

Competent Children: Findings and Issues from the first 7 years

Paper for Ministry of Social Policy seminar, *The Long Road to Knowledge: longitudinal research and social policy*

April 6–7, 2001.

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The Competent Children research project is funded by the Ministry of Education

Introduction

The Competent Children project focuses on a sample of Wellington region children who have been followed since 1993, when they were near five years-old, and attending early childhood education. The fieldwork team is currently gathering material as the children turn 12 from the children themselves, their parents, and their teachers. In this paper, I will describe the origins and purpose of the project, the nature of the sample and the data, and some of the findings and insights which have emerged from the project to date, in order to explore the value of taking a longitudinal approach in social research.

Origins and Purpose

Policy interest in the value of early childhood education played a significant role in the original funding of the Competent Children project. By the early 1990s, the majority of New Zealand children had attended some form of early childhood education by the time they reached school. While there was increasing overseas evidence that early childhood education could provide benefits for children that were evident after they had left early childhood education¹, there was then no New Zealand research on the continuing impact of early childhood education attendance.² The Ministry of Education was prepared to fund a team led by Anne Meade³ to embark on the first three stages of a longitudinal study, covering a pilot study, and then data collection at near age 5, and at age 6, after the children had finished their first year at school.

While the main focus of the study was on the role of early childhood education in children's lives, and, to a lesser extent, its role in their parents' lives, we did not think we would get a true picture by focusing solely on early childhood education alone, as much of the then available international research tended to do. We also needed information about the family resources available to children.

As we developed the study we grew more ambitious to include as much information as we could about children's actual experiences. We wanted to go beyond structural variables of early childhood education, such as the teacher: child ratio, or the proportion of trained staff in a centre, to the quality of experience offered, and, further, to whether individual children attending the same early childhood education centre had different patterns of experience there. We asked parents not only about the "usual suspect" characteristics which were likely to have a bearing on children's development, such as income, parental education and employment, but also about the children's involvement in activities at home, particularly those related to literacy and mathematics. As the children have grown older, we have increasingly asked them directly about their own experiences.

We had a number of reasons for pushing our data collection this far. First, we started with the assumption that development reflects experiences. This assumption is derived from educational theorists such as Vygotsky; it is also derived from Anne Meade's original discipline of sociology, and mine of social anthropology. Second, we wanted to provide parents, practitioners, and policymakers with insights that could be used to improve children's experiences and progress.

Our main research questions when we started were:

1. How does the nature and extent of young children's early childhood education experiences in the Wellington region produce short-, medium-, and long-term effects on what the children can do, and on their participation in education?

¹ This material is reviewed in Wylie (1994) *What research on early childhood education/care can, and can't tell policymakers*. Wellington: New Zealand Council for Educational Research.

² In 1994, material from the Christchurch Health & Development Study was published showing continued associations up to age 13 between length of early childhood education experience and cognitive ability, favouring children with more than 3 years early childhood education experience (Fergusson, D.M., Horwood, L.J., & Lynskey, M.T. (1994). A longitudinal study of early childhood education and subsequent academic achievement. *Australian Psychologist* 29(2), pp. 110-115.

³ Working with me and Anne Kerslake Hendricks

2. Can early childhood education experiences temper the influences of family backgrounds on children's competence?
3. What is it about the nature of different early childhood education experiences in the Wellington region which affects the development of children's competencies? Of these, which have the greatest or longest impact?
4. What effect do family characteristics have on the development of children's competencies?

We also included material on parental choice of early childhood education and schools, and patterns of parental contact with their child's early childhood education centre and later school. Relations between parents and educational institutions, including questions of the role played by family characteristics, were initially included to allow the sample for the Competent Children project to form a second cohort for the Ministry of Education funded 'Smithfield' longitudinal study of school choice, which was focused on the transition to secondary school. Thus a number of different policy-related questions have been included in the project from the beginning.

Measuring Outcomes

Outcome data in longitudinal studies are sometimes vexing for the user. The measures can seem very slight sometimes for the weight put on them, particularly if the measures are having to be construed from a sample designed for another purpose, or if the measures are inappropriate for the particular sample. Because most longitudinal studies are expected to provide quantitative data which lend themselves to statistical analysis, and therefore involve hundreds if not thousands of participants, the time taken to gather data on outcomes is probably always more limited than one would like in the ideal world. Considerations of time, meaning cost, play a significant part in the selection and quality of outcome measures, as well as information about the factors which may be shaping outcomes. One is always on the hunt for measures which are like the tips of icebergs, flagging something larger and deeper underneath.

Our pilot study was essential in providing the time to decide what outcomes for children should be included in the study, and how those outcomes could be measured. Much of the current international research used outcome data that was readily available from schools, such as student class grades, or marks on standardised school tests, usually limited to reading and mathematics. New Zealand did not have such measures. We wanted valid data relating to literacy and mathematics; but we also wanted to include other knowledge and skills, particularly those which were included in early childhood education, since any analysis of long-term impact of institutionally-shaped experiences needs to take some account of what the institutions are setting out to achieve. We therefore took note of the main aims of the early childhood education curriculum, *Te Whariki*, then in draft form. These aims were: wellbeing, belonging, contribution, communication, and exploration. They grew from the following set of aspirations for young New Zealand children:

To grow up as competent and confident learners and communicators, healthy in mind, body, and spirit, secure in their sense of belonging and in the knowledge that they make a valued contribution to society.
(Ministry of Education, 1996, *Te Whariki –early childhood curriculum*, p. 9).

These aspirations are also reflected in The National Curriculum Framework, which for the first time in New Zealand identified a set of core skills as well as knowledge.

Thus we identified ten 'competencies' – particular combinations of knowledge, skill, and disposition – that seemed to underpin a successful growth to adulthood, and adulthood itself. We would assess:

- Literacy (reading, writing)
- Mathematics
- Logical Problem-Solving
- Communication
- Perseverance
- Social Skills with Peers

Social Skills with Adults
Individual Responsibility
Curiosity
Motor Skills.

We also wrestled with creativity and temperament, but could not find a way to provide consistent measures of these within the time we would have available for data-collection for each child.

The guiding criteria in our search for relevant measures of these competencies were that they were appropriate for young children, were multidimensional, reflected their environment, and were not superficial. Our search used testing manuals and test reference guides, existing measures of children's achievement, and relevant research. A review of instruments available for children under 5 showed that most are devised for limited purposes: usually to screen (identify) children with developmental delay, or to assign IQ or age-equivalent scores. The Competent Children project was focused on 'ordinary' children, and we did not expect many to have developmental delays. Such tests could not provide the full range of scores which would be needed to differentiate between children.

Some of the instruments developed for overseas research which we trialled were not acceptable in the New Zealand context, using terms which were not widely used here by children, or focusing heavily on problems, and using negative descriptions to which New Zealand early childhood education teachers took exception. Others which were more promising lacked New Zealand norms, or would be too time-consuming to administer. Time – cost – was a factor we could not ignore.

We ended up having to devise or adapt more of our measures than we had anticipated. The measures have had to be further adapted and sometimes changed to suit the children as they grow older.⁴ Some of these measures are tasks performed by the children; but others rely on the knowledge gained over time, and so we have used teacher ratings for most of the attitudinal and social competencies.

This broad range of competencies has allowed the Competent Children project to explore children's progress more fully than we initially anticipated, since it allows us to identify some competencies that become core to children's overall progress, and others which, while they stand in their own right, seem less influential.

The Sample

The value of longitudinal studies is also dependent on their samples, and on their attrition rate, or loss over time. No sample is perfect. Our sample is large enough to carry out most of the analysis we want to, though it is smaller than we would like. Our attrition rate is fairly low.

Our original hope was to have rolling samples taken in different geographic regions one year after the other. Available funding, and the rapidly changing policy environment for early childhood education precluded this. We therefore concentrated on the Wellington region, as far north as Otaki on the west coast, and as far north as Ekatahuna on the eastern side of the North Island. At the time, this region did not appear unrepresentative of New Zealand as a whole. But in fact most of our sample come from the urban areas of this region, and these tend to have higher incomes than the country as a whole. Our descriptions of children's competency levels for the whole sample are therefore accompanied by the caveat that a nationwide sample would probably find a somewhat lower level of performance. However, it was not our intention to provide national norms, but to explore the factors which are associated with different levels and patterns of performance. We have sufficient numbers within the sample to provide analysis by the main family characteristics of income, parental education, parental employment, family type, welfare receipt, and ethnicity.

⁴For more detail on the initial development of measures, see Thompson, J., Hendricks, A.K., Wylie, C. (1997). *Children's competencies at age 5 in the context of family resources and early childhood education Volume II – Appendices*. Wellington: New Zealand Council for Educational Research. 360-377. Each of the Competent Children reports to date (see references at end) contains a description of the measures used for that phase.

We started with 307 children for whom we gathered full information at near-age 5, and whom we have followed through at ages 6, 8, 10, and now 12. The Ministry of Education has continued to fund the Competent Children project throughout. The reports for ages 5, 6, and 8 are available, and the report on age 10 is near completion.

At age 10, 274 of the original 307 children remained, an attrition rate of 11 percent. Around half of those who have left the study have shifted overseas. The family characteristics of those who are no longer in the study vary, with no clear over-representation of low-income families.

In the first phase of the project we also carried out a parallel phone survey of 767 parents of near 5 year olds, with some limited information about the early childhood education centres their children attended.⁵ It was intended that this larger survey could serve as a validation of some of the main findings of the full study, and that children from this study could be picked up around age 11 for inclusion in the second cohort of the Smithfield study. With hindsight, it would have been more useful to increase the number of children in the full study from the start, without undertaking this validation exercise.

At age 8, we decided to include children from this survey in the full study, and increase the size of our sample to 520, to allow for attrition over time, and provide larger numbers for analysis of some family characteristics, particularly low income and non-Pakeha. Before merging the two samples, we checked family characteristics, and found no statistically significant differences between them. Additionally, we compared scores on each of the assessment measures for each sample to ensure they had the same distribution before merging them.

⁵ Lythe, C. (1997). *Spreading their wings*. Wellington: New Zealand Council for Educational Research.

How did we find our sample? Part of the pilot study involved a test of the viability of including children who had had no early childhood education experience at all in the longitudinal study. Extensive efforts were made in the Porirua basin to find such children, using means other than a too costly door-to-door survey. (A phone survey would have missed low-income families without phones, who were among the groups most likely not to be participating in early childhood education, and also would have been prohibitively expensive). These efforts were hampered by the introduction of the Privacy Act, which made organisations which served children and families in this area reluctant to pass over any client lists. Our researchers were based in the community, and used their networks; they also approached schools. Most of those thought by principals to have had no early childhood education experience turned out to have attended some form of early childhood education (an interesting comment on the value attributed to early childhood education by principals).

This extensive effort found around 10 children. Most of these were recent migrants to New Zealand, whose English use was unconfident. Anecdotally, we also heard of some children in families using home-schooling, who did not send their children to early childhood education centres. We reluctantly concluded that we would not be able to afford to include children with no early childhood education experience in the study. Additionally, the fact that many of the non-users we had tracked were recent migrants whose children had spent much of their lives to date in another country and culture, could make it difficult to make valid comparisons between children with early childhood education experience, and those without.⁶

Since our sample would cover early childhood education participants only, and because we wanted data on the quality of children's final early childhood education centre, we decided to find our sample by first sampling early childhood education centres.⁷ We wanted to ensure we sampled a range of early childhood education centres, and the easiest way to do this, in the absence of any external quality data, was to ensure we had comparable numbers of children in the main types of early childhood education centre. Policy changes limiting access to the childcare subsidy just before we started our research meant that the number of children in family day care schemes dropped, and so while we were able to have equal numbers of children in kindergartens, playcentres, and childcare centres, we had fewer numbers of children in family day care, and a'oga amata, the Samoan language nests.⁸

Uses

Longitudinal studies in social research lend themselves to a range of uses. These include:

- Tracking and interpreting change over time, allowing findings from cross-sectional studies and cultural or policy assumptions about influential factors to be checked, and discovering new aspects and relations between factors, which sometimes signal the need for further and different studies;

⁶ Recent interim findings from the Early Childhood Primary Link project being undertaken to improve literacy levels in Mangere-Otara (as part of the Ministry of Education's Strengthening Education in Mangere-Otara project) allow a comparison of the mean literacy scores of 5 year old children coming to school who have attended early childhood education, and those who have not (McNaughton et al, milestone report to the Ministry of Education). These show some benefits to early childhood education attendance per se. Children who had attended early childhood education had higher scores for retelling stories (a comprehension task), on the Peabody Picture Vocabulary Test, and Concepts about Print; there were no statistically significant differences for the Burt vocabulary test, hearing and recording sounds, writing vocabulary, high frequency word or word list tests. Of the 102 children in this group, 30 had not attended any early childhood education, according to school records based on information given by parents when they enrolled their child. Unlike our experiences in Porirua in the early 1990s, the group of children who did not attend early childhood education did not contain a higher proportion of children whose English was a second language, which might otherwise explain this difference in scores.

⁷ It would have been prohibitively expensive to meet and select our sample by random approaches to household.

⁸ At the time, it was hoped that a parallel study could be carried out for kohanga reo children, by the Kohanga Reo National Trust, but funding was unavailable.

- providing snapshot pictures of particular groups or institutions, and the relations between them, useful at the time for policy and other reasons. Because longitudinal studies usually have sizeable samples, these pictures can serve as baseline data to compare similar groups and institutions in new samples at a later date, to trace the impact of policy change
- providing samples for qualitative sub-studies of processes and events which cannot be captured by quantitative measures taken a year or more apart.⁹

The most important use of longitudinal studies is the ability to track changes through time, and to interpret these changes by using contextual information about the conditions and experiences of the children or people involved.

I am hesitant to use words like 'cause', though it is difficult not to talk at times about 'impact' or 'effect'. Longitudinal research on social issues and outcomes which uses large samples and quantitative analysis seeks to isolate the contributions of each factor, and to decide which is weightier. Its quantitative nature and its ability to link things through time makes it seem to some more scientific than other social research, and, therefore, more 'true' or valid. But so much depends on the quality of the data, including the relevance and validity of measures in relation to the core research questions, the nature of the sample, the nature of the analysis and modelling, and the assumptions behind any modelling.

Involvement in a longitudinal research study leads to reflections on the nature of social research, such as *Is it a science? Should we think any the less of it if it cannot provide the proof or use the experimental methods of physical science?* My own conclusion is that we do have to be content with less certainty in social research, and accept that while longitudinal studies which use statistical analysis provide great and useful illumination and understanding, statistical analysis cannot provide causal explanation for social experiences.¹⁰

For social research is of necessity, given its subject, working with material which is difficult or unethical to control or limit. It is also working with factors and processes which are intertwined, and which produce great variability, or what the statisticians call 'noise', obscuring the clarity of the signals which can be obtained from the data.

Moreover, many key aspects of human experience are 'soft', and difficult to properly capture in definitive measures of the kind needed for much statistical analysis. We cannot always be sure that what we measure, or can measure, is actually lying behind, or driving, what we see. Often such data has been distorted to fit proposed models, by making it linear (for example, the assumption that each year of education would add the same amount to a given variable), or dichotomous (which can work where there are is a single clear 'threshold', such as lack of any parental qualification versus some, but which will not show the full picture of different patterns and processes at work if there are further thresholds, such as a difference between school-qualified and university-qualified parents).

We have been concerned in the Competent Children project to provide a full a picture as possible of the factors relevant to children's performance. We have therefore used analysis methods which would allow us to investigate the data we had without distorting it, or reducing it. So we have made no assumptions at the outset of the

⁹ We undertook an analysis of competency levels and other material from the study related to resilience for the low-income group in our sample at age 10. This showed that resilience could not be predicted by earlier scores, and that children's experiences of home and school provided better pointers than family resources (within the low income group). It also showed the need for more in-depth qualitative research to explore the relations between experiences and responses. (Wylie, draft report for the Ministry of Social Policy, *Aspects of Resilience: an analysis of resilience indicators and contributing factors for a sample of New Zealand children from low-income homes*).

¹⁰ From a rather different starting point, Nebycha, T., McEwan, P., & Older-Aguiler, D. (1999). The Impact of family and community resources on student outcomes. An assessment of the international literature with implications for New Zealand. Wellington: Research Division, Ministry of Education reach a similar conclusion based on their review of research about the social factors affecting educational performance.

analysis. If we are to understand, for example, why maternal qualification and family income often make a difference for children, we need to include softer material in the analysis, such as the use of leisure time. In some regression models, such material would disappear, not because it may not matter, but because of a high association with the broader factor, which may play a larger part mathematically in terms of accounting for the variability in the data. Good analysis of good data should aim to show us these different facets; the one does not cancel the other out. It helps to think of analysis in multidimensional terms, rather than a single path which must lead to a single conclusion.¹¹

Some major findings from the Competent Children project

Each of the three Competent Children project reports to date, and the fourth, currently being completed, provides a cross-sectional picture of the children's competency levels and lives at that age, and the relationship of aspects of their lives to their competency levels. Since the second phase, when the children were aged 6, we have also been able to look back and use data from previous phases in our descriptions and analysis, allowing us to carry out an increasing amount of modelling.

Today I will concentrate on one of the major themes which have become evident from our analysis of the accumulated data for the study children at age 10. The Ministry of Education has agreed to allow this analysis to be released at this stage, before we have provided them with our full report on our age-10 findings, in order to encourage debate. I will draw together the findings we have about the role of family resources, the family resources which seem to matter most, and why these might make a difference for children.

The role of family resources

I referred earlier to the 'usual suspects' of family resource variables such as income, parental education, and employment. Family type, ethnicity, and income source (particularly welfare receipt) are also of perennial policy and popular interest. Our main findings in this area are that:

- family income and parental education, which we measured through maternal education¹² largely underpin or account for any differences related to family type, family stability, welfare receipt, and ethnicity.
- The associations between family income and children's competencies are not linear. Children's competency levels do not increase in tandem with family income levels. An analysis we did of the relation between family income levels at near age 5 and at age 10, the change in family incomes over that period, family type and stability, and welfare receipt,¹³ showed that children's competency levels do not necessarily rise if family income levels increase after they are aged 5. Low family income levels (below \$30,000¹⁴) in a child's early formative years have persistent

¹¹ One of the great privileges for me in my involvement in the Competent Children project has been to work with an expert statistician, Jean Thompson. The other key member of our team is Cathy Lythe, who has done a superb job of organising the fieldwork.

¹² Because most of the parents we interviewed were the mothers of the study children, and as we wanted to collect information about parents' continuing education as their children grew older. In addition, maternal education levels are thought to have a somewhat greater impact on children's achievement (UNESCO, 1997, *Adult education in a polarising world*. Paris: UNESCO).

¹³ Wylie, C. & Thompson, J. (draft) *Family income, family type and welfare receipt, and their relation to children's competencies at age 10*. Draft report for Ministry of Social Policy.

¹⁴ This seems a reasonable cut-off point given that the eligibility for a community services card for a family of 2 is \$29,398 or less; Hyslop & Mare (2000) describe low-income households as having incomes between \$15-30,000 in their paper 'Understanding changes in the distribution of household incomes in New Zealand between 1983-86 and 1995-98', p. 10. This paper was available on www.mosp.govt.nz in late 2000.

effects.¹⁵ This finding that there are persistent effects of low family income for children's outcomes which explain some of the apparent differences related to family type and welfare receipt is consistent with U.S. longitudinal research findings.¹⁶

We also found long-term advantages for children whose families had high incomes (\$60,000 or more) when they were near age-5.

Children from high-income families at age 10 tend to have higher average scores than others for all the competencies. But the converse is not true: children from low-income families have lower average scores only for Mathematics, PAT Reading Comprehension, and writing.¹⁷ Unfortunately, these are key areas for both school work, and later employment.

Our analysis of why low-income children are disadvantaged in these areas suggests that it is not because of their attitudes or social skills: their average scores on our measures for these (including perseverance, individual responsibility, and communication) are no different from children in middle-income families. What appears to be at work are lower levels of maternal education,¹⁸ and fewer experiences of the kind which use and extend language and mathematics use. These are intertwined.

Maternal education levels and children's experiences

- Maternal education levels have more bearing on children's competency levels than family income, particularly for Mathematics and the PAT Reading Comprehension test. Children whose mothers have no qualification are noticeably disadvantaged; conversely, children whose mothers have a university qualification are noticeably advantaged. But there are no clear linear patterns in between these two ends of the qualification spectrum.

We found that children whose mothers had no qualification watched more television, which by age 10 has some negative associations for children's competency levels; their parents also watch more television too. These children were twice as likely not to belong to any clubs or groups, and near three times less likely to go to lessons outside school or play a musical instrument. These activities had positive associations with children's competency levels.

Children whose mothers had no qualification found school more interesting than others, perhaps because their out of school activities can be narrower than other children's. But they also found the *work* of school more challenging, less related to what they have experienced in their life before coming to school, or outside school.

While their parents were just as likely as others to know the child's teacher, and work on problems together, the parents were less likely to want things to be done differently at the school. Parental aspirations for children did not reflect family income levels, but did reflect maternal qualification. Mothers with no qualification were half as likely as those with university degrees to specifically mention tertiary or university education.

¹⁵ Income data was obtained by asking parents to indicate their family income bracket from a list ranging from over \$80,001 a year, to less than \$5,000, before tax. We took this approach because of the sensitivity of the question, the use of income brackets in the Census, and because the main use of the information was to allow comparison within the sample, rather than, for example, establish adequacy of income against given expenditure.

¹⁶ A review of relevant literature is provided in Wylie (n.d.) *Does welfare receipt harm children? A review of the literature*. Report for the Ministry of Social Policy.

¹⁷ There is a difference in average scores, but children from the highest income families are among the lowest scorers, and vice versa.

¹⁸ Patterns of maternal qualifications are similar for the low-income and middle-income families in our sample. Twenty-two percent of the mothers in low-income families in our sample had no qualification, 63 percent had a mid-senior school level qualification, 9 percent a tertiary, and 7 percent a university qualification. Mothers in the high-income group show a quite different pattern: 4 percent have no qualification, 42 percent a mid-senior level, 21 percent a tertiary, and 33 percent a university qualification.

Unpacking the usual suspects

Analysis

Our exploration of the factors which have an association with children's competencies levels starts with one-factor modelling. From this we develop a clear picture of the factors which continue to have a statistically significant association with children's competency levels after taking maternal qualification and family income levels into account. It is not only the statistical significance that matters, but the size of the difference which a factor can make. If something is statistically significant¹⁹ but the size of the difference is small, say 1-2 percentage points, then practically speaking it warrants little attention, though it may add weight to an overall picture of similar trends. We have then embarked on two further strands of modelling, using the factors which had emerged in this one-factor modelling as having the largest associations with competencies.

Models of key contributors to children's competency levels at age 10

The first strand modelled the age 10 mean cognitive composite score (the average of their 3 scores on the Literacy, Mathematics, and Logical Problem-Solving measures), against the set of factors which had the largest associations with competencies, after allowing for the child's cognitive composite score at 5, 6, and 8, producing 3 models. This enables us to see the likely key contributors to children's competency levels. Some of these factors underpin others, particularly if the factors are closely linked, some are there in their own right. This modelling is particularly useful in getting further insight into why maternal qualification and family income levels affect children.

Previous mean cognitive competency scores alone can account for quite a lot of the variance, or spread, of student scores in the mean cognitive competency score at age 10. We can account for 70 percent of the variance by allowing for the score at age 8 alone. The age 6 score accounts for 53 percent of the variance in children's scores at age 10, and the age 5 score, 34 percent. Looking simply at previous scores provides some information, but does not on its own shed much light on the children's development, and the reasons why there are different patterns evident, since previous scores subsume other factors. However, it is consistent with our other analyses of competency development which show that the window of opportunity for laying down some of the basic mathematics and literacy knowledge and skills narrows after age 8.

Thus we turn to models which include experiential and resource factors. Starting with a model which includes the age 5 mean composite score, we can explain a further 28 percent of the variance in children's scores, a total of 62 percent. This model included these factors, in the following order:

Child's Composite Cognitive Competency age 5

Maternal qualification

Family income age 5

School decile (age 10)

Early childhood education centre teachers were responsive

Early childhood education centre teachers asked open-ended questions of children

Television watching (amount) age 10

Child enjoys reading (age 10)

Child does their homework (age 10)

Child gets the help they think they need at school (age 10).

The early childhood education, family income, and school decile factors were subsumed within the remaining group of factors when we fitted all the other factors in this set first: that is, their contribution was no longer separable.

¹⁹ In our study, at a level of $p < 0.0$, or one chance in a 100 that the result we have could have arisen by chance; we also describe 'indicative' relationships where p is < 0.05 and > 0.01 .

A similar picture was found when the age 6 Composite Cognitive Competency, was used in the model of age 10 Composite Cognitive Competency, but with the factor of early childhood education teachers asking open-ended questions continuing to make some separate contribution beyond the group of other factors.

The model which used the age 8 mean composite cognitive competency measure with experiential and resource factors accounted for 83 percent of the variance, (another 13 percent on top of the age 8 mean composite cognitive competency score) This model included the factors below, in the following order:

Child's Composite Cognitive Competency age 8
Maternal qualification
Early childhood education socio-economic mix
Early childhood education centre teachers were responsive
Early childhood education duration
Television watching (amount) age 10
Child enjoys reading (age 10)
Child does their homework (age 10)

The duration of early childhood education experience did not make a separate contribution after the other factors in the model were fitted first. Note that family income effects have gone off the centre stage. This does not mean that family income levels do not matter, but that they are subsumed within this group of factors (including previous performance).

There are several things that are striking about these sets of strong contributors to children's competency levels at age 10. First, early childhood education still shows, particularly aspects related to quality. Socio-economic mix in children's educational settings does seem to matter (though we cannot explain why school decile is replaced by early childhood education socio-economic mix when we fit later average cognitive competency scores). Third, what children do with their time outside school matters, with benefits in restricting television watching (our data show benefits associated with watching less than an hour's television or none a day, with low scores particularly apparent among children who watch 3 hours or more).

What can we do?

The second strand of modelling which we have done at age 10 is to focus on activities and experiences which have a large to moderate association with key competencies, particularly Mathematics and the PAT Reading Comprehension test, but also Perseverance and Communication, and to explore factors which may be more readily amenable to policy, home, and school action than the social and economic conditions which shape income inequalities and which shaped previous educational access and opportunities. These are the factors which can largely mitigate the influence of low family income or maternal education levels.

I will focus here on the models for mathematics, and the PAT Reading Comprehension test. We have omitted earlier performance levels in these models. The factors which show in this analysis are not the only things that have a bearing on performance at age 10. Some of them may be 'standing' for others, or standing ahead of others, simply because they are most likely to co-occur with other activities (tip of the iceberg), or have subsumed others. The strength of these activities lies in the fact that they occur as a cluster.

Mathematics

In the model below, which accounted for 46 percent of the variance between children's scores at age 10, we see something of the importance of the way children spend their out-of-school time. Children who always have to help out at home have less time for activities where they need to think to apply something learnt at school to something in their own environment (e.g. measuring), and less time to widen their world and find out new things by reading.

Table 1
Effects of factors in a model for Mathematics at age 10

Factor (largest contrast of factor categories in brackets, first level given is "the best")	p-value from ANOVA with this factor fitted last	size of largest contrast (%points advantage)	s.e.	prob for this contrast
Reading of books from library (3 weekly cf none)	0.006	15.8	4.1	0.0002
Socio-economic status of ECS (middle-class vs wide)	0.0004	13.5	3.2	0.00003
Helps out at home (sometimes cf always)	0.002	10.6	3.3	0.002
At home tells the time (yes cf no)	0.020	10.2	4.3	0.020
At home uses ruler to measure (yes cf no)	0.016	9.2	3.8	0.016
Child enjoys reading (yes cf no)	0.034	8.8	3.9	0.024
At home uses proportions (other than ½ and ¼) (yes cf no)	0.002	8.4	2.6	0.002
Home maths – tables over 10 (yes cf no)	0.002	7.9	2.6	0.002
At home uses scales to weigh (yes cf no)	0.019	6.5	2.7	0.019

Each of these factors continues to make a separate contribution to children's scores after allowing for all the other factors in the group. But after allowing for the full set, we find no remaining association with family income (current and previous), or maternal qualification. Thus these activities can mitigate any disadvantage associated with low income or parental educational levels.

We found it interesting that more skills-based mathematics activities which had shown some positive associations with children's competency levels when they were younger, such as playing board or card games, no longer did at age 10.

Why should the socio-economic mix of the child's final early childhood education centre still have a bearing five years later? We find some marked associations when we include some quality aspects of early childhood education into the modelling, but these are overtaken if the socio-economic mix of the final early childhood education centre is then included. This also occurred in an earlier model of mathematics performance when we included maternal qualification, and maternal qualification showed no further associations when the socio-economic mix of the child's final early childhood education was included.

When we look at the association of these aspects with the socio-economic mix of children's final early childhood education centre, we get some clues. Early childhood education centres serving children from mainly middle-class homes tended to score more highly than those serving mainly low-income children, or those with what the early childhood education centre teachers described as a 'wide' social mix.

Table 2
Relationships between child's final early childhood education centre socio-economic mix²⁰ and key early childhood education quality factors.

Early childhood Education socio-Economic mix	Wide n=86	Middle N=117	Low-Middle n=60	Low n=39
ECE staff are responsive	%	%	%	%
1 st quartile	35	19	15	44
4 th quartile (best)	15	33	25	10
ECE staff ask Open-ended Questions				
1 st quartile	51	29	27	54
4 th quartile (best)	6	14	8	0
ECE allowed children time to complete activities				
1 st quartile	34	25	18	33
4 th quartile (best)	16	27	32	5
ECE Print-saturated				
1 st quartile	35	17	28	44
4 th quartile (best)	6	14	23	23
Mother's Qualification	N=80	N=113	n=57	n=35
	%	%	%	%
None	20	4	16	17
University	9	33	9	6

²⁰ As described by the early childhood education teachers; the quality factors are rated by researchers.

Literacy

Some of the activities which appear to be key (or key indicators of others) for mathematics are also apparent for the PAT Reading Comprehension test. How a child spends their time matters. But with reading, school factors are also evident.

The next model accounted for 54 percent of the variance between children's PAT scores.

Table 3
Effects of factors in a model for Literacy at age 10

Factor (largest contrast in brackets)	p-value from ANOVA with this factor fitted last	Size of largest contrast (% points advantage)	s.e. of this diff.	prob for this difference
Homework (yes cf no)	0.0007	17.8	4.7	0.0002
Final early childhood education centre socio-economic mix (middle-class cf low)	0.00002	17.4	3.8	0.000007
TV watching at age 10 (none cf 2-3 hours daily)	0.008	17.3	5.5	0.002
Parental support for class (fantastic cf little)	0.025	14.4	5.3	0.007
Child feels they are doing well at school through solving a problem by working hard (agree cf not sure)	0.004	13.7	4.2	0.001
Child enjoys reading (yes cf qual. yes or no)	0.00005	11.6	3.1	0.0002
Child read library books at age 6 (yes cf no)	0.0006	9.4	2.7	0.0006
ECS was a print-saturated environment (4 th quartile rating cf 1 st quartile rating)	0.013	8.9	3.6	0.014
At home uses proportions other than ½ and ¼ (yes cf no)	0.022	5.2	2.3	0.022
Home maths – tables over 10 (yes cf no)	0.031	4.9	2.2	0.031

Again, each of these factors made a separate contribution after the other factors in the group has been allowed for, and there were no further effects for family income or maternal qualification.

With the data we have accumulated, we are now able to undertake some more formal longitudinal data modelling, such as structural equation modelling, which can distinguish between directly related and indirectly related factors, and to delve further into some of the earlier experiences of children.

However, already the project has shown the importance of enlarging the activities of children whose own parents' educational experience was limited. Some of the previous reports in the project have provided useful information for teachers and policymakers to use in their work with parents, such as the Ministry of Education's *Feed the Mind* campaign.

As we see the persistent associations with preschool experience, and with the quality of early childhood education, the importance of working with parents and early childhood education teachers to enlarge and deepen young children's activities in ways which provide them with a solid base of knowledge and thought also becomes more apparent.

Conclusion

The longer the Competent Children project continues, the richer the picture we are gaining of the influences on children's development over time. It is richer, but it is also increasingly complex, as I hope is evident in the findings offered above. Yet this is the reality of human lives, and one which social research must endeavour to show. Our analysis can reveal useful patterns and configurations of related factors, and should shed some light on the complexity without further complicating it.

What we feel is particularly valuable about longitudinal research is the opportunity it gives to show how early experiences and resources can affect children's progress, how these can be modified or entrenched by later experience, and the opportunity to check some of the popular, policy, and research assumptions about the factors that help shape what we are and can contribute.

Like any other research, much depends on the quality and relevance of the data. Longitudinal social research, perhaps because it attracts people from quite different disciplines, and calls on deeper statistical knowledge and wisdom than many researchers have, also brings to the fore the quality and relevance of methods of analysis, and assumptions behind models. We have taken an exploratory approach, drawing our lead from the patterns revealed in the data, rather than starting with a theoretical model requiring a more reductive approach. If we are to make the most of longitudinal data-sets, from both a research and a policy perspective, we will probably need more understanding of the relationship of statistical analysis and interpretation, and an appreciation of social research in its own terms.

Competent Children project reports

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