controlled environment (Wartofsky, 1979). A turbine propeller can be scaled down, placed in a wind tunnel, and its energy generation plotted as the effects of changes in pitch, wind speed, and so on, are systematically tested. Statistical models in educational research can be considered to have this general form. An input-output model, able to predict, for example, the gain in student achievement resulting from a given change in teacher salaries, when other variables are controlled, would appear to offer policymakers a valuable instrument of management. Models of this type are explanatory in as much that if the system does behave in the way predicted (if an increase in teacher salaries is followed by a gain in reading scores), then it can be argued that the assumptions on which they are based are correct. If the social world is a closed system, as the model is by definition, then the explanation will be correct, but if the social world is an open system, which is actually so, then the information provided by the model is not determinate and may even be irrelevant (Byrne, 1998).

This means that an investigation into what is the case, attained by means of a model, may provide an explanation that is correct in the conditions that exist, but not necessarily correct for other possible conditions. If it is so, for example, that a given level of verbal stimulation is necessary to the development of the capacity to generate grammatical sentences in a natural language, then severe linguistic deprivation, of the kind suffered, for example, by many of the Romanian orphans adopted by British families in the early 1990s, will be a cause of differences in educational attainment if, as a consequence of this relative incapacity, they are

unable to equal the attainments of those whose development has taken place in more favourable environments (O'Connor et al., 2000). It is obvious that if these conditions are not present they cannot be a cause of differential attainment. Moreover, if the educational system is so efficient that differences in linguistic capacities present on entry to school are prevented from affecting attainment, this source of variation will not exist. Now suppose, with Coleman, that the educational system does have such powers and, for one reason or another, fails to realise them. In this situation it can be said that the origin of social disparities is not the simple presence of certain effective causal conditions but of systems that allow them, or their consequences, to exist. This is actually the stance taken by almost all sociological theories of social disparity in education. Bourdieu, for example, thus condemns the School's "neglect" of working-class students, with an "inferior" *habitus*, and, in one form or another, this theory is widely accepted (Bourdieu, 2000). The argument, however, rests on the assumption that such institutional power does exist, and only demonstration on an adequate scale, which has never been forthcoming from any educational system, can provide the necessary evidence.

The question of whether, in the conditions that exist at a given time in a given system, observed social disparities in educational attainment arise, to some extent at least, outside the educational system is, therefore, to be distinguished from the question of whether the system has, or shall be deemed to have, the power to overcome those conditions. What is the case, in this respect, moreover, is by no means easily established. That is to say, even were it agreed that school and non-school social organizations – their structural properties and institutional practices – have causal powers of this kind, the task of weighing their separate effects is not a purely technical matter. Even to maintain, for example, that practices within the home might be a greater source of class variation in educational attainment than practices within the school, is at least to imply that there is a method by which such information can be obtained. Such a method is quantitative simply by virtue of this definition, and yet, as standard techniques of statistical modelling are unable to provide definitive answers to what the social world is like, it will always be necessary to interpret quantitative evidence in the light of what we know of the way families live, schools educate, and students behave.

Whether or not a correlation indicates a purely contingent relationship between indicators or one of causality, with a certain direction, is always a matter for theory. There are, for example, modest but statistically significant negative correlations in the PIRLS dataset between reading attainment and several variables including class size, attendance at reading practice seminars, and teachers' expectations of the proportion of students likely to succeed in reading. Should one take this as evidence that small classes and participation in professional training are a cause of low reading attainment? It seems more plausible to suppose that students in need of most help are grouped in smaller classes and that their teachers are more likely to engage in related study. But what of the association between teachers' low expectations and students' poor reading attainment? Are low expectations the cause of poor reading? Or is this correlation a reflection of the fact that some poor readers cannot, in any sound professional judgement, be expected to become average readers? These questions cannot be answered by statistical analysis using data from a non-longitudinal dataset.

All models that must rely on data obtained at one point, with no longitudinal measures of attainment, face a difficult problem. The correlations between indicators, which are the basis of the entire analysis, can be arranged into patterns

of infinite variety. If a critic declares that the observed differences in literate competencies possessed by students as they enter school need have no durable effects on educational attainment, that such relative abilities that do exist are widened and stabilized by teachers' expectations, and insists, moreover, that ethnic disparities are evidence of institutional racism in the forms of the curriculum, pedagogy, and modes of evaluation, then that thesis should be subjected to empirical test. If something more than lip service is to be paid to "evidence-based research", then that Popperian advice must be followed. The model derived from the PIRLS data is not consistent with such a theory, nor could a remotely plausible model be constructed that would lend support to such a theory, but it does not have the power to refute the possibility that the educational system operates in a way that the techniques of quantitative educational research are unable to capture.

CONCLUSION

The policy-driven interest in evidence-based research, as exemplified by Durie's (2001) studies of Maori health, tends to give broad recognition to the fact that the social world is not a closed system, and that knowledge of what a model represents is a necessary condition of being able to put it to good use. A statistical model requires considerable interpretation. One should resist the temptation to take sides in the struggle between quantitative and qualitative methodologists. Some researchers, often influenced by critical theory, reject all forms of statistical analysis as inherently positivist, determinist, and biased in favour of the *status quo*, and accordingly defend their preference for qualitative research methods. There also are quite as many who dismiss any investigation unsupported by quantitative analysis, or presented outside the conventions of statistical explanation, as generally worthless. The debate between quantitative and qualitative methods in these terms is located more on the terrain of politics rather than science: it is essential not to become sidetracked by such disputes.

Realist explanations, the nature of which this paper has attempted to describe, must have regard to quantitative information when it is relevant to the argument at stake, and should be prepared to make appropriate use of statistical models when there is something to be learned. What is to be learned, however, has to be extracted by a process of constructing *substantive* (rather than *statistical*) explanations. The realist objection is not so much against statistical modelling, but against the positivist interpretations conventionally supported by the language and traditions of this field. Where these positivist assumptions can be set aside, the analysis of quantitative data can make a useful contribution to a realist explanation of social differences in education, and may actually enhance the value of qualitative studies. A whole set of indicators in the PIRLS analysis, for example, point at literacy practices within the family and its community and this is an area about which nothing of any value can be known without fine-grained observational research. The extent of inequality/difference in PIRLS reading attainment, for example, is documented by tables that show an 8-point gap (0.8 s.d.) between European students from households in the highest and lowest income categories. The regression model provided attempts, of course, to explain not this "gap" but the overall variance in reading attainment, but as it is possible to show that a considerable proportion of that variance is associated with indicators of family resources and practices, and not much at all to definitive indicators of school resources and practices, there is a case that research might be directed at the

processes that might offer the greatest potential for remediation by the collective agency of communities, families, and schools. If we are looking for hole where the water gets in, to pick up this analogy, then there is little in the PIRLS data to suggest that we will find it in the school fabric.

How can one suppress an immediate sympathy with the thought that it should be no great matter to construct a sound explanation of the processes that generate social and cultural disparities in educational attainment? And yet this sentiment *should* be suppressed. The entire problem is much more difficult than it appears. The common sense view that inequality of educational opportunity is the result of various practices at home, at school, and in the community, which depend on the application of unequally distributed financial, social, and cultural resources, is almost certainly correct. But this knowledge is not as much help as it should be. The various processes are so complex that any formulaic attempt to express their nature is bound to be inadequate. This is why we have "list theories": the reality is so "chaotic" that the necessary multifaceted narrative of explanation is easily reduced to a kind of list in which the importance attributed to a "factor" process, is given, by quantitative researchers, whatever "weight" is technically allocated by a statistical model and, by qualitative researchers, whatever substance can be justified by field observations that support their theoretical position. If there must be list theories, then the statistical variety ought to be preferred to the latter, but there may be a more satisfactory to proceed. We have to progress, it is suggested, from ordinary common sense to an elaborated, systematic, theory of inequality/difference based on a family resource framework. The accounts produced within this structure will be supported by a "numbers and narratives" methodology, and advanced by theoretical concepts sufficiently robust to conduct the business of scientific enquiry.

All intellectual labour is motivated by a sense of dissatisfaction with the existing state of affairs. And this is an area where there is a lot to be dissatisfied with. There is hardly any need to mention a deep feeling of disquiet provoked by the now dominant explanations of Maori educational underachievement. But there are matters of a general and theoretical nature that need to be considered. Take just three of these more fundamental sources of dissatisfaction: no one should be satisfied with circular forms of argument; no one should be satisfied with the idea that a technical "explanation" of variance amounts to a substantive explanation in accordance with the tenets of nominalism; and, finally, no one should be satisfied with a critique that dismisses all statistical methods as the intrinsically flawed tools of a positivist science. It is perhaps because these dissatisfactions are so evenly balanced in this discussion that it may leave the impression of not knowing what side it is on. That would be unfortunate: let it be stated clearly, therefore, that it is on the side of developing a realist approach to inequality/difference with genuine explanatory power. This is as necessary in the specific field of reading as it is in any other, and the data provided by the PIRLS exercise should be subjected to the most powerful forms of analysis available and interrogated for their ability, although that might actually be quite limited, to contribute to a comprehensive explanation of the disparities they document.

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