MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga
New Zealand

Competencies at age 14 and competency development for the Competent Children, Competent Learners study sample

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RESEARCH DIVISION
Wāhanga Mahi Rangahau

ISBN **0-478-13405-3**

Web Copy ISBN **0-478-13406-01**

Research reports are also available on the Ministry's website: www.minedu.govt.nz under the Research heading.

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NEW ZEALAND COUNCIL FOR EDUCATIONAL RESEARCH

TE RŪNANGA O AOTEAROA MŌ TE RANGAHAU I TE MĀTAURANGA

WELLINGTON

2006

New Zealand Council for Educational Research
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Acknowledgements

We are grateful for the continued interest and willingness of the study's participants, their parents, and teachers.

We are also grateful for the funding and support of the Ministry of Education.

The fieldwork, which lies behind this report, was undertaken from late 2002 to late 2003. Data collection became more complex as the study followed its participants into secondary schools. All went smoothly thanks to the dedicated work of Cathy Lythe and Tineke Fijn, who co-ordinated the fieldwork, and our very able fieldwork team, which consisted of Marion Bayne, Clare Falkner, Joanne Leith, Betty Irons, Patricia Meagher-Lundberg, Elizabeth Wagner, Marilyn Weir, Anna Wildey, Brigid Wikinson, and Kath Wood. The data cleaning benefited from the keen eyes of Kim Lau, Denise Falloon, and Melissa Anslow. We have had high-quality secretarial support from Christine Williams, and Lorraine Thompson.

The project advisory group has been very helpful in our instrument design and the issues we might encounter in fieldwork and analysis. For this phase, the group has been Lynne Whitney, Jacky Burgon, Sharon Cox, Heleen Visser, Jude Allison, Clive McGee, Dick Harker, Sandie Aikin, Anne Meade, and Robyn Baker.

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Executive summary

This report focuses on the competency levels and development of competencies for 475 14-year-olds, as part of the Competent Children, Competent Learners project, which is a longitudinal study of a sample of New Zealand young people who have been followed from their final early childhood education centres in the Wellington region. The main aim of the project is to chart the development of competencies in the context of home and educational experiences which may account for differences in patterns of development and young people's performance.

The competency measures we describe are results from reading comprehension, writing, mathematics, and standard progressive matrices (non-verbal pattern completion) tasks, and ratings from core-subject teachers (English, mathematics, and science) in relation to attitudinal competencies. The latter comprise curiosity, perseverance, self-management, self-efficacy, social skills with peers, social skills with adults, and communication.

COGNITIVE COMPETENCY LEVELS AT AGE 14

Scores on the standard progressive matrices were much the same as the scores for this age group found in 1984 when the matrices were normed for New Zealand. This sample had slightly higher scores on the PAT reading comprehension tests than the age-14 sample when these tests were revised in 1990, and somewhat higher scores on the mathematics items from the PAT test.

In the writing task, spelling was more accurate than punctuation. Grammar and syntax were simple rather than complex. Just under half the 14-year-olds were using or beginning to use vocabulary that was appropriate to their task and audience. Fifty-five percent were organising and linking ideas logically and sequentially. Eighty-nine percent provided some justification for their ideas, and 37 percent expressed personal viewpoints and arguments.

ATTITUDINAL COMPETENCY LEVELS AT AGE 14

Teacher perceptions of the young people they taught were largely consistent across the three core subjects, indicating that they behaved similarly in different classes. These perceptions show a wide range of behaviours, attitudes, and reactions.

Curiosity

Around 60 percent of the study sample were thought by their core subject teachers to often or always enjoy new experiences or challenges, and take an active interest in the world around them. Around a third were seen to often or always think of new ways to solve problems, and 27 percent, to ask a lot of questions.

Perseverance

Around two-thirds of the study sample would often or always meet any promises they made, and finish all their homework and class work. Over half would also often or always have a good concentration span when working, and meet any of their own goals. Just under half would persist in solving a problem.

Self-management

The young people in the study did not always fit into class routines. Just over half the sample always turned up for class on time, and 43 percent always brought with them all the equipment they needed for the class. This would have some implications for teachers' planned lessons. However, at the other end of the spectrum,

only 8 percent only sometimes or rarely turned up to class on time, and 15 percent, to bring all their equipment with them. Forty-two percent of the study sample often or always checked their work before completing or handing it in.

Self-efficacy

Seventy percent of the study sample were thought by their core-subject teachers to be often or always optimistic, and willing to learn from mistakes. Around half often or always carried out any leadership role they were given, or saw other students' point of view.

Social skills with peers

Most of the study sample was seen by their core-subject teachers to get on well with other students. Forty percent were often or always good at resolving disputes or keeping things smooth with their peers, and 28 percent, to support other students in class. Five percent of the study sample were seen by their core-subject teachers to be sometimes or often bullied, and 7 percent to sometimes or often bully. Five percent often or always associated with antisocial peers.

Social skills with adults

At age-14, just over half the study sample always showed their core-subject teachers respect. Most were confident in their interactions with teachers, and presented their point of view appropriately.

Communication

The highest ratings for items in the communication measure were for being able to follow a conversation, listening well, and expressing views and needs appropriately. More than 60 percent of the study sample were seen by their core-subject teachers to do this often or always. Around a quarter of the sample hardly ever or never asked for something to be repeated if they did not understand it the first time.

ASSOCIATIONS BETWEEN THE COMPETENCY MEASURES

There are very strong correlations amongst perseverance, self-management, and self-efficacy, indicating strong links between these measures, that is, those who show a high level of perseverance also tend to display high levels of self-management and self-efficacy.

The cognitive competencies show substantial linear associations with each other. Amongst the cognitive competencies, writing is most weakly correlated with the other cognitive competencies, while the strongest relationships are logical problem-solving with mathematics, and reading with mathematics.

PREDICTABILITY OF AGE-14 COMPETENCY LEVELS

Correlations between previous scores and age-14 scores increase with time, for example, in mathematics, from 0.57 between age 5 and age 14, to 0.82 between age 12 and age 14. Of the age-5 scores, mathematics has the highest correlation with age-14 scores. The attitudinal competency scores have lower correlations than the cognitive competencies.

How do attitudes support cognitive competencies? Or is it vice versa? When we analysed the relationship at age 14 alone, we found that the cognitive competencies could not account for the variance in the attitudinal competencies: someone with a high level of reading comprehension is not necessarily going to have a higher score for, say, curiosity than someone with a low level of reading comprehension. But attitudinal competencies did account for a reasonable proportion of the variance in cognitive scores, particularly perseverance, communication, and curiosity. So a 14-year old who listens carefully, keeps going when they face a problem, or keeps an open mind, is more likely to get a higher reading comprehension or mathematics score than one who does not.

The relationship between attitudes and cognitive performance is more complex when traced over time. Attitudinal competencies contribute to cognitive performance at the same age, but not to cognitive performance at a later age. Cognitive performance at one age does contribute to attitudinal performance at the next age. Thus though these two dimensions are distinct from one another, they are connected over time.

Social characteristics have some bearing on competency levels at age 14. We have used four in our analyses: family income levels, maternal qualification, gender, and ethnicity. Very high and very low competency scores were achieved in all social groups. However, there are differences in average scores. The higher the level of family income and maternal qualification, the higher the average score in the cognitive competencies at age 14. The gradients were present, but not so steep, for the attitudinal competencies. Students whose family income was low at age near-5 had lower scores than others. Females had higher average scores for reading comprehension and writing, and all the attitudinal competencies other than curiosity. Pākehā/European and Asian young people had higher average scores than Māori and Pacific young people, but not for logical problem-solving.

PREDICTABILITY OF HIGH AND LOW PERFORMANCE

Earlier high performance is highly likely to result in later scores that are above the median, and earlier low performance is highly unlikely to do so. However, a small minority do show marked changes in performance over the years, indicating that current performance levels at each age should not be taken for granted, or accepted as inevitable.

The majority of those whose scores at age 5 or age 8 are in the highest quartile are also in the highest quartile at age 14. However, there is some volatility in these patterns—not all remain above the median at every age. Yet those whose scores do dip often recover their performance level, suggesting that they have a reasonably robust core of knowledge, skills, and support, to fall back on.

The majority of those whose scores at age 5 or age 8 are in the lowest quartile are also in the lowest quartile at age 14. Of those who do progress above the median, the ones who make gradual improvements over some years are more likely to make sustained gains that put them above the median than do those who have rapid spurts. This is a different pattern from those who were initially in the highest quartiles, suggesting a less robust core of knowledge, skills, and support.

1. Introduction

The **Competent Children, Competent Learners** study is a longitudinal study of a sample of New Zealand young people, who have been followed from their final early childhood education centres in the Wellington region. The main aim of the project is to chart the development of competencies in the context of home and educational experiences which may account for differences in patterns of development and young people's performance. Reports from the study and associated papers are available on the NZCR website, www.nzcer.org.nz. The project is funded by the Ministry of Education, with some additional funding from NZCER.

At age 14, we have data for 475 young people. This data includes results from reading comprehension, writing, mathematics and pattern completion tasks, and ratings from core-subject teachers (English, mathematics, and science) in relation to attitudinal competencies. The latter comprise curiosity, perseverance, self-management, self-efficacy, social skills with peers, social skills with adults, and communication. Some of these overlap with the key competencies that are now being included in the curriculum.

In this first report of the results and analysis of the material gathered from late 2002 and during 2003, when the sample was aged 14 years, we start by describing their competency levels, and relationships between the competencies. We then turn to analyse the relationship between the young people's current competency levels, and four social characteristics: gender, family income levels, maternal qualification levels, and ethnicity. To do so, we have made comparisons of performance above and below the median, followed by modelling to see which of these characteristics contributes significantly to performance.

Finally, we report our analysis of the predictability of current levels of performance in relation to earlier levels of performance. To answer this question, we have analysed the data at a number of different levels. Overall trends have been modelled using structural equation modelling. Quartile groupings have been used to describe differences in patterns for high and low performers.

The Competent Children, Competent Learners sample was originally chosen in relation to the main focus of the first phase of the study, which was the role of early childhood education experiences and quality. This meant our units for sampling were early childhood education types, other than ngā kōhanga reo, rather than social characteristics. This and the fact that our sample was chosen from the Wellington region, has resulted in a sample that is not nationally representative in terms of social characteristics. Our sample has higher proportions of young people from high-income families, and those whose mothers have trade or tertiary level qualifications than the national average, and lower proportions of Māori and Pacific young people.

Five hundred and forty-nine children have been part of the Competent Children, Competent Learners study. The characteristics of the 475 who took part at age 14 and those who have departed the study (74, or 13 percent), including those who took part at age 12 but not at age 14 (21, or 4 percent) were compared to see if there were any differences in social characteristics, and age-8 competency scores. There were no differences in social terms. However, those who have left the study had slightly lower mathematics and logical problem-solving scores at age 8. Those who left the study between age 12 and age 14 had somewhat lower scores at age 12 for mathematics and the attitudinal competencies.

The table below describes the sample at age 14 in terms of the four social characteristics we analyse in the study.

Table 1 **Social characteristics of Competent Learners study sample at age 14**

	(*n* = 475)	%
Family income		
Low income (< $30,000)	58	12
Medium income ($30-60,000)	123	26
High income ($60 – 100,000)	150	32
Very high income ($100,000+)	123	26
Not known	21	4
Maternal qualification		
None	65	14
Trade/mid-school	235	49
Tertiary/senior secondary	86	18
University	85	18
Not known	4	1
Gender		
Male	247	52
Female	228	48
Ethnicity		
Pakeha/NZ European	376	79
Māori	50	11
Pacific	23	5
Asian	14	3
Other	12	3

2. Age-14 competency levels for the Competent Learners sample and relationships between competencies

THE COMPETENCY MEASURES

In this section, we look first at the scores on each of our competency measures, with some description of trends in particular items making up the competency measures. Then we look at the relationships between the competency measures at age 14. The selection and development of the measures in this study have been described elsewhere.[1] Because of the period of growth covered in the young people's lives, it has not been possible to use the same measures in every phase of the study.

Cognitive competencies

We have been able to use the same test for logical problem-solving (Standard Progressive Matrices) between ages 8–14, and over the same period we have used the age-related PAT standardised tests for reading comprehension, and cut-down versions of the age-related standardised PAT mathematics test. For writing, we have used much the same task between ages 8–14, asking for a greater length at each age. We used the Burt word reading test between ages 6–12, but because of the ceiling effect apparent at age 12, did not use it at age 14.

Mathematics

At age 14, we used a reduced set of 25 items from the PAT mathematics tests. The items selected from the whole test for Year 9 and Year 10 students were those that were around the median in their level of difficulty (the proportion of students who got them right), and in their power to differentiate between students (high scorers overall got the items right, and low scorers overall did not). The mean raw score out of 25 was 16.79 (s.d. 6.01), and the median, 18. The scores on the age-14 reduced set were more skewed toward the upper end than they had been in the earlier mathematics tests. The Year 9 student mean raw score was 16.15 (s.d. 6.11), and Year 10 student mean raw score was 17.28 (s.d. 5.86).

Logical problem-solving

The average raw score for the sample was 46.44 (s.d. 6.15), which is much the same as the mean raw score of 48.8 (s.d. 6.9) for the 14–14.5 year group on which the Standard Progressive Matrices were normed for New Zealand children and young people in 1984. The lowest score was 15 items of the 60 test items correct, and the highest, 59 items. The raw mean score at Year 9 was 45.78 (s.d. 6.36), and at Year 10, 46.94 (s.d. 5.97).

PAT reading comprehension test

PAT reading comprehension test results were obtained from schools for most of the sample. This meant that many had been done some time before, with 57 percent of the tests done at age 13. The PAT test has different questions for Year 9 and Year 10 students. Thirty-six percent of the sample did the Year 9 test (form A), with a mean raw score of 26.3 (s.d. 9.95). This is slightly higher than the mean raw score of 24.89 (s.d. 9.45) for

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[1] Wylie, C., Thompson, J., & Kerslake Hendricks (1996). *Competent children at 5: Volume II, Appendices.* Wellington: New Zealand Council for Educational Research; Wylie, C. (2003). Longitudinal research. In D. Davidson & M. Tolich (Eds) *Social science research in New Zealand*, (pp. 217-228). Auckland: Pearson Education New Zealand.

Form 3 students on the 1990 NZCER revision of the test. The mean raw score for those who did the Year 10 test was 26.24 (s.d. 10.19), also slightly higher than the mean raw score of 25.08 (s.d. 8.87) for Form 4 students in the 1990 revision.

As in earlier phases of the study, we adjusted the scores to take account of the differences in tests for each year level for analysis purposes. This was done by looking first at responses to the 35 questions which were common at both year levels, and converting them to percentages. The median score on these common questions was 51.4 for the Year 9 students, and 62.9 for the Year 10 students. A Student's T-test showed that the difference in means was significant. A 95 percent confidence interval of the true difference was between 3.8 and 12.8 percent, with the average difference of 8.31 percent. The Year 9 student scores were therefore adjusted downwards by 8.3 percent.

Writing

The writing task we gave at age 14 asked for 20–25 lines about something interesting the young person had seen or done, a television programme, or a book, explaining clearly what they were writing about, and what they liked most about it, including their reasons. A non-fiction topic was chosen to be gender-neutral.

Forty-two percent of the young people wrote about something they had done. Their main topics included outdoor activities or adventures (15 percent), sports (11 percent), a New Zealand holiday (8 percent), an overseas trip (6 percent), or cultural/arts events or a social event (5 percent each).

Twenty-one percent wrote about a favourite book, somewhat fewer than the 27 percent at age 12. Most wrote about fiction (83 percent of those writing about a favourite book), and the main categories of books written about were books about people/relationships/family sagas (43 percent), fantasy (32 percent), a classic novel (14 percent), the *Harry Potter* series (12 percent), or history (10 percent).

Sixteen percent wrote about a favourite television programme, with situation comedies being the main category (31 percent of those choosing this topic).

Seven percent wrote about something they had seen, mainly a movie, or sport.

Completed writing tasks were marked by a panel of five NZCER staff and fieldworkers. A graded selection of samples was used to develop a set of exemplars for surface and deep features modelled on the Assessment Resource Bank (ARB) assessment for transactional writing, which gives descriptions of levels of writing performance. This was used in an initial marking session. The panel met again to review the marks allocated to ensure consistency. A moderators' set of marked examples was then developed to complement the marking guidelines.

Surface features were marked out of 11, and the deep features out of 15, with marks doubled to give more weight for the deep features.

The mean raw score out of a total of 41 points was 26 (s.d. 6.1). The lowest score was 12, and the highest, 41. Year 9 students' mean raw score was 25.04 (s.d. 5.76), and Year 10 students' was 26.7 (s.d. 6.24). The reliability score for the writing test part-scores was 0.82. Completion of the number of lines asked for, spelling, and clarity of thought had the lowest correlations with the overall raw score (0.33 to 0.42).

The median score when the scores were converted to a percentage was 61. The highest quartile was 73, and the lowest quartile was 54.

At age 14, 87 percent of the young people produced text that had just a few words misspelled. Thirty-one percent were largely using punctuation accurately, and 16 percent, grammar and syntax which included complex sentences. Seventy-eight percent were using other than high-frequency words, and 45 percent were using or beginning to use vocabulary that was appropriate to their task and audience. Fifty-five percent were organising and linking ideas logically and sequentially. Eighty-nine percent provided some justification for their ideas, and 37 percent expressed personal viewpoints and arguments.

Table 2 **Writing task—scores for particular features**

Features	%
Completion of task	81
Surface features	
Spelling	
Over 5% spelling errors, in relation to breadth of vocabulary.	13
Uses appropriate spelling, fewer than 5% spelling errors.	87
Punctuation	
Beginning use of full stops and capitals.	23
Mostly correct use of full stops, capitals, commas for listing, question marks, and beginning use of quotation marks.	46
Mostly correct use of full stops, capitals, commas for listing, question marks, exclamation marks, and quotation marks.	25
Using conventions of punctuation accurately and confidently.	
Accurate use of full stops and capitals, commas, question marks, exclamation marks, speech marks, apostrophes, parentheses, dashes, colons, and semi-colons. *Curriculum level 4–5*	6
Grammar & syntax	11
Beginning use of conventional syntax [word order].	
Conventional syntax generally evident. Control of verb forms, i.e. singular/plural agreement, subject/verb agreement and tense.	73
Using conventions of grammar accurately and confidently.	
Wide use of subordinated structures in sentences with variety in length and errors rare. [Complex sentences with subject/object, descriptive passages, and use of pronouns, adverbs, and adjectives. Clauses appropriately linked. Tense mostly correct.]	16
Deep features	
Vocabulary choice	
High-frequency vocabulary predominates.	22
Vocabulary broadening beyond high frequency.	34
Beginning to use vocabulary appropriate to task/genre.	34
Makes language choices appropriate to the audience. Vocabulary generally appropriate to task/genre.	11
Choice of form	
Beginning to vary sentence beginnings and structure. Beginning to extend sentences with conjunctions.	29
Varies sentence beginnings and length. Beginning to use clauses within sentences.	54
Varies sentence beginnings and sentence length to suit purpose. Range of sentence types showing accurate use of clauses within sentences.	17
Progression of description	
Writes several related sentences on the topic.	8
Some sequencing is evident.	38
Sequences ideas logically. Beginning to organise some ideas into paragraphs.	45
Organises and links ideas logically. Organises ideas into coherent paragraphs.	10
Links main and supporting ideas. Strong sequential structures evident within and between paragraphs.	
Clarity of thought	
No justification for ideas.	11
Includes several ideas, some with supporting detail—some facts and opinions.	52
Beginning to support main ideas with some detail—expresses personal viewpoints.	29
Justifies point of view persuasively—expresses and argues a point of view.	
Consistently includes details to support main ideas—expresses and explains a point of view. Links main and supporting ideas.	8

Attitudinal competencies

The reliability of each of the attitudinal measures (the degree to which the scores on each of the items within it are associated with the total score for the measure) has been above 0.7 for all measures, with the exception of the measure for social skills with peers, largely because for this measure we combined teacher ratings with the sample's responses to a social problem-solving task. In this phase, we used only teacher ratings.

At age 14, we gathered information from the young people's teachers on seven aspects of competency in terms of the sample's approach to learning, communication skills, and social skills. In previous phases we had covered six; in this phase, we added the aspect of self-efficacy.

We also asked the study sample's parents some of the same items. In exploratory analyses of the item scores it was found that the parent items seldom if ever "added" to the information in the teacher items. A calculation of Cronbach's alpha on any one of the items using the three or four available teacher responses and the parent responses was almost always highest if only the teacher responses were used. This suggested that the responses of the teachers and those of the parents were different in some way. This may have been because young people behaved differently at home and at school; parents and teachers may have interpreted the questions quite differently, or they may have used different standards when answering the questions. The differences between subject teachers were far less marked.

It was decided to use only the teacher items when constructing the age-14 attitudinal competencies, as previous attitudinal variables were based on teacher judgements alone, the age-14 teacher ratings showed a high correlation with the corresponding age-12 scores, and use of the parent responses typically decreased the Cronbach's alpha values.

In previous phases of the project, classroom teachers could provide ratings for individual children. At age 14, all the sample are in secondary level education, with different teachers taking them for each subject. We therefore sought ratings from teachers of the compulsory subjects at Years 9 and 10: English, mathematics, and science, and from the teachers who taught the subject which the young people said was their favourite.

In calculating the competency measures, we decided to leave out the ratings given by the "favourite subject" teacher as many data were missing. This was because English, science, or mathematics were favourite subjects for a quarter of the young people. Other "favourite subject" teachers sometimes felt unable to rate their students because their courses (e.g. physical education) tended to have fewer contact hours and teachers did not know the young people well enough to make a judgement at the time we collected the data.

The average time that the English, mathematics, and science teachers had taught the Competent Learners sample was 6 months, much the same as in previous phases of the study.

For the attitudinal competencies, teachers rated young people by matching a set of statements for each competency area to the child, using a 5-point scale, which we then converted to a numerical rating: always (5); often (4); sometimes (3); hardly ever (2); never (1). All competency measures were calculated as the mean over all the mathematics, English, and science teacher ratings available for each young person in the relevant items, giving equal weight to each teacher's rating. Competency measures were formed for young people where ratings were available for all competency items from at least one teacher. We had close to full data for 98 percent of the sample. About 2 percent had ratings available from only two teachers, and a very few from just one teacher.

The reliability of the competency measures groupings was checked using Cronbach's α coefficient of reliability, first across the single items which were grouped to form each competency measure, and second, across teachers. In each of the following tables, a preliminary mean calculation has been made before calculating the α coefficient. The *n*s appear to increase for the combined measures in Table 2. This is caused by absorbing missing data points into the preliminary mean calculation, for example, in Table 3, we have 474 young people who were assessed by at least one teacher on all items relevant to the curiosity competency, but only 424 whose English teacher assessed them on all curiosity items, 395 whose mathematics teacher

assessed them on all curiosity items, and 424 whose science teacher assessed them on all curiosity items. In Table 4 the *n*s are different again: here we have 466 young people who were assessed on the curiosity items by three teachers, 472 assessed on the perseverance items by three teachers, and so on.

Table 3 **Consistency of items within each competency measure**

	English		Maths		Science		Combined*	
Competency	***n***	**α**	***n***	**α**	***n***	**α**	***n***	**α**
Curiosity	424	0.87	395	0.81	424	0.85	474	0.88
Perseverance	413	0.94	374	0.93	384	0.93	474	0.96
Self-management	455	0.89	459	0.89	447	0.89	475	0.94
Self-efficacy	411	0.81	359	0.82	401	0.81	474	0.87
Social skills with peers	403	0.76	360	0.75	403	0.75	473	0.82
Social skills with adults	454	0.73	418	0.71	439	0.67	472	0.75
Social skills combined	401	0.84	351	0.83	394	0.82	471	0.88
Communication	429	0.88	358	0.85	394	0.87	470	0.91

* Means were taken across teachers for each item; then α was calculated over the items for each competency.

Table 4 **Consistency of competency measure across teachers**

Competency	***n***	**α**
Curiosity	466	0.69
Perseverance	472	0.83
Self-management	471	0.81
Self-efficacy	448	0.72
Social skills with peers	469	0.72
Social skills with adults	471	0.62
Social skills combined	471	0.74
Communication	471	0.73

Means were taken for each teacher over items forming the competency; then α was calculated across the three teachers.

All but two reliability coefficients relating to the consistency of the measure were greater than 0.7. The social skills with adults measure had lower reliability coefficients in relation to both the internal consistency of the measure, and the consistency across teachers. This may be because it had only three items. On the basis that at age 14 social skills with peers and adults are likely to be similar, we combined it with the measure for social skills with peers, and the combined measure had a higher consistency both internally and across teachers.

We look at each of these competency measures in turn, giving the sample scores on the individual items that comprise them.

Curiosity

Around 60 percent of the study sample were thought by their core subject teachers to often or always enjoy new experiences or challenges, and take an active interest in the world around them. Around a third were seen to often or always think of new ways to solve problems, and 27 percent, to ask a lot of questions.

Table 5 **Curiosity**

Ranking →	**5**	**4**	**3**	**2**	**1**
Item ↓	%	%	%	%	%
Asks a lot of questions	3	24	40	29	3
Enjoys new experiences or challenges	10	47	35	7	1
Takes an active interest in the world beyond themselves	12	49	31	8	1
Thinks outside the square—thinks of new ways to solve problems	6	28	39	23	4

The pattern of scores for the whole sample was much the same as in earlier years, with the exception of the item "asks a lot of questions", where the overall scores were lower. This may reflect changes in the classroom environment, but it may also reflect the deletion of "wants to know how and why" from the wording of this item at age 14.

The correlations between individual items ranged from 0.46 (asking a lot of questions, and thinking of new ways to solve problems), to 0.78 (enjoys new experiences or challenges, and takes an active interest in the world beyond themselves).

Perseverance

Around two-thirds of the study sample would often or always meet any promises they made, and finish all their homework and class work. Over half would also often or always have a good concentration span when working, and meet any of their own goals. Just under half would persist in solving a problem.

Table 6 **Perseverance**

Ranking →	**5**	**4**	**3**	**2**	**1**
Item ↓	%	%	%	%	%
Persists with solving a problem	9	38	37	14	1
Has a good concentration span when working	17	40	30	13	1
Finishes all class work	24	42	24	10	1
Finishes all homework	23	42	22	12	1
Meets any goals that they set themselves	12	46	33	8	1
Meets any promises they make	22	50	22	5	1

Four of these items are comparable with items asked at age 12. The age-14 and age-12 scores show similar patterns for three of the items, but somewhat fewer of the sample were seen to always or often persist with solving a problem at age 14 than at age 12 (47 percent compared with 56 percent).

Correlations between individual items were within a smaller range than they were for the curiosity measure. The range was from 0.73 (persists with solving a problem, and meets any promises they make), to 0.89 (finishes all class work, and finishes all homework).

Self-management

The young people in the study did not always fit into class routines. Just over half the sample always turned up for class on time, and 43 percent always brought with them all the equipment they needed for the class. This would have some implications for teachers' planned lessons. However, at the other end of the spectrum, only 8 percent only sometimes or rarely turned up to class on time, and 15 percent, to bring all their equipment with them. Forty-two percent of the study sample often or always checked their work before completing or handing it in.

Table 7 **Self-management**

Ranking →	**5**	**4**	**3**	**2**	**1**
Item ↓	%	%	%	%	%
Checks their work before completing it or handing it in	8	34	40	16	3
Follows all class routines and rules without reminders	28	37	27	7	1
Turns up to class on time	56	37	7	1	–
Brings all the equipment they need to class	43	42	13	2	–
Takes responsibility for their action	36	45	15	3	1
Acts without thinking of the consequences*	1	5	26	44	24

* reverse-scored

Three of the items were comparable with the age-12 measure, and the age-14 patterns of scores are similar for two of those. At age 14, the young people in the study were less likely to follow all class routines and rules without reminders (65 percent compared with 78 percent at age 12).

Correlations between individual items ranged from 0.58 (turns up to class on time, and acts without thinking of the consequences), to 0.85 (follows all class routines and rules without reminders, and takes responsibility for their actions).

Self-efficacy

This is the first time we have measured self-efficacy. Seventy percent of the study sample were thought by their core-subject teachers to be often or always optimistic, and willing to learn from mistakes. Around half carried out any leadership role they were given, or saw other students' point of view.

Table 8 **Self-efficacy**

Ranking →	**5**	**4**	**3**	**2**	**1**
Item ↓	%	%	%	%	%
Takes an optimistic view of life	17	53	26	4	–
Is willing to learn from mistakes	16	54	25	6	–
Carries out any leadership role they are given	13	40	31	15	1
Sees other students' point of view	4	44	44	8	–

The correlations between items in this measure ranged from 0.56 (takes an optimistic view of life, and willing to learn from mistakes or sees other students' point of view), to 0.72 (is willing to learn from mistakes, and sees other students' point of view).

Social skills with peers

Most of the study sample was seen by their core-subject teachers to get on well with other students. Forty percent were often or always good at resolving disputes or keeping things smooth with their peers, and 28 percent, to support other students in class. Five percent of the study sample were seen by their core-subject teachers to be sometimes or often bullied, and 7 percent to sometimes or often bully. Five percent often or always associated with antisocial peers.

Table 9 **Social skills with peers**

Ranking →	**5**	**4**	**3**	**2**	**1**
Item ↓	%	%	%	%	%
Gets on well with other students	24	61	14	1	–
Gets bullied by other students*	–	1	4	33	62
Bullies other students*	–	2	5	24	69
Is good at resolving disputes or keeping things smooth with peers	5	35	42	16	2
Is influenced by peer pressure to do something out of character*	–	3	23	48	25
Helps/supports other students in class	1	27	49	21	2
Mixes with antisocial students*	1	4	19	48	28

* reverse-scored

Two of these items are comparable with those used at age 12; there are similar patterns at both ages for getting on well with other students, and being influenced by peer pressure to do something out of character.

The range of correlations between individual items was the widest for our competency measures. There was least correlation between gets bullied by other students, and mixing with antisocial students (0.13); and most correlation (0.61) between gets on well with other students, and is good at resolving disputes or keeping things smooth with peers.

Social skills with adults

At age 14, just over half the study sample always showed their core-subject teachers respect. Most were confident in their interactions with teachers, and presented their point of view appropriately.

Table 10 **Social skills with adults**

Ranking →	**5**	**4**	**3**	**2**	**1**
Item ↓	%	%	%	%	%
Confident in their interactions with me	22	53	22	3	–
Shows respect	54	38	7	1	–
Presents their point of view in an appropriate manner	22	46	26	5	1

All three items are comparable to those used at age 12 for this measure, and the patterns are similar for both ages. The lowest correlation was 0.33, between shows respect, and confident in their interactions, and the highest was 0.66, between shows respect, and presents their point of view in an appropriate manner.

Communication

The highest ratings for items in the communication measure were for being able to follow a conversation, listening well, and expressing views and needs appropriately. More than 60 percent of the study sample were seen by their core-subject teachers to do this often or always. Around a quarter of the sample hardly ever or never asked for something to be repeated if they did not understand it the first time.

Table 11 **Communication**

Ranking →	**5**	**4**	**3**	**2**	**1**
Item ↓	%	%	%	%	%
Can remember & carry out instructions after hearing them once	15	43	31	11	1
Asks for something to be repeated if they don't get it the first time	4	28	44	22	2
Follows what is being talked about in a conversation	20	48	27	5	–
Is a good listener	21	42	28	9	–
Changes their language according to the situation and audience	8	42	39	10	1
Clearly explains things they have seen or done	12	47	32	9	–
Expresses their views and needs appropriately	17	46	32	5	–

All seven items in the measure of communication were comparable to items used at age 12. There is little change in the patterns in relation to expressing views and needs appropriately. The age-14 pattern shows somewhat lower ratings for the other items, and most markedly for one: only 32 percent of the study children were thought by their core-subject teachers to often or always ask for something to be repeated if they did not get it the first time, compared with 65 percent at age 12. Again, this may indicate changes in classroom environments, but it does raise the issue of whether student misunderstandings are more likely to continue, and how much time teachers spend in revisiting material and concepts that they thought had been grasped.

The correlations between the items in this measure ranged from 0.21 (is a good listener, and asks for something to be repeated if they don't get it the first time), to 0.82 (follows what is being talked about and is a good listener).

RELATIONSHIPS BETWEEN COMPETENCY MEASURES AT AGE 14

We explored the relationships between the competency measures at age 14 using scatterplots and correlation, and then modelled relationships using structural equation modelling. One assumption for any type of regression analysis is that variables are normally distributed. Moderate violations of this assumption can be well tolerated in smaller regression analyses, but could be problematic using structural equation modelling. We decided to "normalise" all the competencies as far as possible. Normality tests on the competency variables showed that most would benefit from some sort of transformation before being used in a regression analysis. The Box-Cox transformation is a straightforward and commonly used transformation. It is a power transformation with the added advantage that it converges to a log transformation as $p \to 0$.

$$\text{The transformation is: } y^* = \begin{cases} \dfrac{y^p - 1}{p} & \text{for } p \neq 0 \\ \log(y) & \text{for } p = 0 \end{cases}$$

The value of *p* was chosen for each variable to bring the variable as close as possible to normal. While skewness could be corrected successfully with this transformation, platykurtosis often remained (a tendency to have a higher than normal probability in the tails of the distribution).

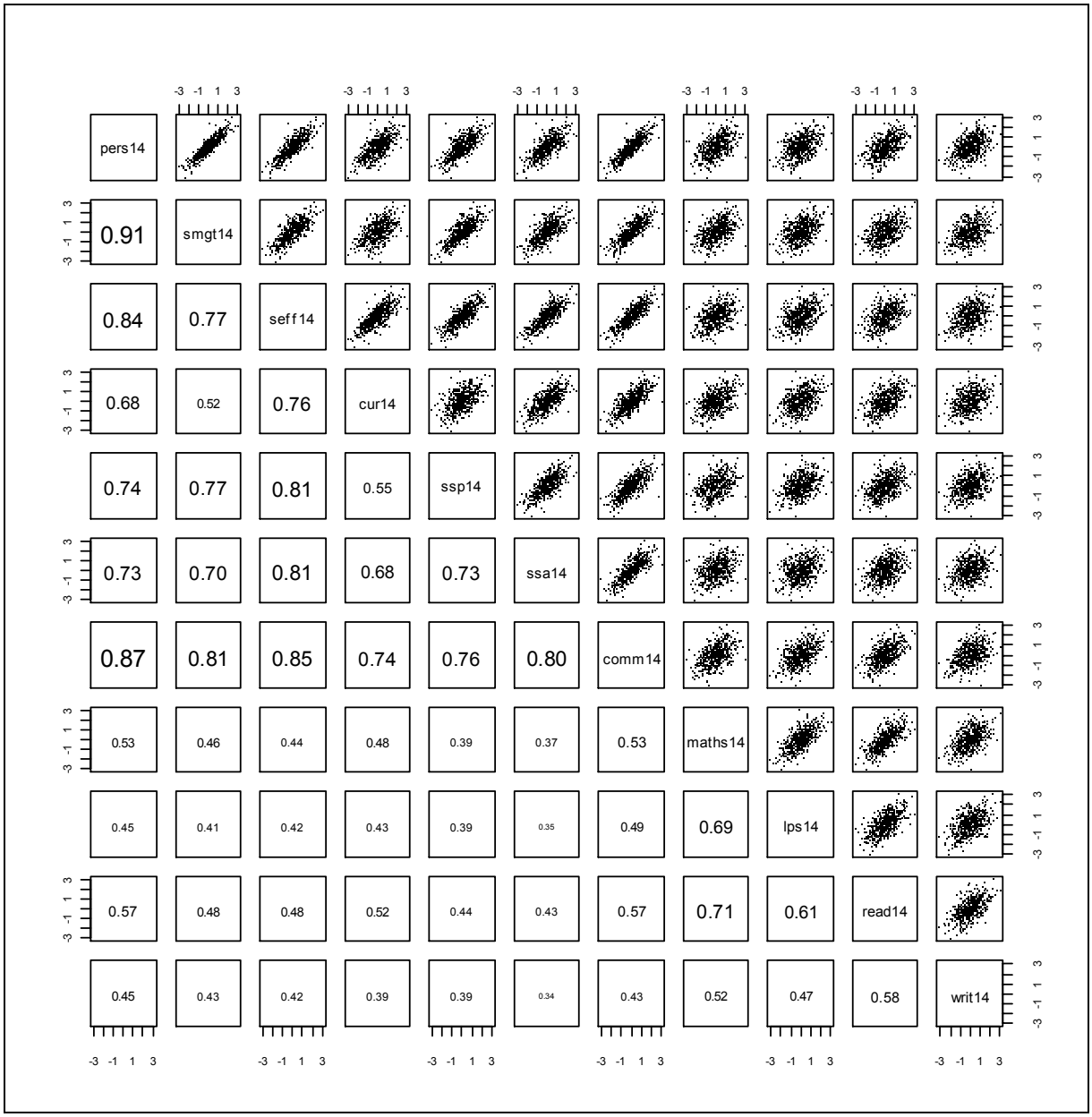
All variables were standardised to have mea*n* =0, and variance = 1.

Given that kurtosis remained even after the Box-Cox transformation had been applied, a normalising transformation was also used for comparison in all the analyses in this part of the report. In essence the normalising transformation assumes that the ranks of children on each competency are normally distributed. Both these transformations preserve ordinality, so correlations are not affected. We also reduce the risk of type I and type II errors in the modelling environment.

We start by exploring linear relationships between all cognitive and attitudinal competency measures at age 14. In regression analysis relationships between variables are assumed to be linear, so it is necessary to explore the extent to which this is the case.

The following lattice of scatterplots shows the extent to which competency variables at age 14 are linearly related. The ranges of both the x- and y-axes are –3 to +3 as all variables have been standardised. This does not affect the size of the correlation, but has the advantage of giving all variables the same mean and variance. The relationships between each and every competency measure at 14 is displayed. In the top triangle the scatterplots are shown, and the related Pearson's correlation coefficient is shown in the lower triangle. Correlation coefficients are displayed with a font size proportional to the size of the correlation. Variable names are on the diagonal. Information for a pair of variables is contained at the corners of the appropriate square. For example, the correlation between mathematics at 14 (maths14, row 8 column 8) and self-efficacy at 14 (seff14, row 3 column 3) is shown by the scatter plot in row 3 column 8, and the correlation coefficient (0.44) in row 8 column 3.

Figure 1 **Linear association between competencies at age 14 (*n*=476)**



Main trends in linear relations between the competency measures

There are very strong correlations amongst perseverance, self-management, and self-efficacy, indicating strong links between these measures, i.e. those who show a high level of perseverance also tend to display high levels of self-management and self-efficacy.

The cognitive competencies show substantial linear associations with each other. Amongst the cognitive competencies, writing is most weakly correlated with the other cognitive competencies, while the strongest relationships are logical problem-solving with mathematics, and reading with mathematics.

The linear relationships between the cognitive competencies and the attitudinal competencies show weaker relationships. The generally higher correlations amongst the attitudinal competencies indicate there may be more co-linearity among them, than among the cognitive competencies. This co-linearity presents a challenge when working on models that try to isolate contributions made by individual attitudinal competencies to cognitive competencies. Our assumption was that the cognitive competencies were more likely to reflect attitudinal competencies than vice versa. This was confirmed by an attempt to model attitudinal competencies as outcome variables. The fit statistics for this model were poor.

The high degree of linear association amongst all competencies at age 14 supports the use of such modelling techniques as multiple regression, path analysis, and structural equation modelling to gain a comprehensive picture of inter-relations between the competencies. We decided on a structural equation model as it allows two or more *"*outcome*"* variables and can model *"*latent*"* variables measured by two or more observed variables. Thus it gives the most useful and complex model of the inter-relationships between the variables.

Structural equation model of relationships between competencies at age 14

We used software packages SAS, R, and MPLUS for this analysis.

Due to the number of the attitudinal competency items (across all seven measures) we decided to consider these as "composite" variables in our structural equation model. The composite variables stand on their own in the model without being modelled by their individual components.

Some preliminary regression analyses were run treating each cognitive outcome separately. Reading comprehension was best predicted by perseverance, curiosity, self-efficacy, logical problem-solving, and writing. Writing was best predicted by self-management, logical problem-solving, and reading. However, substituting communication for self-efficacy and self-management respectively in these models made minimal difference to the explanatory power of the model. This points to the likelihood of co-linearity between communication and the other attitudinal competencies used in this study.

The model diagram below shows the modelled paths (straight arrows) between variables with their estimated coefficients, R^2s for the intermediate and endogenous variables, estimated covariances (curved double-headed arrows) between exogenous (explanatory) variables, and various fit statistics. Manifest (observed) variables are represented by rectangles. Latent variables (unobserved) are depicted by ovals.

Path coefficients indicate the extent to which the variable at the end of the arrows is explained (in this model) by the variables at the beginning of the arrows. A path coefficient of, say, 0.10 shows a relatively weak influence, whereas anything over 0.5 indicates a very strong influence. All path coefficients shown in the diagram are significant, meaning that their inclusion makes a significant contribution to the model.

The R^2s shown by each of the intermediate and endogenous (outcome) variables are a measure of how well the model explains those variables. Numbers closer to 1 indicate that the model is explaining that variable well. Numbers closer to 0 indicate the variable is not being explained well by the model. In this case the R^2s indicate that the model is working well overall.

Several useful fit statistics are quoted (from the MPLUS output). The χ^2 goodness-of-fit statistic compares the observed covariance matrix with the modelled covariance matrix, and tests the null hypothesis that they are equal. The *p*-value states the probability that (given the data) the null hypothesis is true. In this case we can say that the data supports the hypothesis, and the model fits very well. The other statistics further confirm the (good or bad) fit of the model. For a good fit, the RMSEA (root mean square error of approximation) should have a value of less than 0.06 and a confidence interval whose upper limit does not exceed 0.065. The *p*-value for this test gives the probability that the null hypothesis (RMSEA <= 0.05), is true. The third statistic quoted, SRMR (standardised root mean square residual), should not exceed 0.08 if the model is to be considered a good fit. Recommendations for acceptable cutoff values for fit statistics values are made by Hu and Bentler (1999).[2]

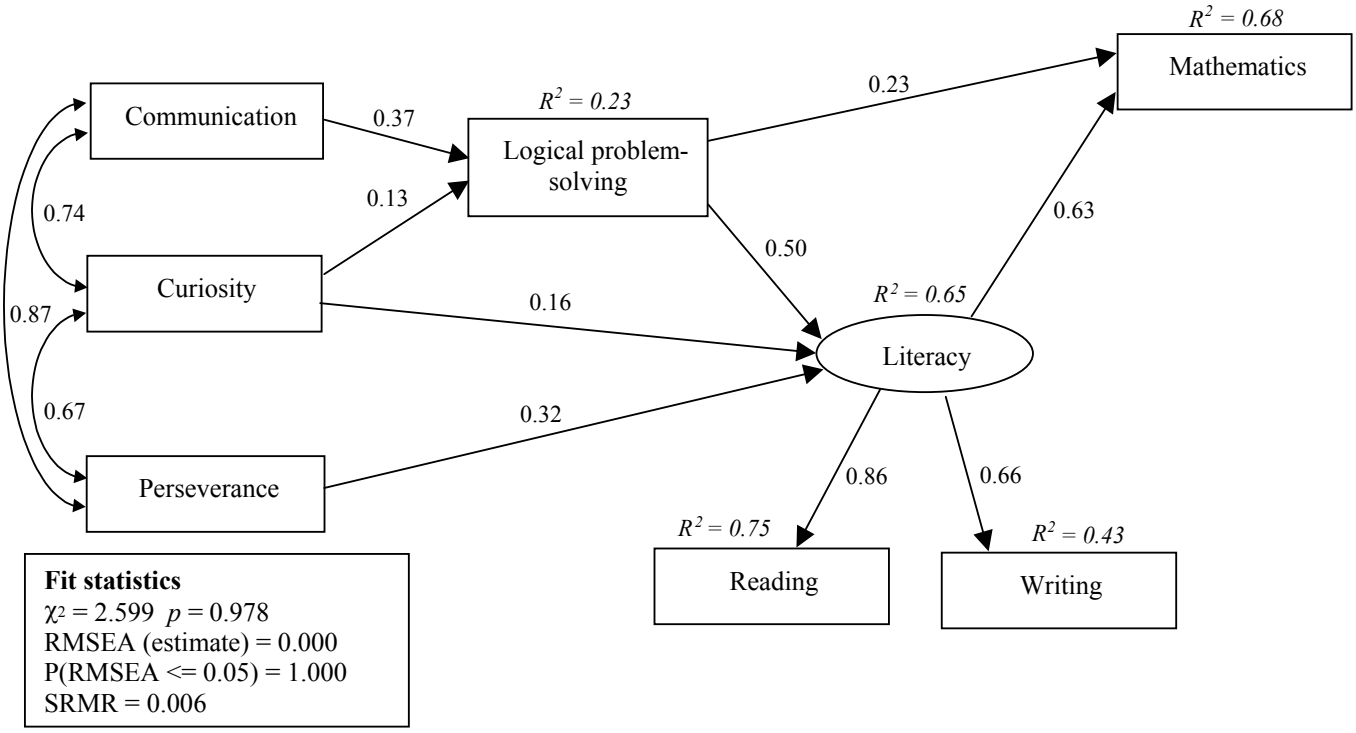
This structural equation model has excluded self-management, self-efficacy, and social skills from being useful predictors for cognitive outcomes. This does not mean that these competencies are not important, but

[2] Hu, L.T., & Bentler, P.M. (1999). Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1–55.

that in the presence of communication skills, curiosity, and perseverance they are not useful additions for the purposes of predicting cognitive outcomes in the structural equation model.

The model shows that reading and writing appear to "belong together". It is hard to say whether reading comprehension should come *before* writing skills (as something of a prerequisite), or *after* (implying a "result of"). At age 14 these skills may well be quite interdependent, with neither one being easily separable from the other. Fitting a structural equation model with a "literacy" factor made up of reading comprehension and writing fitted the data well.

Figure 2 **Structural equation model describing inter-relationships between competencies at 14**



The model shows that there are strong relationships between the attitudinal competencies, and also between mathematics and literacy. It also shows moderate associations between the attitudinal competencies and logical problem-solving, and with literacy. Sixty-five percent of the variance in literacy scores could be accounted for by scores in communication, curiosity, perseverance, and logical problem-solving. The link between the attitudinal competencies and mathematics appears to be indirect, with more direct associations between the former and logical problem-solving and reading comprehension.

The data support the hypothesised model very well. The arrows in the diagram are not necessarily causal. The model proposed here simply offers the best predictors of cognitive outcomes, given the data, and restricted to the competency variables we have constructed.

3. Differences in age-14 performance related to social characteristics

At each stage of the study, we have looked at whether there have been differences in achievement between different groups of young people. At age 14, we are looking at maternal qualification, age-5 family income, gender (of the young person), and ethnicity (of the young person). This is not to say that we are attributing any differences to the particular social group, but rather that it is likely that the individuals in a group would have had common experiences that may be associated with a tendency to higher (or lower) levels of achievement.

We start with comparisons of the performance of different groups. First, tables giving the percentage of young people achieving above the median in each group. [3] Then we look at notched box-plots displaying the actual scores.

ABOVE MEDIAN PERFORMANCE AND SOCIAL CHARACTERISTICS

Table 12 shows clear linear trends in relation to the cognitive competencies for maternal qualification and family income levels. Gender differences are significant in relation to the literacy measures, but not mathematics and logical problem-solving. Logical problem-solving scores are also unrelated to ethnicity.

[3] Note that in several of the competencies there were several young people (between about 1 percent and 11 percent of the total number) whose score equalled the median, in which case under half of the whole group achieved "above the median", so the percentages in the tables need to be read with some care. Some of the differences may have been more (or less) marked had we used "percentage at or above the median", or had we excluded all individuals achieving the median score.

Table 12 **Percentage of age-14 young people scoring above the median in the cognitive competencies**

Competency measure→ Group↓		Logical problem-solving	Mathematics	PAT Reading Comprehension	Writing
Maternal qualification[1]					
None	(*n*=65)	25	12	19	20
School	(*n*=146)	42	42	43	46
Trade/Tertiary	(*n*=174)	52	49	51	54
University	(*n*=85)	67	76	80	67
Family income group at age 5[2]					
Under $30,000	(*n*=123)	39	25	27	36
$30,000 to $60,000	(*n*=207)	48	48	50	50
$60,000 to $80,000	(*n*=64)	58	59	66	58
Over $80,000	(*n*=68)	59	72	74	66
Gender[3]					
Female	(*n*=227)	52	48	55	56
Male	(*n*=248)	44	45	43	43
Ethnicity[4]					
Pākehā/Asian	(*n*=388)	49	51	53	52
Māori/Pacific	(*n*=73)	42	21	25	30

1 All differences significant with $p < 0.0001$.

2 Logical problem-solving differences significant with $p < 0.05$; Writing differences significant with $p < 0.01$; Mathematics and PAT reading comprehension differences significant with $p < 0.0001$.

3 Mathematics, logical problem-solving no significant difference; PAT reading comprehension differences significant with $p < 0.05$; Writing difference significant with $p < 0.01$.

4 Logical problem-solving no significant difference; all other $p < 0.001$.

The logical problem-solving test involved no words. The young people merely had to work out a pattern established in between one and nine figures, and then choose a "missing piece" from six options. This is a skill that is not explicitly taught in school, although pattern finding and problem-solving will have been encouraged more in some educational and home environments than in others. It is interesting that for this competency score there are significant differences between the groups defined by maternal qualification (which may include some genetic differences, as well as importance placed on pattern recognition, lateral thinking, and problem-solving in the home environment), with a clearly defined gradient (25 percent of those with mothers with no educational qualifications scored at or above the median, compared to 67 percent of those with mothers with university education), but there are no significant differences between the two ethnic categories, nor between the genders (although the direction of the differences in both cases is consistent with those where the differences were statistically significant).

The largest differences, with the strongest gradients, are for mathematics and reading comprehension across the groups defined by maternal qualifications, age-5 family income, and ethnicity. These are the two competencies that are most strongly "learned" at school, and where by age 14 the young person will have the most strongly established view of their own ability (or lack thereof). The scores in logical problem-solving suggest that some of the young people have underachieved in mathematics and reading comprehension, and what will be of interest is to attempt to establish what home, school, or peer group factors may have

contributed to this, as the under- and over-achievers appear to be concentrated in certain of the socially defined subgroups.

The next table shows the trends in relation to the attitudinal competencies. Gradients exist for five of the competencies in relation to maternal qualification, but not as steep as for the cognitive competencies. In relation to age-5 family income, there is a gap between those whose family income fell below $30,000 when they were near-age 5, and others. Gender and ethnicity were associated with significant differences, which were somewhat larger than for the cognitive competencies.

Table 13 **Percentage of age-14 young people achieving above the median in the attitudinal competencies**

Competency measure→ / **Group↓**		**Curiosity**	**Commun-ication**	**Perseve-rance**	**Self-manage-ment**	**Self-efficacy**	**Social skills**
Maternal qualification[1]							
None	(*n*=65)	29	35	40	42	38	42
School	(*n*=147)	47	44	45	48	40	43
Trade/Tertiary	(*n*=174)	52	52	50	47	54	53
University	(*n*=85)	68	67	67	64	65	64
Family income group at age 5[2]							
Under $30,000	(*n*=123)	37	34	34	34	30	38
$30,000 to $60,000	(*n*=207)	49	50	54	54	52	50
$60,000 to $80,000	(*n*=64)	69	69	58	58	70	64
Over $80,000	(*n*=68)	62	54	56	50	56	54
Gender[3]							
Female	(*n*=227)	54	58	59	60	59	59
Male	(*n*=248)	46	42	41	39	40	41
Ethnicity[4]							
Pākehā/Asian	(*n*=389)	53	53	54	53	53	52
Māori/Pacific	(*n*=73)	33	32	26	27	30	36

1 Self-management $p < 0.05$; all other $p < 0.01$.

2 All differences significant with $p < 0.01$.

3 Curiosity no significant difference; all other $p < 0.001$.

4 All differences significant with $p < 0.01$.

What are these differences reflecting? They may reflect different levels of comfort in the classroom environment of secondary school, relating in turn to the accumulated effects of each young person's previous experiences, as these encourage or discourage the behaviours required to achieve a high score on these competencies.

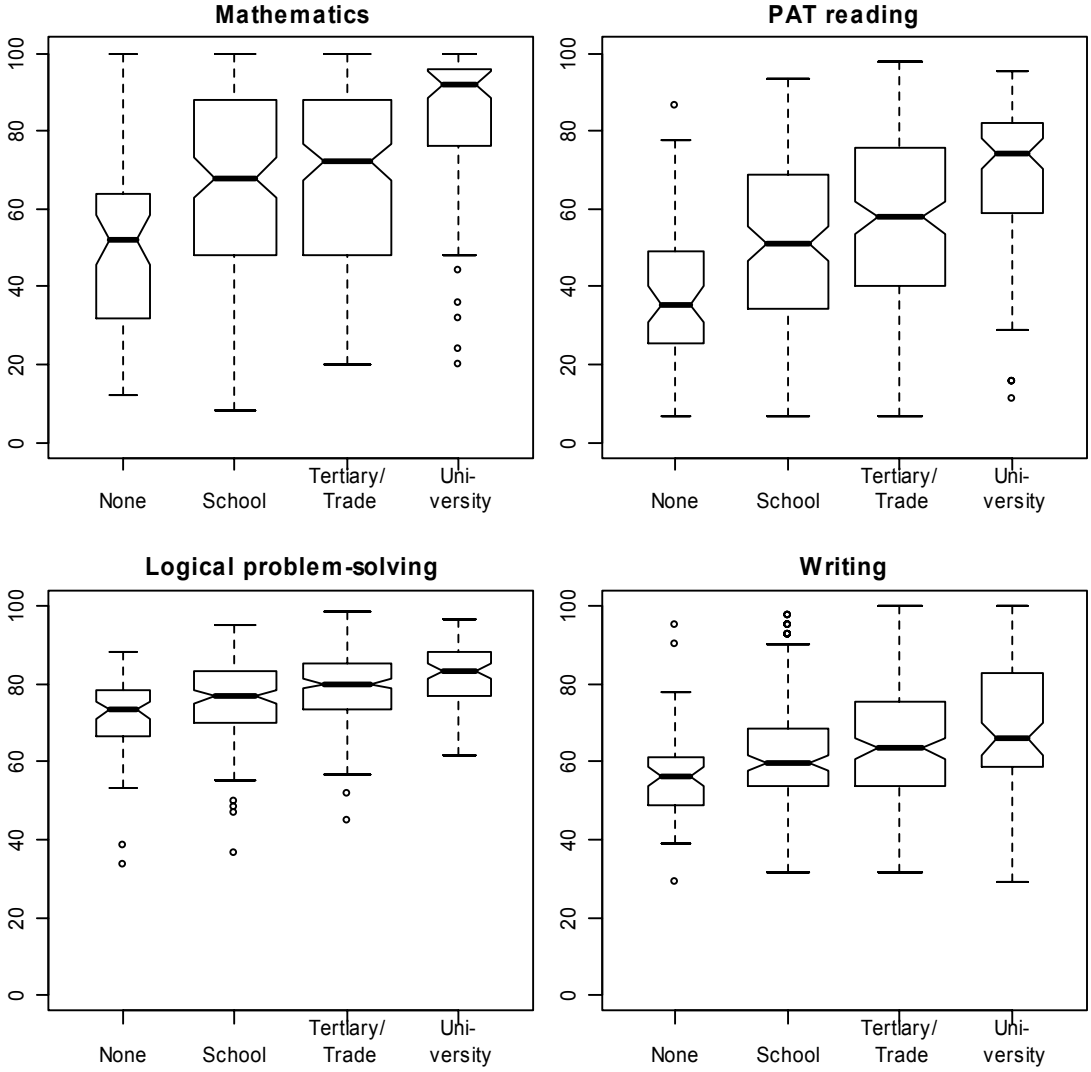
VARIATION IN COMPETENCY SCORES RELATED TO SOCIAL CHARACTERISTICS

The box plots (Figures 3 to 10), show in greater detail how the competency scores varied across the levels of each social characteristic. The features of the box plots are:

- The width of each box is proportional to the number of young people in that group (the sample size).
- The vertical axis gives the percentages achieved for the test (the raw score out of the total possible score converted to a percentage).
- The bars at the top and bottom of the plot show the values of the highest and lowest scores respectively.
- Where there are extremely high (or low) scores, these outliers are shown by circles above (or below) the maximum (or minimum) scores.
- The dashed whiskers show the range of scores achieved by the top 25 percent of the young people and the lowest 25 percent of the young people (the first and fourth quartile groups, respectively).
- The box shows the scores achieved by the middle 50 percent of the young people (the second and third quartile groups, respectively), with horizontal lines at the top and bottom of the box at the first and third quartiles.
- The narrower line at the centre of the box shows the value of the median. If the distribution of the scores is symmetric, the median is at the centre of the box and the whiskers are more or less the same length. If the distribution of the scores is skew (see, for example, the mathematics scores, where many of the young people achieved high scores, and only a few had low scores), then the median is closer to one quartile than to the other, and, typically, the whisker on the "short quartile" side is shorter and the other whisker is longer.
- The notch on the side of the bars indicates an approximate 95 percent confidence interval for the median. If the notched sections on two boxes do not overlap, then it is probable that the competency scores for the two groups defined by those boxes are significantly different. This is only a rough guide, but can give a fairly good indication of where there are (or are not) differences.

In the discussion of each of the sets of box plots that follows, mention is made of groups that are "likely" to be statistically significantly different for each competency. This relatively informal approach is supplemented in the next section, where models are fitted for each competency separately with the social characteristics as explanatory variables. In the tables in that section the levels of each social characteristic that did differ significantly for the competency are listed.

Figure 3 **Cognitive competencies measured as percentages for maternal qualification groups**



If we look at Figure 3 for the variation in cognitive competencies related to maternal qualifications, we can see the following:

- The mathematics scores of those with university-educated mothers tended to be very high (the top whisker is very short, indicating that the scores of the first quartile group were all very close, and there is an equally short gap between the first quartile and the median), but there were at least five young people who achieved relatively low scores for that group (the five circles for the outliers).
- There were students in each of the groups who scored 100 percent for mathematics (the top whisker ends at 100 for each plot), and the lowest score was achieved by a young person with a school-educated mother. The lowest scores in each group for the other competencies tended to be approximately equal, particularly in reading comprehension, and writing.
- For each of the four competencies, there is a relatively clear gradient across the qualification groupings, and the median in each group is at least a little higher than that of its nearest but "less qualified" neighbour. Further, in each of the competencies there is a probable significant difference between those whose mother had a university qualification and those whose mother had no qualifications.

- The gradient across groups is steepest (indicating the biggest difference between groups) for mathematics and reading comprehension. However, in these competencies the biggest differences are between the groups with least and most educated mothers; the differences between the middle two groups are not significantly different (the notches overlap).
- In the other two competencies, logical problem-solving and writing, it is unlikely that any two adjacent groups have significantly different scores, but the group with mothers with no educational qualifications is significantly different from the groups whose mothers have tertiary/trade qualifications, or university qualifications, and the group with mothers with university qualifications is significantly different from both the group whose mothers have no qualifications and those with school qualifications.

Figure 4 **Attitudinal competencies measured as percentages for maternal qualification groups**

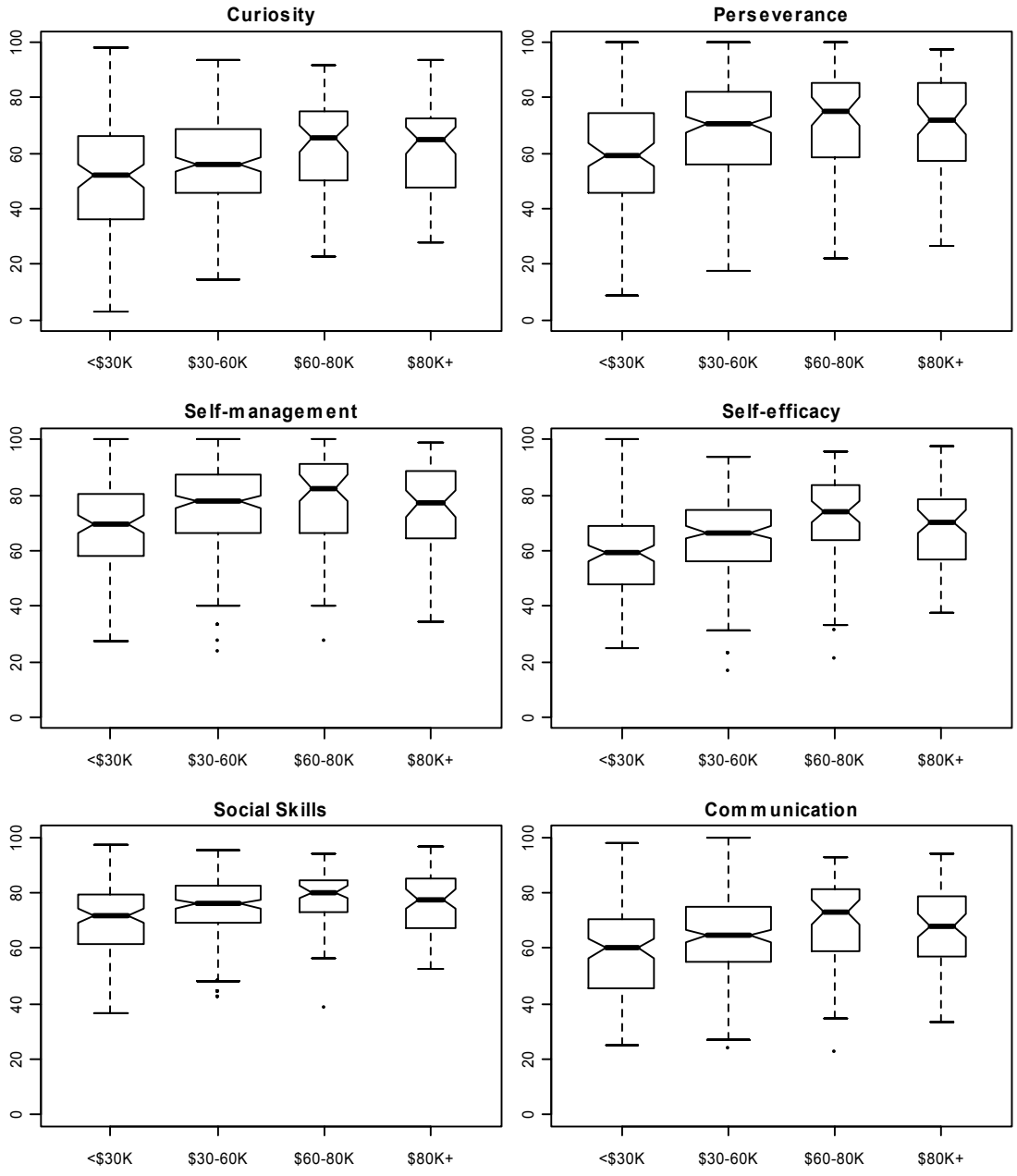


Figure 4 shows that:

- For perseverance, self-management, self-efficacy, and communication, the scores for the group with university-educated mothers are likely to be significantly higher than those of each of the other groups.
- The highest and lowest scores in each group for each of the competencies seldom differed markedly between groups.
- There are unlikely to be any statistically significant differences between groups for social skills.
- For curiosity, the only statistically significant differences are likely to be between the group whose mothers had no educational qualifications, and the group with university-educated mothers.

Figure 5 **Cognitive competencies measured as percentages for age-5 family income groups**

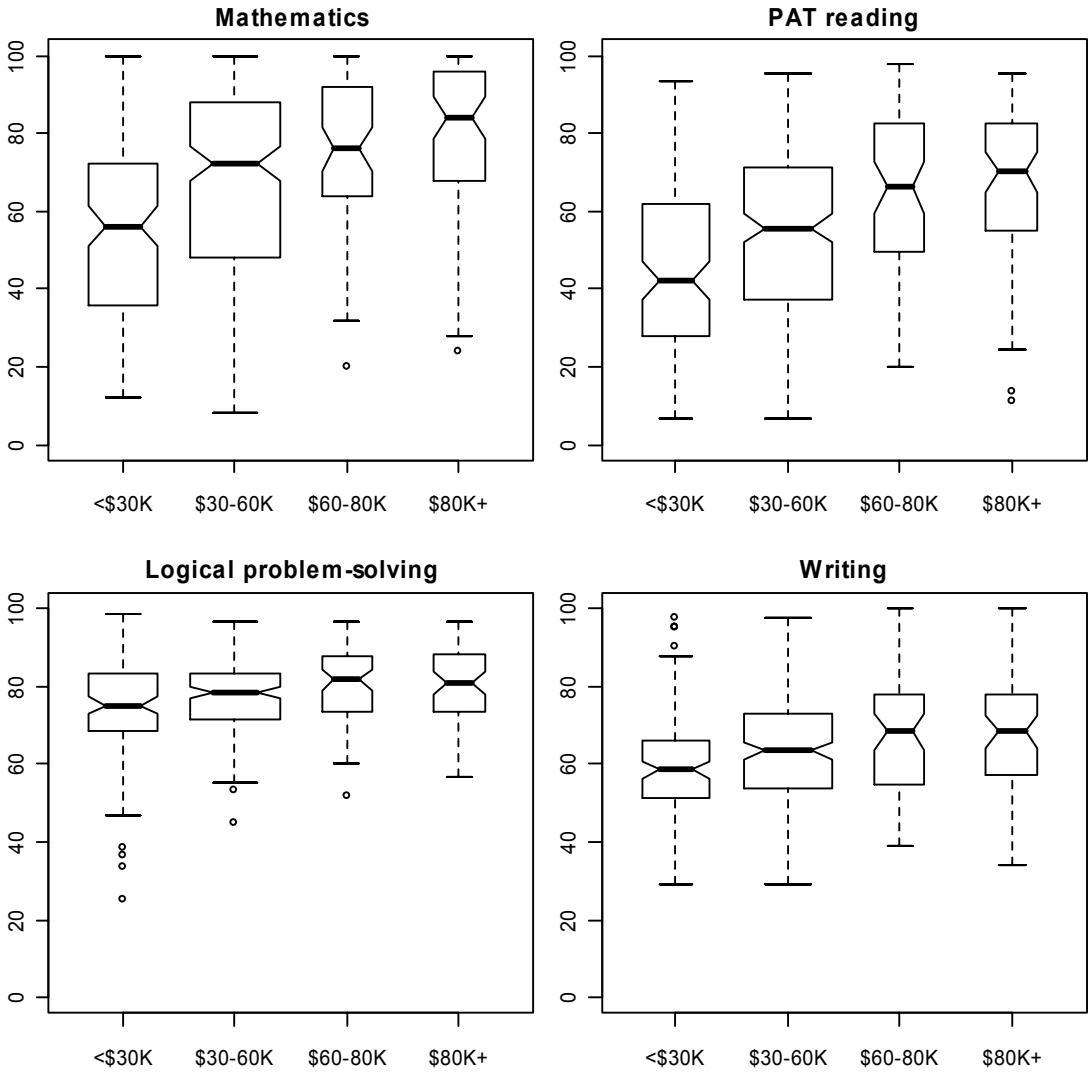


Figure 5 shows that:

- Logical problem-solving had the flattest gradient, with in fact the highest and lowest scores being achieved by young people from the lowest income group. The only probable statistically significant differences are between those from the lowest and highest income groups.
- Writing also had a flat gradient, and there was little difference between the scores for the two highest income groups. There is a probable statistically significant difference between the scores of these two groups, and the scores of the lowest income group.
- Mathematics and reading comprehension show the steepest gradients, with statistically significant differences in mathematics between all groups except the low-middle ($30–60K) and high-middle ($60–80K) income groups, and in reading comprehension between all groups except the two highest income groups.

Figure 6 **Attitudinal competencies measured as percentages for age-5 family income groups**

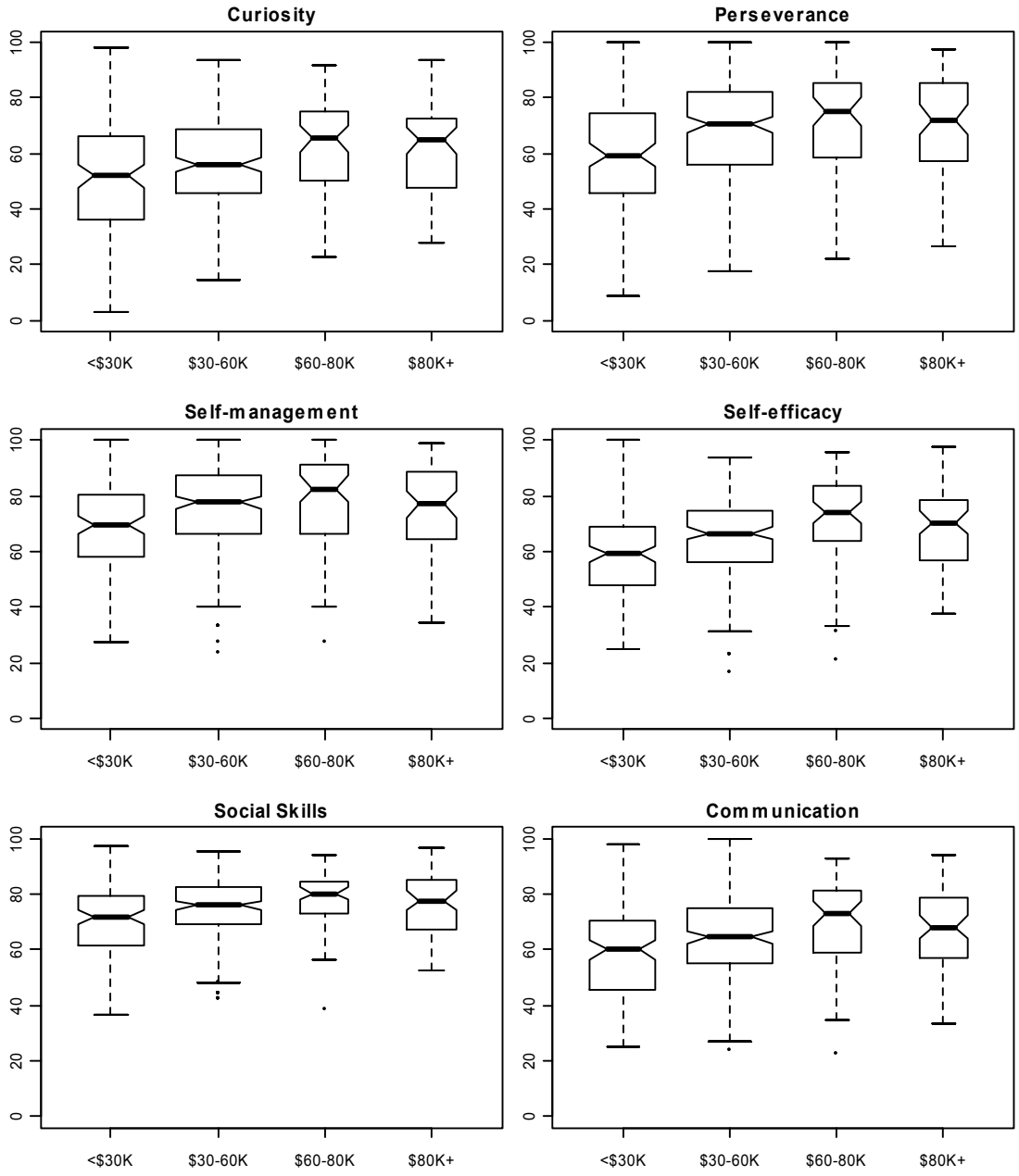


Figure 6 shows that:

- There is a slight gradient across the first three (lowest) income groups, but for all the attitudinal competencies the median score for the highest income group is slightly lower than that for the high-middle group. In all instances, the highest score is achieved by a young person from the low or low-middle income groups, and the lowest score is never achieved by a young person from the high income group.
- In all competencies, the score for the low income group is statistically significantly lower than the score in the high-middle income group, and in curiosity, perseverance, and self-efficacy the difference between the lowest and highest income groups is significant.

Figure 7 **Cognitive competencies measured as percentages for gender**

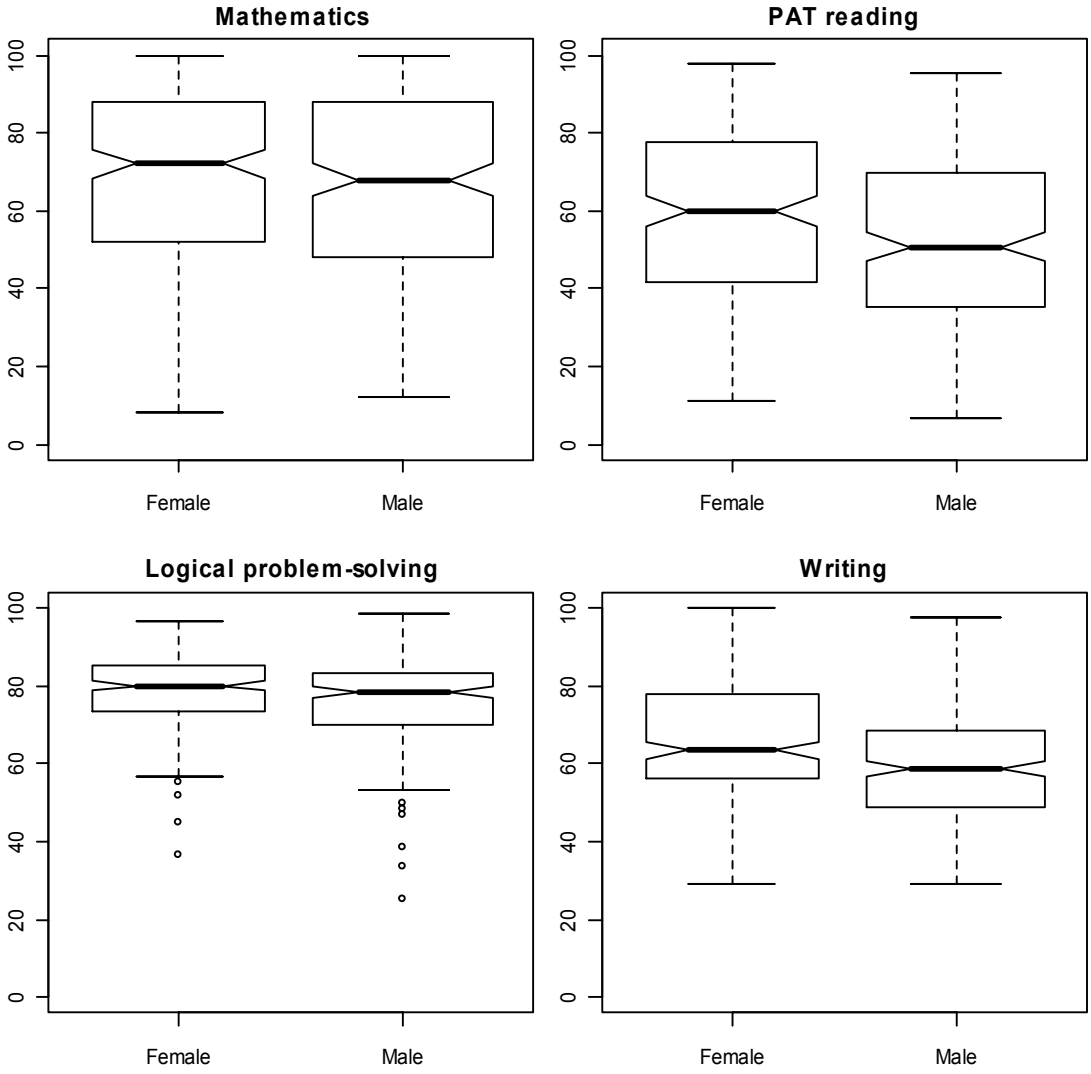
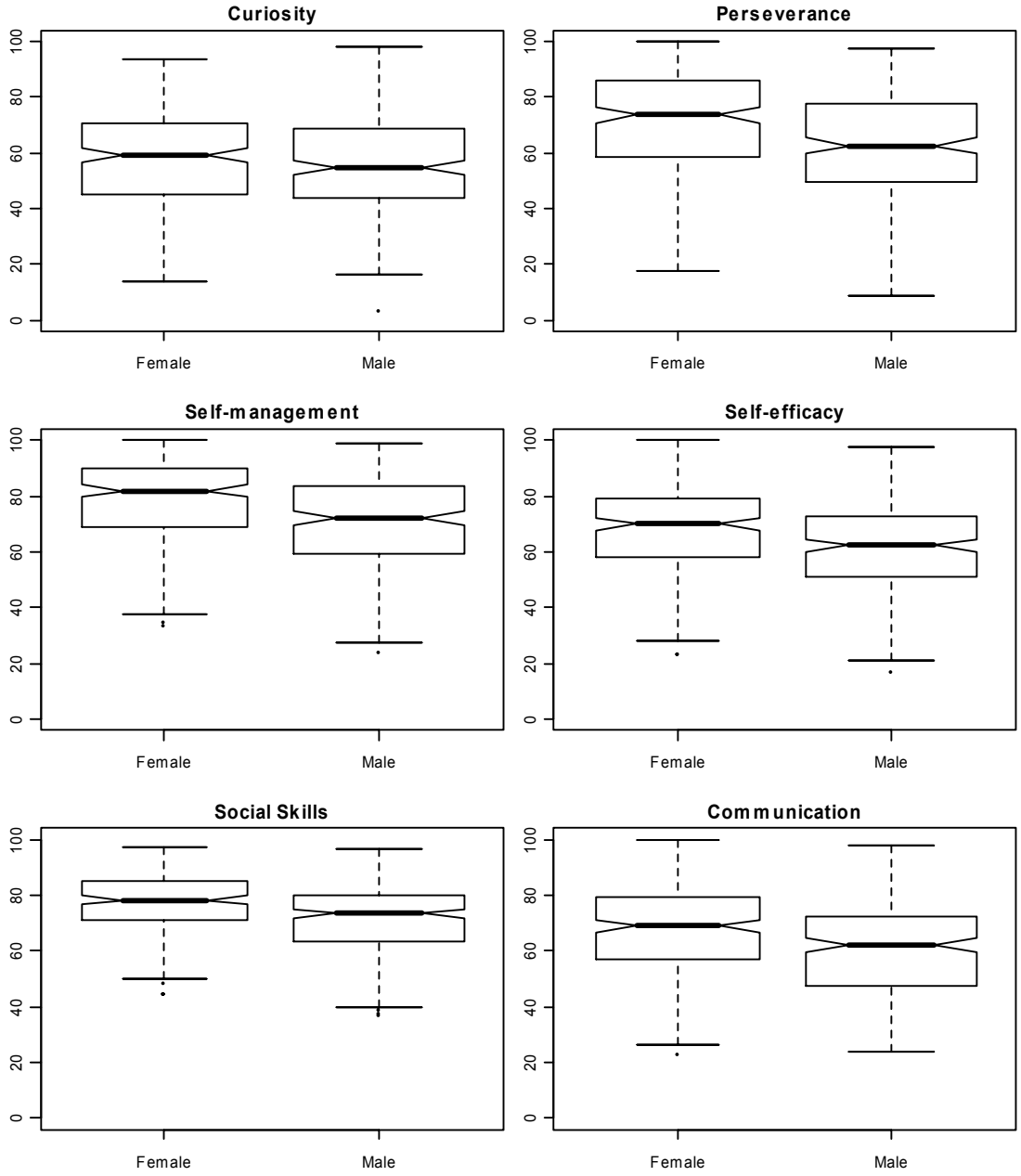


Figure 8 **Attitudinal competencies measured as percentages for gender**



Figures 7 and 8 show that:

- The girls achieved statistically significantly higher scores in reading comprehension and writing, but not in mathematics or logical problem-solving (although they did on average achieve higher scores in all competencies).
- The girls achieved statistically significantly higher scores in all the attitudinal competencies other than curiosity (although they did on average achieve higher scores in all competencies).
- The highest and lowest scores for the two groups in each of the competencies seldom differed by much.

Figure 9 **Cognitive competencies measured as percentages for ethnic groups**

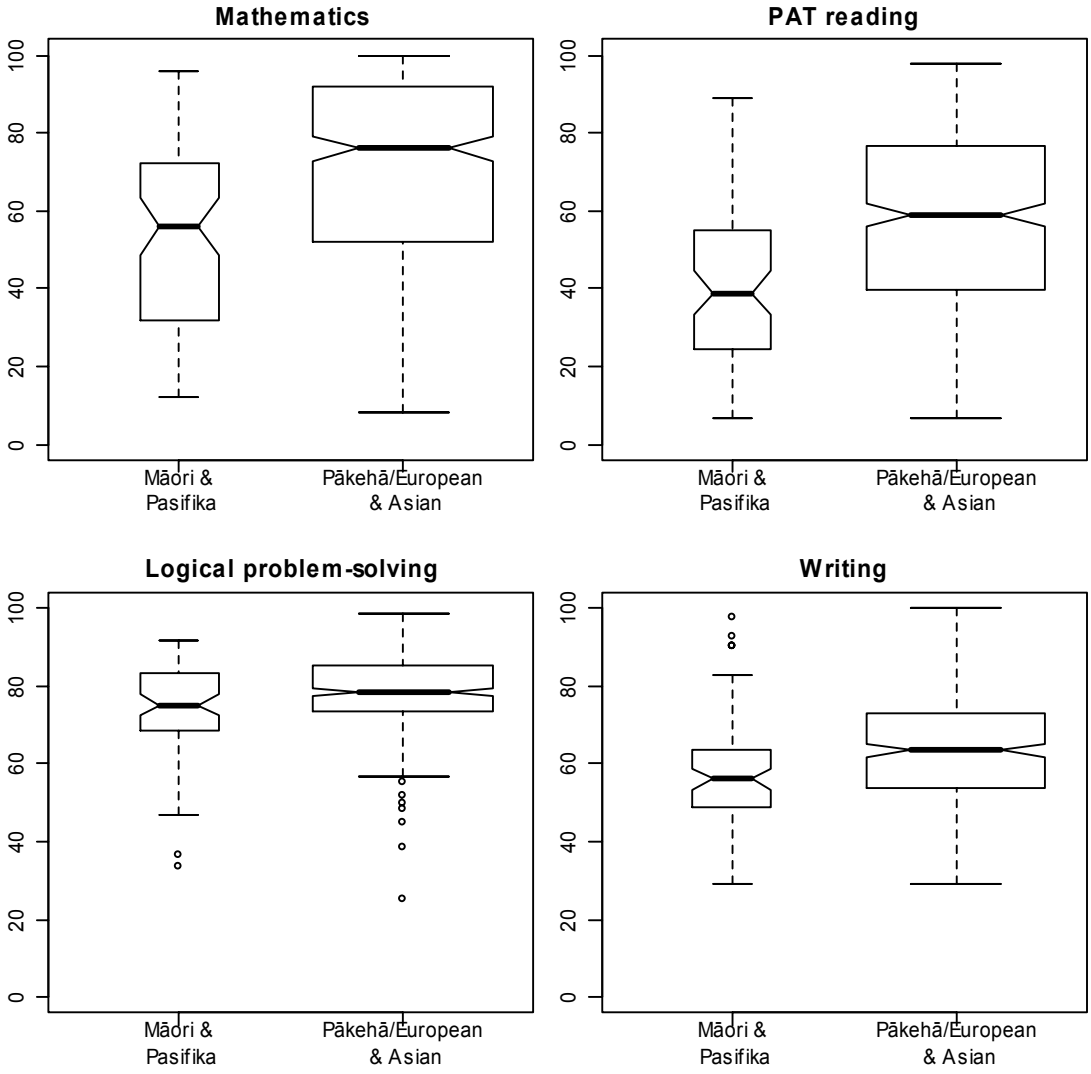
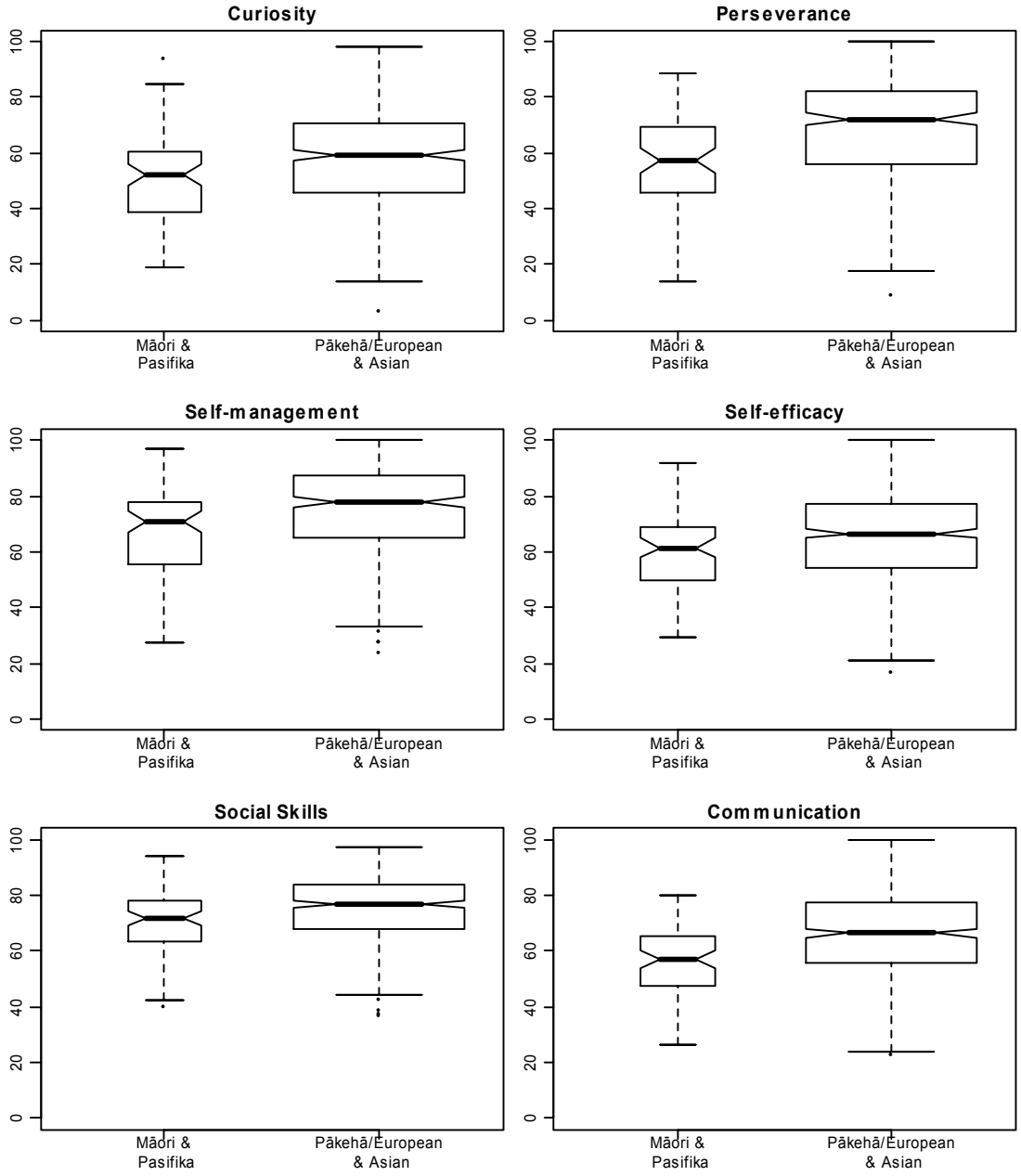


Figure 10 **Attitudinal competencies measured as percentages for ethnic groups**



Figures 9 and 10 show that:

- Pākehā/European and Asian young people achieved statistically significantly higher scores in all cognitive competencies other than logical problem-solving than Māori and Pacific young people did.
- Pākehā/European and Asian young people achieved statistically significantly higher scores in all the attitudinal competencies than Māori and Pacific young people did.
- In spite of the differences in the average scores, the lowest scores were almost always achieved by young people in the Pākehā/Asian group.

What this somewhat crude examination of the scores does not do is show whether differences found between levels of maternal qualification account for the (same) differences found between levels of age-5 family income (or vice versa), or the differences between ethnic groupings. We next explore such questions, and later (in another report) will seek to explain these differences more fully.

Models of social characteristics' contributions to each competency

We now look at each competency in turn, and see which of the social characteristics contribute significantly to that competency, and how well they "explain" the variation observed in the competency variables.

We used analysis of variance (ANOVA, or equivalently, regression with dummy variables) to fit the models. The models assumed that the competency score could be explained by the level of maternal qualification and/or age-5 family income and/or ethnicity and/or gender of the young person, plus other factors that were not accounted for in these models (extra random variation). Further, the models assumed that the effect/s of the social variable/s was *additive* (the predicted score was the sum of the effects).

The model was fitted with a corner-point parameterisation, which means that all the estimates produced by the model can be compared to a reference group. In this case, the reference group was those with mothers with no qualifications, with the lowest age-5 income, who were female, and Māori/Pacific (where all four social variables were kept in the model).

In previous reports from the Competent Children, Competent Learners study, differences between groups have been reported in terms of contrasts between group means. Here the differences are reported slightly differently, in terms of the *amount added to* (or subtracted from) *the reference category mean*.

As we have modelled (as in previous reports) additive effects for the social variables, we illustrate only the "marginal" effects—this is because we have assumed that the effect of an increase in age-5 family income is **the same** at each level of maternal qualification, and for each ethnic or gender group.

Mathematics

Maternal qualification, age-5 income, and ethnicity were significant predictors of the young people's mathematics score ($p < 0.0001$ for the model as a whole). These three social variables accounted for 20 percent of the variability (adjusted[4] R^2) in the mathematics scores.

The coefficients in the model are given in Table 14. These coefficients can be used to obtain estimated mathematics scores as in the following examples:

- The estimated score for a young person in the reference group (mother with no qualifications, Māori or Pacific, age-5 family income of under $30K) is 37.5.
- The estimated score for a young person with a mother with school education, in the $60–80K age-5 income group who is Māori or Pacific is
  37.5 + 14.3 = 51.8
- The estimated score for a young person with a mother with university education, in the $80K+ age-5 income group who is Pākehā/European/Asian is
  37.5 + 25.4 + 10.0 = 72.9

[4] The adjusted R^2 takes into account the number of parameters in the model, and is typically lower than the unadjusted R^2, which in this case was 21.6 percent.

Table 14 **Parameter estimates for age-14 mathematics scores**

Parameter	Estimate	Standard error	*p*-value[a]
Reference group[b]	37.5	3.54	<0.0001
School qualifications	14.3	3.34	<0.0001
Tertiary/trade	15.2	3.33	<0.0001
University	25.4	3.94	<0.0001
$30–60K	7.3	2.56	0.0043
$60–80K	11.5	3.47	0.0010
$80K+	12.8	3.52	0.0003
Pākehā/European & Asian	10.0	2.91	0.0006
Other significant differences between:			
School qualifications & university	11.0	3.18	0.0003
Tertiary/trade & university	10.2	2.98	0.0003
$30–60K & $80K+	5.5	3.12	0.0407

[a] *p*-values for *t*-test of whether the parameter estimated is zero. If the effect estimate is significant, this means that the mean for that (marginal) group is significantly higher than the mean for the reference group. Between group tests for other (non-reference) groups are given at the bottom of the table.

[b] Those with mothers with no qualification, with age-5 family incomes under $30K, and who are Māori or Pacific.

From the table we can see that there were statistically significant differences between those:

- whose mothers had no qualifications, and each of the other maternal-qualification groups;
- whose mothers had school-level qualifications and those with university qualifications;
- whose mothers had tertiary/trade qualifications and those with university qualifications (but there were no significant differences between those with school qualifications and tertiary/trade qualifications);
- in the lowest income group and those in each of the other income groups;
- in the low-middle income group and those in the high income group (but there were no significant differences between those in the low-middle and high-middle groups, nor between the high-middle and high groups); and
- in the two ethnic groups.

Logical problem-solving

Maternal qualification was the only significant predictor of logical problem-solving score ($p < 0.0001$ for the model as a whole). That is to say, once maternal qualification had been entered in the model, the other social variables did not add significantly to the model. This model accounted for 8 percent of the variability (adjusted R^2) in the logical problem-solving scores. The coefficients from the model are in Table 15.

Table 15 **Parameter estimates for age-14 logical problem-solving scores**

Parameter	Estimate	Standard error	*p*-value[a]
Reference group[b]	72.1	1.24	<0.0001
School qualifications	4.2	1.49	0.0045
Tertiary/trade	6.2	1.44	<0.0001
University	10.2	1.64	<0.0001
Other significant differences between:			
School qualifications & university	5.9	1.36	<0.0001
Tertiary/trade & university	4.0	1.3	0.0026

[a] *p*-values for *t*-test of whether parameter is zero. If the effect estimate is significant, this means that the mean for that (marginal) group is significantly higher than the mean for the reference group. Between group tests for other (non-reference) groups are given at the bottom of the table.

[b] Those with mothers with no qualification.

From the table we can see that there were statistically significant differences between those:

- whose mothers had no qualifications, and each of the other maternal-qualification groups;
- whose mothers had school-level qualifications and those with university qualifications; and
- whose mothers had tertiary/trade qualifications and those with university qualifications (but there were no significant differences between those with school qualifications and tertiary/trade qualifications).

Reading comprehension

All four social variables were statistically significant predictors of the PAT reading comprehension score. The model ($p < 0.001$ for the model as a whole) accounted for 21 percent of the variability in reading comprehension scores. The parameter estimates are listed in Table 16.

Table 16 **Parameter estimates for age-14 PAT reading comprehension scores**

Parameter	Estimate	Standard error	*p*-value[a]
Reference group[b]	33.1	3.5	<0.0001
School qualifications	10.1	3.16	0.0015
Tertiary/trade	13.0	3.14	<0.0001
University	21.7	3.71	<0.0001
$30–60K	5.5	2.41	0.0244
$60–80K	12.3	3.27	0.0002
$80K+	13.1	3.3	<0.0001
Pākehā/European & Asian	8.1	2.76	0.0006
Male	-5.6[c]	1.91	0.0033
Other significant differences between:			
School & university	11.6	2.99	0.0001
Tertiary/trade & university	8.7	2.79	0.0019
$30–60K & $60–80K	6.9	2.93	0.0194
$30–60K & $80K+	7.7	2.93	0.0093

[a] *p*-values for *t*-test of whether parameter is zero. If the effect estimate is significant, this means that the mean for that (marginal) group is significantly higher than the mean for the reference group. Between group tests for other (non-reference) groups are given at the bottom of the table.

[b] Those with mothers with no qualification, with age-5 family incomes under $30K, and who are female and Māori or Pacific.

[c] The coefficient for males is negative as males scored *less* than females.

From the table we can see that there were statistically significant differences between those:

- whose mothers had no qualifications, and each of the other maternal-qualification groups;
- whose mothers had school-level qualifications and those with university qualifications;
- whose mothers had tertiary/trade qualifications and those with university qualifications (but there were no significant differences between those with school qualifications and tertiary/trade qualifications);
- in the lowest income group and those in each of the other income groups;
- in the low-middle and high-middle income groups;
- in the low-middle income group and those in the high income group (but there were no significant differences between the high-middle and high income groups);
- in the two gender groups; and
- in the two ethnic groups.

Writing

All four social variables were statistically significant predictors of the writing score. The model ($p < 0.001$ for the model as a whole) accounted for 12 percent of the variability in writing scores. The parameter estimates are listed in Table 17.

Table 17 **Parameter estimates for age-14 writing scores**

Parameter	Estimate	Standard error	*p*-value[a]
Reference group[b]	55.6	2.43	<0.0001
School qualifications	4.8	2.19	0.0302
Tertiary/trade	6.0	2.18	0.0061
University	8.6	2.57	0.0009
$30–60K	2.4	1.67	0.1547
$60–80K	4.4	2.26	0.0553
$80K+	4.1	2.29	0.0078
Pākehā/European & Asian	3.9	1.90	0.0078
Male	-6.1[c]	1.32	<0.0001

[a] *p*-values for *t*-test of whether parameter is zero. If the effect estimate is significant, this means that the mean for that (marginal) group is significantly higher than the mean for the reference group. No other contrasts between groups were significant.
[b] Those with mothers with no qualification, with age-5 family incomes under $30K, and who are female and Māori or Pacific.
[c] The coefficient for males is negative as males scored *less* than females.

From the table we can see that there were statistically significant differences between those:

- whose mothers had no qualifications, and each of the other maternal-qualification groups (but between no other combinations of the levels);
- in the lowest income group and those in the high-middle and high income groups (but not the low-middle group, nor between any of the other pairs of income groups);
- in the two gender groups; and
- in the two ethnic groups.

Curiosity

Maternal qualification and ethnicity were the only significant predictors of curiosity score ($p < 0.0001$ for the model as a whole). That is to say, once maternal qualification and ethnicity had been entered in the model, the other social variables did not add significantly to the model. This model accounted for 7 percent of the variability (adjusted R^2) in the curiosity scores The coefficients from the model are in Table 18.

Table 18 **Parameter estimates for age-14 curiosity scores**

Parameter	Estimate	Standard error	*p*-value[a]
Reference group[b]	45.2	2.64	<0.0001
School qualifications	4.8	2.56	0.0613
Tertiary/trade	7.7	2.51	0.0024
University	13.3	2.89	<0.0001
Pākehā/European & Asian	6.2	2.23	0.0058
Other significant differences between:			
School & university	8.5	2.36	0.0003
Tertiary/trade & university	5.7	2.25	0.0120

[a] *p*-values for *t*-test of whether parameter is zero. If the effect estimate is significant, this means that the mean for that (marginal) group is significantly higher than the mean for the reference group. Between group tests for other (non-reference) groups are given at the bottom of the table.
[b] Those with mothers with no qualification, and who are Māori or Pacific.

From the table we can see that there were statistically significant differences between those:

- whose mothers had no qualifications, and each of the other maternal-qualification groups;
- whose mothers had school-level qualifications and those with university qualifications;
- whose mothers had tertiary/trade qualifications and those with university qualifications (but there were no significant differences between those with school qualifications and tertiary/trade qualifications); and
- in the two ethnic groups.

Perseverance

All four social variables were statistically significant predictors of the perseverance score. The model ($p < 0.001$ for the model as a whole) accounted for 15 percent of the variability in perseverance scores. The parameter estimates are listed in Table 19.

Table 19 **Parameter estimates for age-14 perseverance scores**

Parameter	Estimate	Standard error	*p*-value[a]
Reference group[b]	55.6	3.01	<0.0001
School qualifications	2.9	2.77	0.2876
Tertiary/trade	2.5	2.76	0.3742
University	9.1	3.27	0.0058
$30–60K	5.6	2.12	0.0087
$60–80K	7.4	2.88	0.0109
$80K+	5.8	2.92	0.0465
Pākehā/European & Asian	9.3	2.42	0.0001
Male	-9.6[c]	1.68	<0.0001
Other significant differences between:			
School & university	6.1	2.63	0.0104
Tertiary/trade & university	6.6	2.47	0.0039

a *p*-values for *t*-test of whether parameter is zero. If the effect estimate is significant, this means that the mean for that (marginal) group is significantly higher than the mean for the reference group. Between group tests for other (non-reference) groups are given at the bottom of the table.

b Those with mothers with no qualification, with age-5 family incomes under $30K, and who are female and Māori or Pacific.

c The coefficient for males is negative as males scored *less* than females.

From the table we can see that there were statistically significant differences between those:

- whose mothers had no qualifications, and those with university qualifications (but not any of the other groups);
- whose mothers had school-level qualifications and those with university qualifications;
- whose mothers had tertiary/trade qualifications and those with university qualifications (but there were no significant differences between those with school qualifications and tertiary/trade qualifications);
- in the lowest income group and those in each of the other income groups (but there were no significant differences between any other pairs of income groups);
- in the gender groups; and
- in the two ethnic groups.

Self-management

All four social variables were statistically significant predictors of the self-management score. Maternal qualifications, when fitted after the other variables, was only just significant ($p = 0.027$, when that effect was fitted last). The model ($p < 0.001$ for the model as a whole) accounted for 12 percent of the variability in perseverance scores. The parameter estimates are listed in Table 20.

Table 20 **Parameter estimates for age-14 self-management scores**

Parameter	Estimate	Standard error	*p*-value[a]
Reference group[b]	68.3	2.71	<0.0001
School qualifications	1.6	2.43	0.5189
Tertiary/trade	-0.3	2.43	0.8863
University	6.1	2.87	0.0330
$30–60K	5.0	1.86	0.0080
$60–80K	5.5	2.53	0.0308
$80K+	3.3	2.56	0.1961
Pākehā/European & Asian	6.4	2.12	0.0029
Male	-8.5[c]	1.48	<0.0001
Other significant differences between:			
School & university	4.6	2.32	0.0245
Tertiary/trade & university	6.5	2.17	0.0015

[a] *p*-values for *t*-test of whether parameter is zero. If the effect estimate is significant, this means that the mean for that (marginal) group is significantly higher than the mean for the reference group. Between group tests for other (non-reference) groups are given at the bottom of the table.

[b] Those with mothers with no qualification, with age-5 family incomes under $30K, and who are female and Māori or Pacific.

[c] The coefficient for males is negative as males scored *less* than females.

From the table we can see that there were statistically significant differences between those:

- whose mothers had no qualifications, and those with a university qualification (only);
- whose mothers had school-level qualifications and those with university qualifications;
- whose mothers had tertiary/trade qualifications and those with university qualifications (but there were no significant differences between those with school qualifications and tertiary/trade qualifications);
- in the lowest income group and those in the two middle income groups (but not the highest income group, nor between any other pairs of income group);
- in the gender groups; and
- in the two ethnic groups.

Self-efficacy

Maternal qualifications, age-5 family income, and ethnicity were statistically significant predictors of the self-efficacy score. The model ($p < 0.001$ for the model as a whole) accounted for 13 percent of the variability in self-efficacy scores. The parameter estimates are listed in Table 21.

Table 21 **Parameter estimates for age-14 self-efficacy scores**

Parameter	Estimate	Standard error	*p*-value[a]
Reference group[b]	60.9	2.16	<0.0001
School qualifications	0.4	2.23	0.8662
Tertiary/trade	3.6	2.22	0.1057
University	7.3	2.61	0.0055
$30–60K	5.3	1.70	0.0019
$60–80K	9.8	2.32	<0.0001
$80K+	6.2	2.34	0.0087
Male	-6.1[c]	1.36	<0.0001
Other significant differences between:			
$30–60K & $60–80K	4.5	2.09	0.0160
School & tertiary/trade	3.2	1.66	0.0265
School & university	6.9	2.11	0.0006
Tertiary/trade & university	3.7	1.99	0.0325

[a] *p*-values for *t*-test of whether parameter is zero. If the effect estimate is significant, this means that the mean for that (marginal) group is significantly higher than the mean for the reference group. Between group tests for other (non-reference) groups are given at the bottom of the table.

[b] Those with mothers with no qualification, with age-5 family incomes under $30K, and who are female.

[c] The coefficient for males is negative as males scored *less* than females.

From the table we can see that there were statistically significant differences between those:

- whose mothers had no qualifications, and those with university qualifications (but not any of the other qualification groups);
- whose mothers had school-level qualifications and those with tertiary/trade qualifications;
- whose mothers had school-level qualifications and those with university qualifications;
- whose mothers had tertiary/trade qualifications and those with university qualifications;
- in the lowest income group and those in each of the other income groups;
- in the low-middle income group and those in the high-middle income group (but there were no significant differences between those in the low-middle and high groups, nor between the high-middle and high groups); and
- in the gender groups.

Social skills

Gender, ethnicity, and age-5 family income were statistically significant predictors of the social skills score. The model ($p < 0.001$ for the model as a whole) accounted for 11 percent of the variability in scores. The parameter estimates are listed in Table 22.

Table 22 **Parameter estimates for age-14 social skills scores**

Parameter	Estimate	Standard error	*p*-value[a]
Reference group[b]	55.6	2.43	<0.0001
$30–60K	3.4	1.31	0.0091
$60–80K	6.6	1.76	0.0002
$80K+	4.9	1.74	0.0053
Pākehā/European & Asian	3.8	1.50	0.0126
Male	-5.6[c]	1.06	<0.0001
Other significant differences between:			
$30–60K & $60–80K	3.2	1.61	0.0235

[a] *p*-values for *t*-test of whether parameter is zero. If the effect estimate is significant, this means that the mean for that (marginal) group is significantly higher than the mean for the reference group. Between group tests for other (non-reference) groups are given at the bottom of the table.

[b] Those with age-5 family incomes under $30K, and who are female and Māori or Pacific.

[c] The coefficient for males is negative as males scored *less* than females.

From the table we can see that there were statistically significant differences between those:

- in the lowest income group and those in each of the other income groups;
- in the low-middle income group and those in the high-middle income group (but there were no significant differences between those in the low-middle and high groups, nor between the high-middle and high groups);
- in the gender groups; and
- in the two ethnic groups.

Communication

All four social variables were statistically significant predictors of the communication score. The model ($p < 0.001$ for the model as a whole) accounted for 15 percent of the variability in communication scores. The parameter estimates are listed in Table 23.

Table 23 **Parameter estimates for age-14 communication scores**

Parameter	Estimate	Standard error	*p*-value[a]
Reference group[b]	54.6	2.50	<0.0001
School qualifications	5.2	2.25	0.0222
Tertiary/trade	5.7	2.25	0.0113
University	10.9	2.66	<0.0001
$30–60K	3.4	1.72	0.0472
$60–80K	6.6	2.34	0.0047
$80K+	3.9	2.37	0.1026
Pākehā/European & Asian	5.5	1.96	0.0050
Male	-7.3[c]	1.37	<0.0001
Other significant differences between:			
School & university	5.7	2.14	0.0038
Tertiary/trade & university	5.2	2.01	0.0051

[a] *p*-values for *t*-test of whether parameter is zero. If the effect estimate is significant, this means that the mean for that (marginal) group is significantly higher than the mean for the reference group. Between group tests for other (non-reference) groups are given at the bottom of the table.

[b] Those with mothers with no qualification, with age-5 family incomes under $30K, and who are female and Māori or Pacific.

[c] The coefficient for males is negative as males scored *less* than females.

From the table we can see that there were statistically significant differences between those:

- whose mothers had no qualifications, and each of the other maternal-qualification groups;
- whose mothers had school-level qualifications and those with university qualifications (but not with those with tertiary-trade qualifications);
- whose mothers had tertiary/trade qualifications and those with university qualifications;
- in the lowest income group and those in each of the two middle income groups (but not those in the high income group, nor between any other pairs of income group);
- in the gender groups; and
- in the two ethnic groups.

Summary

Table 25 summarises the social variables that were significant predictors of young people's scores, and the proportion of variance accounted for by them.

Table 24 **Social variables' contribution to the variance in age-14 scores**

Competency					Proportion of variance accounted for by social characteristics %
Mathematics	Maternal qualification	Family income		Ethnicity	20
Logical problem-solving	Maternal qualification				8
Reading comprehension	Maternal qualification	Family income	Gender	Ethnicity	21
Writing	Maternal qualification	Family income	Gender	Ethnicity	12
Curiosity	Maternal qualification			Ethnicity	7
Perseverance	Maternal qualification	Family income	Gender	Ethnicity	15
Self-management	Maternal qualification	Family income	gender	Ethnicity	12
Self-efficacy	Maternal qualification	Family income		Ethnicity	13
Social skills		Family income	Gender	Ethnicity	11
Communication	Maternal qualification	Family income	Gender	Ethnicity	15

If we look at the competency scores as a whole, there are some, like mathematics, reading comprehension, and writing, that we may expect to be higher in young people who are intelligent, and who come from intellectually rich, print-saturated home and school environments. There are some where we would expect environmental differences to have little effect on the competency—such as logical problem-solving.

What the tests above have shown is that maternal qualification levels, which may be associated with whether a young person is more likely to be intellectually advantaged or not, and to have had a print-saturated home environment or not, are strongly associated with mathematics, reading comprehension, logical problem-solving, and curiosity. The effects of maternal qualification were least strong in the attitudinal competencies, particularly social skills.

Age-5 family income, which may be associated with resources available in the home environment, and the (non)deprived home environment, and early childhood education and school socioeconomic mix, is relatively strongly associated with mathematics, reading comprehension, self-efficacy, and social skills, with increasing advantage being associated with increasing competency scores. The advantages conferred by a higher age-5 family income were least marked in logical problem-solving, curiosity, perseverance, self-management, and communication.

Ethnicity is most strongly associated with mathematics, and is relatively strongly associated with reading comprehension, writing, curiosity, perseverance, self-management, and communication. It is not associated with logical problem-solving, nor with self-efficacy (although the differences for these competencies, while smaller than those for other competencies, were in the same direction—Māori and Pacific students did, on average, achieve slightly lower scores). In the models fitted, where ethnicity was significant, it indicated a significant effect over and above effects due to maternal qualification and age-5 income.

Gender differences were greatest in the attitudinal competencies (with the exception of curiosity, where the difference was not statistically significant), in writing, and to a slightly lesser extent in reading comprehension. Gender differences were not statistically significant in mathematics, logical problem-solving, and curiosity.

4. How predictable are age-14 competency levels?

In this chapter, we start with correlations between the individual competency measures over time. We then present overall models using the measures grouped into two factors—the cognitive, and the attitudinal. Finally, we focus on movements over time in relation to initial levels of performance at ages 5 and 8 for those who were performing at low or high levels at earlier ages, using quartiles.

CORRELATIONS BETWEEN AGE-14 SCORES AND EARLIER SCORES

Correlations between scores across the years would be very high if each study participant maintained his or her level of each competency relative to the others. Thus these correlations can loosely be considered as measures of "coherence" or maintenance of relative position in the group. We look first at the consistency of performance for the cognitive competencies measured at age 14. With the exception of writing, the correlations increase from age 8. Mathematics has the highest consistency between age near-5 and age 14.

Table 25 **Correlations for cognitive composite scores 5–14**

	Correlation between 5yrs' & 14yrs' scores % (*n*=252–258)	**Correlation between 6yrs' & 14yrs' scores % (*n*=259–260)**	**Correlation between 8yrs' & 14yrs' scores % (*n*=471–474)**	**Correlation between 10yrs' & 14yrs' scores % (*n*=469–474)**	**Correlation between 12yrs' & 14yrs' scores % (*n*=468–474)**
Mathematics	0.57	0.57	0.72	0.77	0.82
PAT reading comprehension *(cf. early literacy at age 5, cf. Burt word reading age 6)*	0.41	0.57	0.69	0.78	0.82
Writing *(cf. early literacy at age 5, cf. Burt word reading age 6)*	0.34	0.50	0.36	0.44	0.54
Logical problem-solving	0.38	0.39	0.56	0.66	0.71

The consistency over time in performance on the attitudinal measures is lower than for the cognitive competencies. There is increasing consistency with time.

Table 26 **Correlations for attitudinal competency scores comparing ages 5, 6, 8, 10, and 12 with age 14 within each competency**

	Correlation between 5yrs' &14yrs' *scores %* (*n*=259)	Correlation between 6yrs' &14yrs' *scores %* (*n*=259)	Correlation between 8yrs' &14yrs' *scores %* (*n*=474)	Correlation between 10yrs' & 14yrs' *scores %* (*n*=474)	Correlation between 12yrs' & 14yrs' *scores %* (*n*=473)
Curiosity	0.17	0.29	0.22	0.25	0.41
Perseverance	0.20	0.35	0.42*	0.43*	0.58*
Self-management	0.14	0.35	0.42*	0.46*	0.50*
Self-efficacy	0.14	0.40	0.38*	0.42*	0.45*
Social skills with peers	0.32**	0.30	0.35*	0.37*	0.41*
Social skills with adults	0.12	0.30	0.29*	0.29*	0.36*
Communication	0.19	0.38	0.37*	0.44*	0.48*

* These values involved one more student than the *n* given.

** This value involved one less student than the *n* given.

We also calculated the correlations for both the cognitive and attitudinal competencies separately for those for whom we have competency measure at age 5, and those for whom we have it from age-8 only. There were no significant differences.

MODELLING OF COMPETENCY FACTORS OVER TIME

In the analysis of the age-12 data, we combined the competency measures into factors to gain a clearer overall picture of the predictive capacity of early cognitive and social competencies for later competency outcomes. We have used this approach to analyse the predictability of age-14 competency levels from two key earlier ages—age 8, and age 5. We start with the analysis of age-8 competency levels in relation to the young people's current competency levels.

AGE 8 TO AGE 14

A factor analysis on all competency measures was applied to data for each stage of the study (8, 10, 12, and 14 years old) separately. At each stage there is clear demarcation between the attitudinal and cognitive competencies. Cronbach's α's for the competency factors are given below.

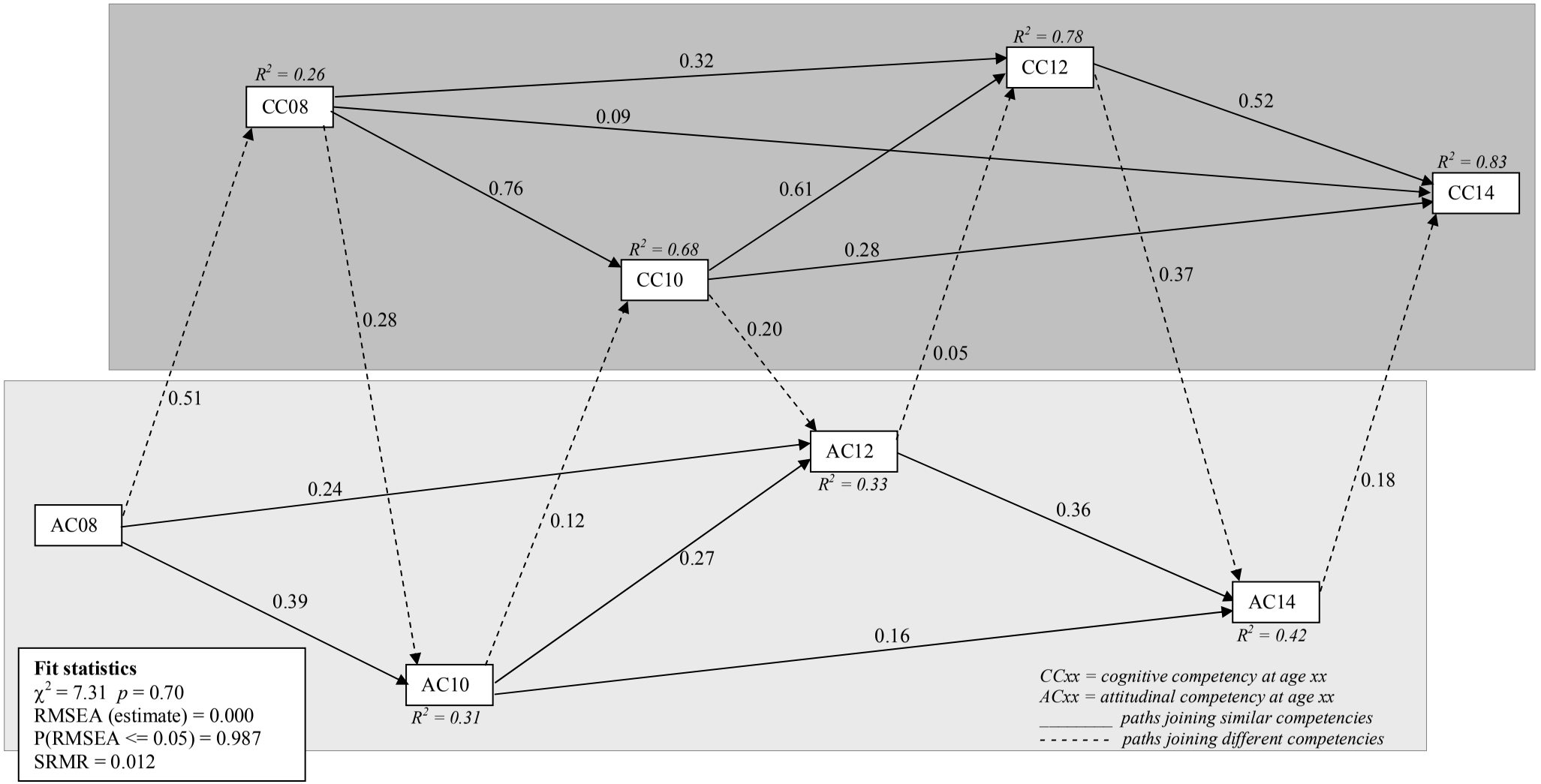
Table 27 **Reliability coefficients for competency factors ages 8–14**

Age	Competency factor	α
14 years	Cognitive	0.85
	Attitudinal	0.96
12 years	Cognitive	0.86
	Attitudinal	0.89
10 years	Cognitive	0.84
	Attitudinal	0.88
8 years	Cognitive	0.85
	Attitudinal	0.87

At age 12, a path analysis model suggested that attitudinal competencies were useful for predicting cognitive competencies at the same stage of development, and also for predicting attitudinal competency outcomes both 2 and 4 years later. Cognitive competencies were useful for predicting cognitive outcomes in the future,

and also for predicting attitudinal competency outcomes 2 years later. This time we wanted to see whether this pattern had persisted, or changed. The model diagram below shows a series of dotted lines (paths) zig-zagging between the attitudinal, and cognitive competencies. The lines have been dotted to distinguish them from paths within the same competency across time. The zig-zag pattern was observed at age 12 and it has persisted here. Attitudinal competencies have a statistically significant association with cognitive competencies at the same age. Cognitive competencies have a statistically significant association with attitudinal competencies at the **next** stage. On the whole, the latter set of paths (cognitive to attitudinal at the next stage) are stronger than the former but certainly there is a considerable amount of interplay between the attitudinal, and cognitive aspects of children's performance.

Figure 11 **Path analysis of competency factors: ages 8–14**



Cognitive competency at age 14 may be predicted by cognitive competency at age 12, 10, and 8, although this last path is weak (just significant at the 5 percent level, and using a normalising transformation, drops out altogether). This indicates that the pattern observed at 12 is persisting. Young people's level of cognitive competence from age 8 is long-lasting—at least 4 years, maybe longer.

At each stage, cognitive competencies also have significant contributions from the attitudinal competencies. At 14, attitudinal competency at 14 is a useful predictor; at 12, attitudinal competency at 12 is a useful predictor; and so on. This indicates the attitudinal competency **at the same age** is connected to cognitive competency. However, attitudinal competency ratings at previous times do not appear to have a lasting association with cognitive outcomes.

Attitudinal competencies are most strongly predicted by their immediate predecessors, i.e. attitudinal competency 2 years previously. There are also, however, significant contributions made by attitudinal competency 4 years previously and cognitive competency 2 years previously.

Looking at the two grey rectangles separately, we observe that the pattern is similar for attitudinal and cognitive competencies. That is, competencies in both areas are strongly related to their direct predecessors (the same measure 2 years previously), and also related to their predecessors 4 years previously. These relationships are stronger for cognitive competencies (see the size of the path coefficients). This indicates that cognitive competencies may be part of a more consistent trait than the attitudinal competencies, or that cognitive performance is harder to change than attitudinal performance.

AGE NEAR-5 AND 6 YEARS TO AGE 14

For this part of the modelling process we have a greatly reduced sample size. There are 260 young people for whom we have age-5 competency measures. This makes the use of path analysis much less attractive. Good models of this type need a large sample, preferably as many as 10–20 observations for each estimated parameter.[5] Thus we have too few observations to model a detailed picture which includes cognitive and attitudinal competencies at all stages.

Cronbach's α's for cognitive and attitudinal competencies at near-5 and 6 were calculated.

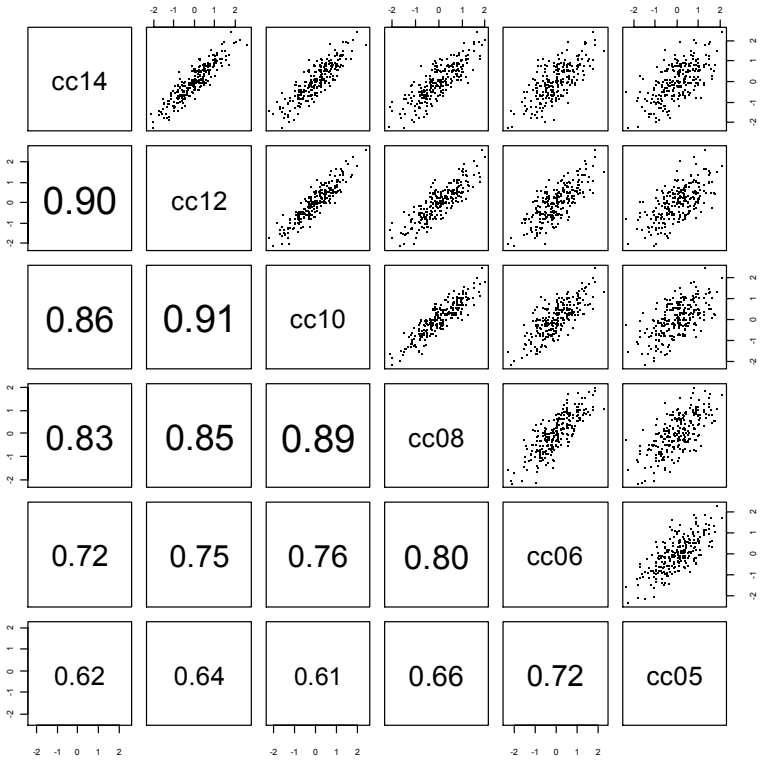
Table 28 **Reliability coefficients for competency factors at ages 5 and 6**

Age	Competency factor	α	Variables making up the factor
6 years	Cognitive	0.81	Mathematics, Word recognition, Spelling (invented), Logical problem-solving
	Attitudinal	0.88	Perseverance, Independence, Curiosity, Social skills with peers, Social skills with adults, Communication skills
5 years	Cognitive	0.73	Early number knowledge, Early literacy, Logical reasoning
	Attitudinal	0.83	Perseverance, Self social-emotional skills, Inquisitiveness, Social skills with peers, Social skills with adults, Communication skills

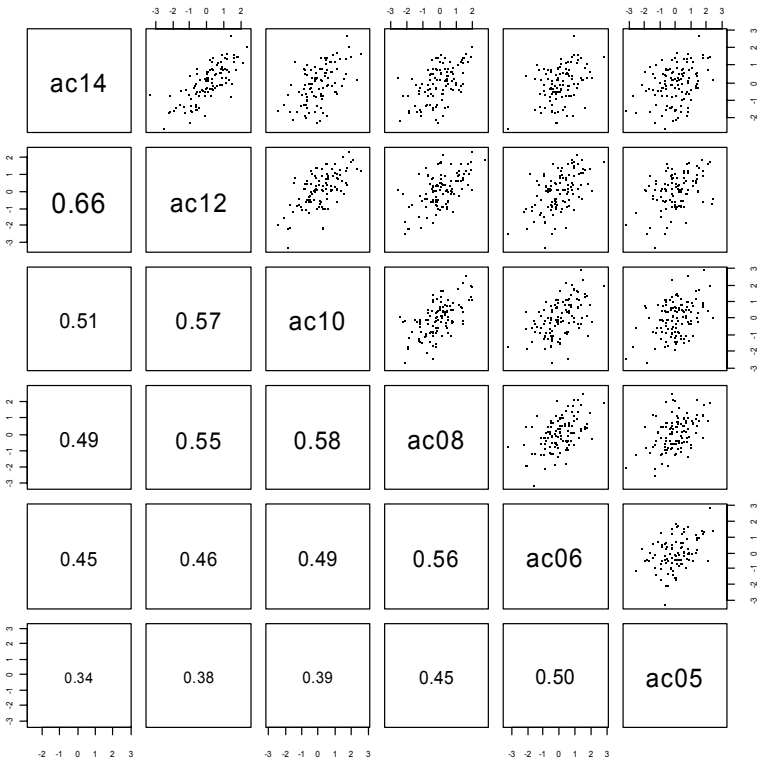
We investigated the linear associations across time for both attitudinal and cognitive competencies. There is a very high degree of correlation for the cognitive factors, and weaker, but meaningful, correlations across time for the attitudinal competencies.

[5] Kline, R.B. (1998). *Principles and practice of structural equation modelling*. NY: Guilford Press.

Figure 12 **Linear associations across time (*n*=260)**



CCxx = cognitive competency at age xx



ACxx = attitudinal competency at age xx

To gain a picture of how the early competencies relate to each other, separate regressions were run to ascertain how important earlier competencies are for predicting outcomes at 8. The following table shows that cognitive competency at 8 is well modelled by cognitive competency at 6 and attitudinal competency at 8. Attitudinal competency at 8 is predicted by attitudinal competency at 6 and 5. Cognitive competency at 6 is effectively modelled by cognitive competency at 5 and attitudinal competency at 6. Attitudinal competency at 6 is best predicted by attitudinal, and cognitive competencies at 5. Variables which made no significant contribution to explaining the outcome variable are omitted from the table.

Table 29 **Predicting age-8 outcomes**

Outcome variable	Predictors	Estimate	s.e.	R^2
CC08	CC06	0.68	0.04	0.67
	AC08	0.25	0.04	
AC08	AC06	0.38	0.06	0.39
	AC05	0.30	0.06	
CC06	CC05	0.77	0.04	0.68
	AC06	0.13	0.04	
AC06	AC05	0.40	0.06	0.34
	CC05	0.33	0.05	

CCxx = Cognitive (composite) competency at xx years
ACxx = Attitudinal (composite) competency at xx years

These models support the patterns found in the modelling of competencies from 8 to 14. However, when we attempted to build a more global picture with a path analysis model, the fit was not good. It may be that we did not have enough observations to secure a plausible model using path analysis, i.e. the hypothesised patterns do exist, but we do not have enough data to validate them. It could also be the case that it is harder to measure or isolate competencies at early ages, and therefore no strong overall picture emerges.

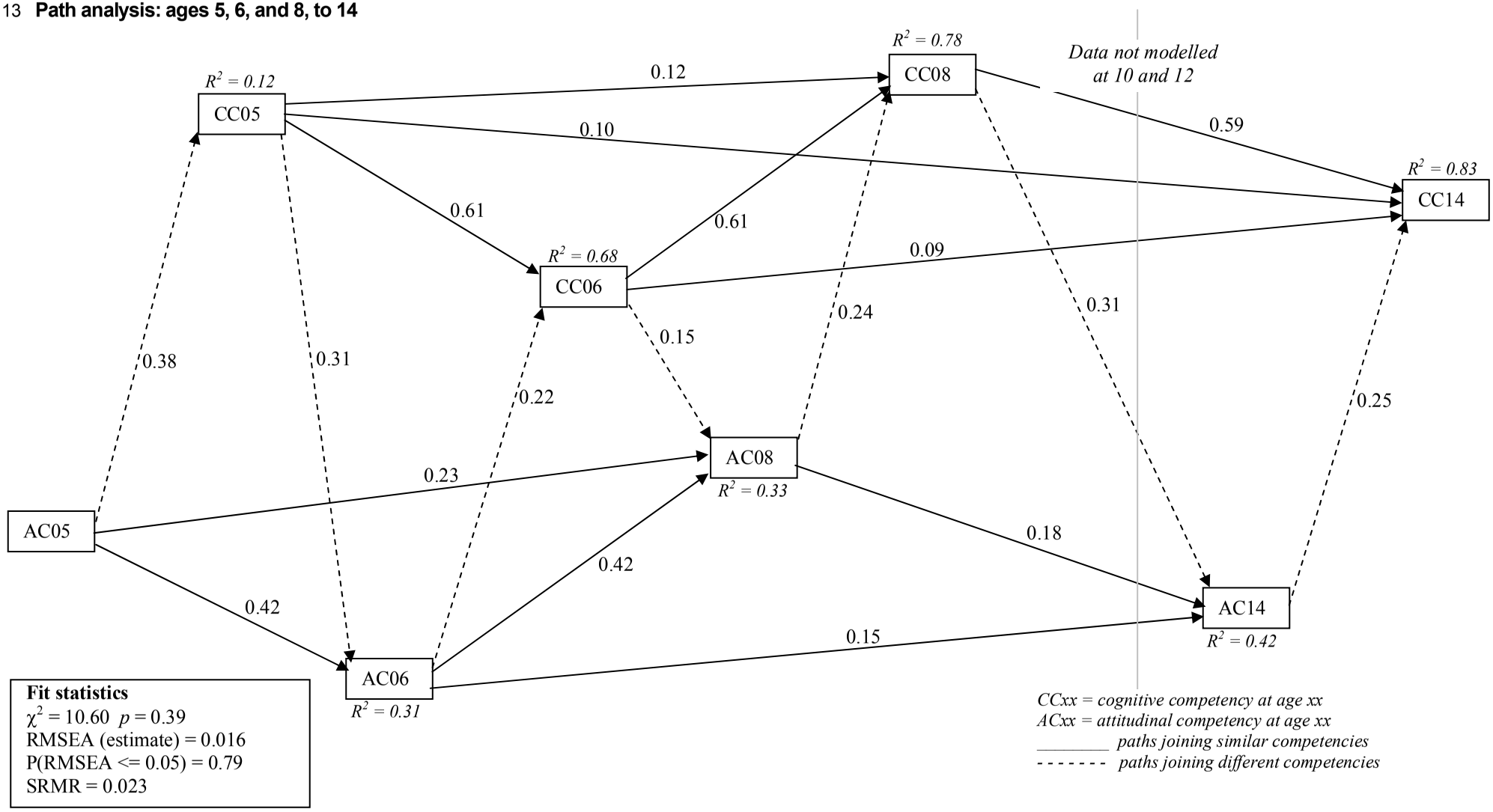
CAN WE USE COGNITIVE AND ATTITUDINAL COMPETENCIES AT 5, 6, AND 8, TO PREDICT COGNITIVE AND ATTITUDINAL COMPETENCIES AT 14?

Modelling data from near-5, 6, and 8, to 14 (without data from age 10 and 12) gives us an indication as to whether earlier competencies are related to later competencies or whether over time the effects of earlier competencies are completely lost. In the absence of competencies at 10 and at 12, competencies at 5, 6, and 8 can predict outcomes at 14 comparatively well. R^2s dropped by around 10 percent for the competencies at 14 compared to the first model in this chapter. This implies a high level of consistency between very early competencies and competencies at 14.

The patterns both within and between cognitive and attitudinal competencies that we observed using age-10 and age-12 data are repeated in the model below. The paths are somewhat more tenuous (as one should expect) but it is interesting to notice how the same patterns hold. Cognitive competency at 14 is modelled by the three latest available cognitive competencies and the current attitudinal competency; and attitudinal competency at 14 is directly affected by the two latest available attitudinal competencies and cognitive competency at the most recent stage.

This model also supports the hypothesis that cognitive performance is more consistent than attitudinal performance. One possible inference from this is that attitudinal competencies are less fixed over time, and may be more context-dependent. However, it is also possible that less consistency is observed in the attitudinal competencies because different teachers are asked for their perceptions of the sample, whereas the cognitive competencies are measurements taken directly from the children/young people.

Figure 13 **Path analysis: ages 5, 6, and 8, to 14**



We now model competencies at 12 and 14 on competencies from near-5 and 6. In the first model in this chapter, most of the explanation for outcomes at 14 was given by competencies at 12. We were interested to see whether there was an effect over and above this coming from the very early stages of education without the benefit of competency data at 8 and 10.

When we include cognitive competency at 12, cognitive competency at 5 shows no effect over and above this, and the path from cognitive competency at 6 is only just significant. Attitudinal competency at 14 is largely explained by the two competencies at 12. There is a barely significant path from attitudinal competency at 6.

The zig-zag paths between attitudinal, and cognitive competencies persist, emphasising the links between attitudinal, and cognitive competencies that we have observed in the other models. For a good fit, this particular model requires a direct path from attitudinal competency at 5 to cognitive competency at 14. This may be a feature peculiar to this particular dataset. More observations would help to confirm or deny this. The path coefficient is not particularly strong and could well drop out if other paths (from 8- and 10-year-old competencies) were able to be added.

Figure 14 **Path analysis near-5 and 6, to 12 and 14**

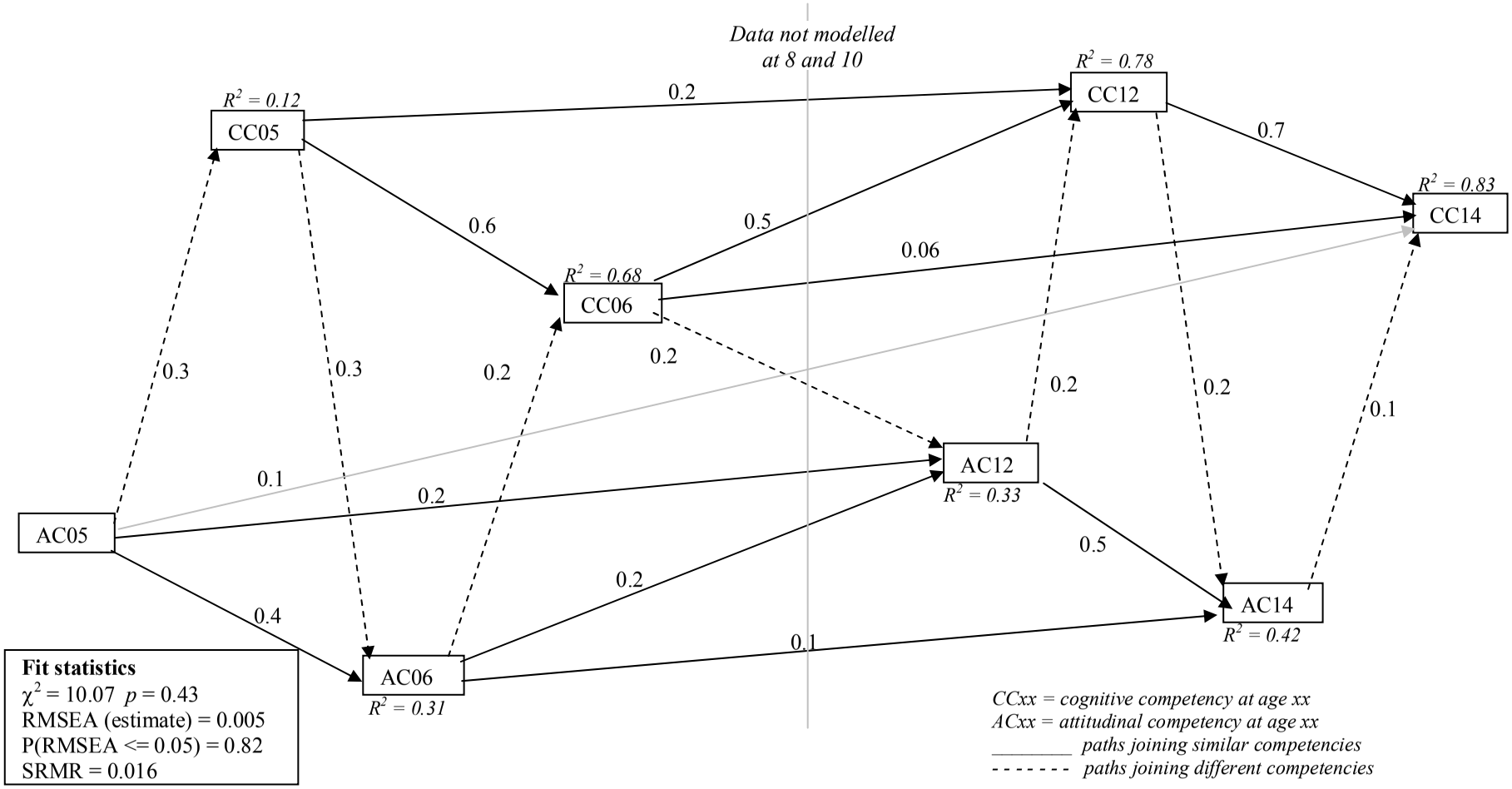


Figure 15

5. Analysis of progress over time in terms of low and high performance

In this section, we take a more in-depth look at the overall patterns of predictability of performance which were shown by the correlations and modelling, to see if they are also evident for young people whose earlier performance was either high (in the top quartile group)—or low (in the lowest quartile group), and, conversely, by focusing on those whose age-14 performance is either high or low, in relation to their performance level at earlier ages. We do this by tracking their performance in relation to the median score at each age, using standardised scores. We focus first on the predictability of changes between ages 5 and 14, and then on changes between ages 8 and 14, working forward to age 14; and then we look backwards, from the perspective of high and low performance at age 14.

The graphs we have used clearly show overall trends. For instance, in Figure 15 below, it is easy to see that at age 5 the highest quartile group scored well above the median (this is true by definition), but at age 6 at least five children scored below the median, at age 8 at least 10 scored below the median, and so on. Overall, the majority scored above the median at each age.

Any one of the line segments in the figures below may represent more than one young person. Because often two or more children achieved the same score, it is not always possible to trace individual trajectories across ages in the graphs given here, or to be sure where trajectories meet in substantial nodes whether an upward (or downward) movement for any one child was sustained. Some comments in the text are based on further graphs (not shown here) of subgroups of the data, where more individual trajectories can be identified.

In each competency, between each pair of ages, some young people performed markedly differently relative to the group as a whole. At age 6 their score may have been high relative to the group, and at age 8, low. These differences in performance show as peaks or troughs in the trajectory. Some variation is due to "random" variation or "noise", including "off" days for individual students when they undertook the tests. Other variation is likely to reflect differences in individual experiences, and reactions to those experiences, which affect the growth and consolidation of skills, knowledge, and understanding.

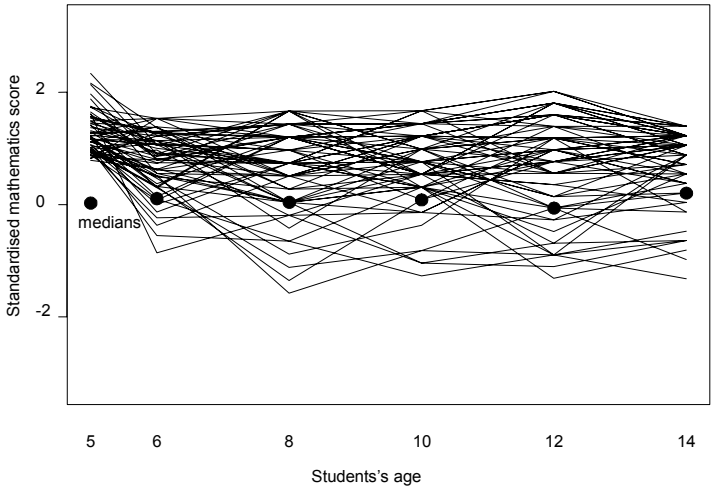
On the whole, our analysis confirms the findings from previous phases of the study that earlier high performance is highly likely to result in later scores that are above the median, and earlier low performance is highly unlikely to do so. However, a small minority do show marked changes in performance over the years, indicating that current performance levels at each age should not be taken for granted, or accepted as inevitable.

MATHEMATICS

Predictability of performance from age-5 performance level[6]

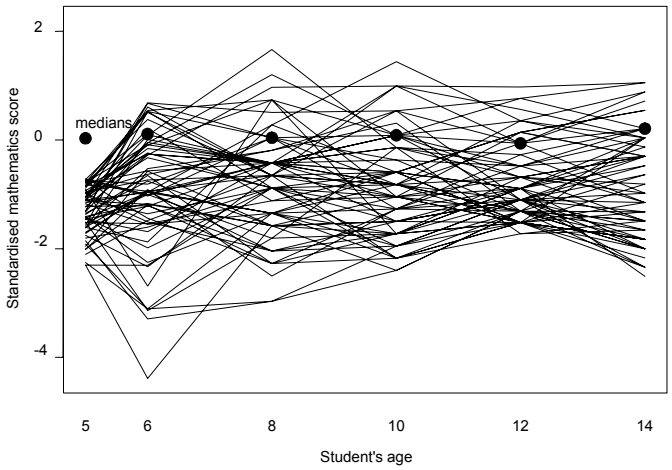
Twenty percent of the children who were performing in the highest quartile group at near-age 5 for mathematics performed at the median or below at age 14. Some of these lost ground in the early years of school, though there is an interesting pattern of recovery for some who slipped below the median by age 6.

Figure 16 **Standardised maths scores, ages 5 to 14 for those in the highest quartile group at age 5 (*n* = 65)**



Eleven percent of those who were in the lowest quartile group at near-age 5 improved their performance to have mathematics scores that were above the median at age 14. Note that some who made initial gains in the early years of school did not sustain them, indicating that they may have needed more continued support at that age, and that those who have risen above the median at age 14 often show a pattern of steady rather than steep change.

Figure 17 **Standardised maths scores, ages 5 to 14 for those in the lowest quartile group at age 5 (*n* = 65)**



[6] Here we use the subsample of those for whom we have full data from age 5 onwards.

Predictability of performance from age-8 performance level[7]

The figures below compare the performance at age 14 of study participants who were in the highest and lowest quartile groups respectively at age 8. Thirteen percent of those who had been in the highest quartile group at age 8 scored at or below the median at age 14; 9 percent of those who had been in the lowest quartile group at age 8 scored above the median at age 14.

The differences in retention between age 5 and 14 and age 8 and 14 are to be expected; firstly, the size of the quartiles is small (so the estimates are expected to vary), and secondly, more changes are to be expected over a longer time period.

Figure 18 **Standardised maths scores, ages 8 to 14 for those in the highest quartile group at age 8 (*n* = 108)**

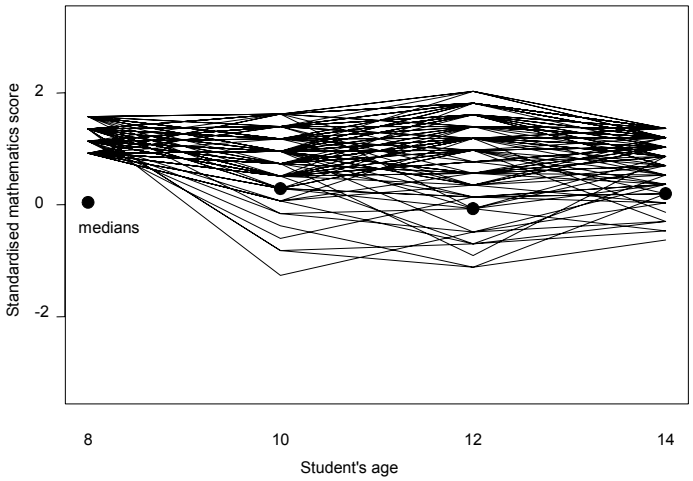
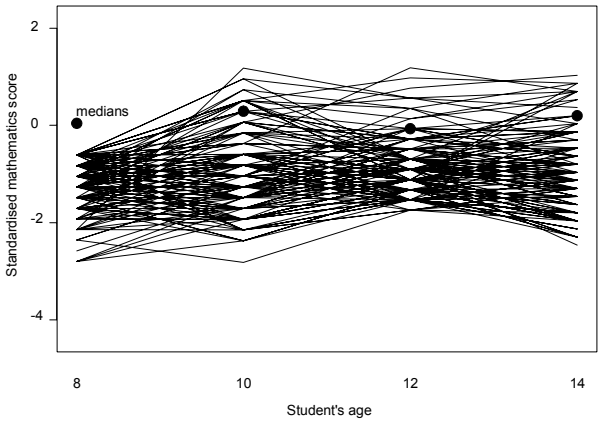


Figure 19 **Standardised maths scores, ages 8 to 14 for those in the lowest quartile group at age 8 (*n* = 138)**



Note that there are different patterns among those whose level of performance changes between 8 and 14. Of the earlier highest quartile group performers whose scores were below the median at age 14, some show a steady downward decline evident from age 8; others appear to be heading upwards again, and some who had dipped below the median at age 10 were above it again by age 14.

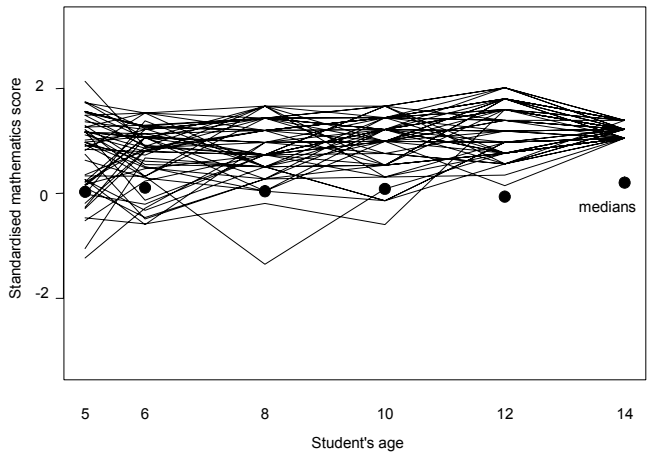
Of those who started in the lowest quartile group, most who scored above the median at age 14 showed steady upward growth from age 8; but there are also others whose growth between ages 8 and 10 does not endure.

[7] Here we use the full sample.

Consistency of performance at age 14—looking back

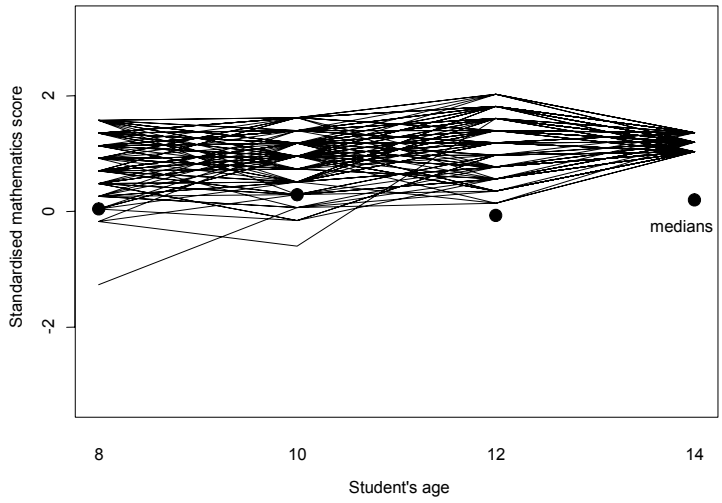
If we look back to age 5 mathematics performance for the young people who were in the highest quartile group at age 14, we find that 17 percent had performed at the median or below at age 5. All but two of these were performing above the median at age 8.

Figure 20 **Standardised maths scores, ages 5 to 14 for those in the highest quartile group at age 14 (*n* = 53)**



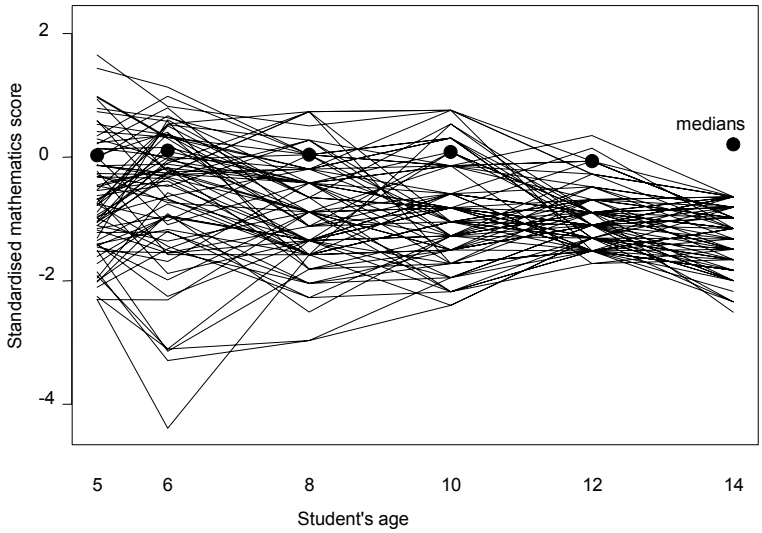
Tracing the highest quartile group at age 14 back to age 8, we found that 8 percent were performing below the median at age 8. Some of these began their upward trajectory at age 10.

Figure 21 **Standardised maths scores, ages 8 to 14 for those in the highest quartile group at age 14 (*n* = 106)**



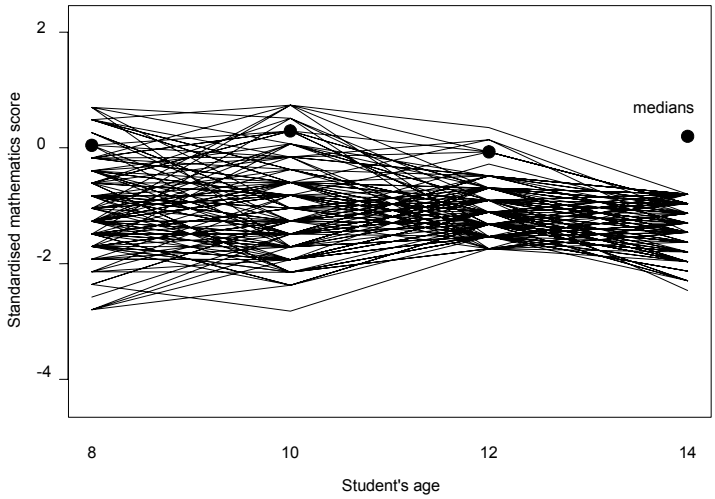
Most of those in the lowest quartile group at age 14 had performed below the median since age 5. However, 23 percent had then been at the median or above. There is quite a range of patterns in this group, including steady declines across time, and initial steady rises which peak at age 10 or 12. This may point to vulnerability to transitions between primary and secondary, and intermediate and secondary schools.

Figure 22 **Standardised maths scores, ages 5 to 14 for those in the lowest quartile group at age 14 (*n* = 75)**



Focusing on the period between 8 and 14, we find that only 10 percent of those who were in the lowest quartile group at age 14 were above the median at age 8, 6 percent at age 10, and 2 percent at age 12. Note that some of those in the lowest quartile group at age 14 were on upward trajectories between ages 8 and 12, suggesting that this group may be more vulnerable in the transition to secondary school.

Figure 23 **Standardised maths scores, ages 8 to 14 for those in the lowest quartile at age 14 (*n* = 124)**

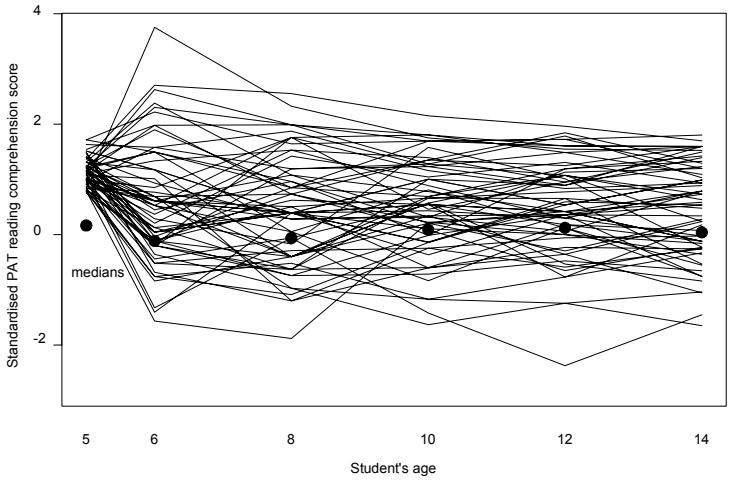


READING COMPREHENSION

Predictability of performance from age-5 performance level

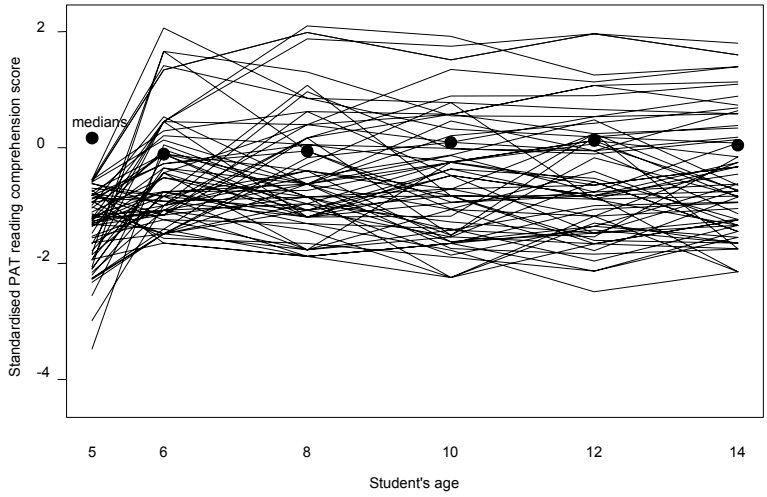
Compared with mathematics, a higher proportion of children who were performing in the highest quartile group on our age-5 early literacy measure had slipped below the median at age 14: 36 percent. There is some volatility in the overall patterns of the highest quartile group at age 5, with a number slipping below the median at age 6, most of whom recovered again, and a number who slipped below the median between ages 12 and 14.

Figure 24 **Standardised PAT reading comprehension scores, ages 5 to 14 for those in the highest quartile group at age 5 (*n* = 61)**



Twenty-nine percent of the students in the lowest quartile group at age 5 on our early literacy measure had scores above the median at age 14. Note that an initial steep improvement, or a steep improvement between the ages of 10 and 12 was not always sustained.

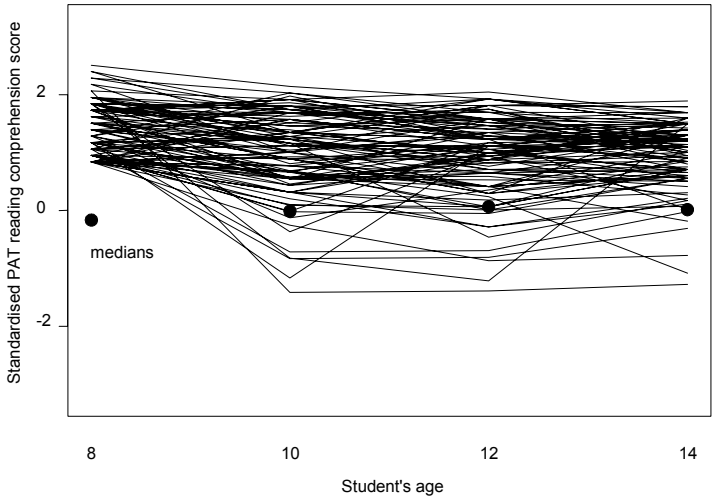
Figure 25 **Standardised PAT reading comprehension scores, ages 5 to 14 for those in the lowest quartile group at age 5 (*n* = 63)**



Predictability of performance from age-8 performance level

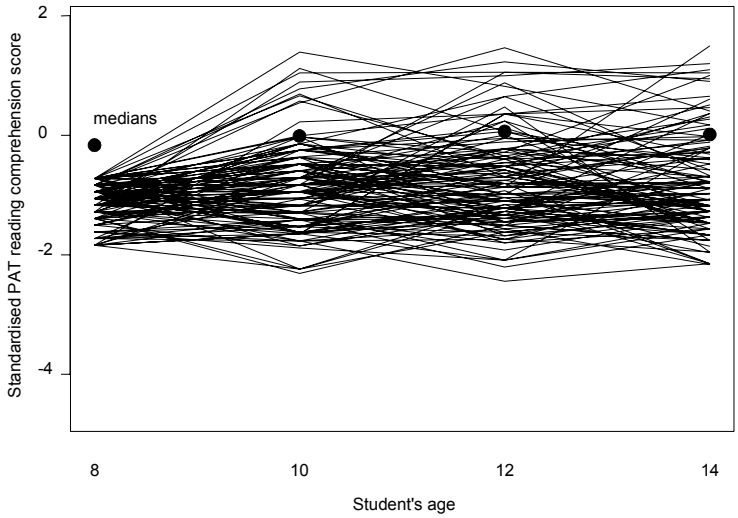
Only 6 percent of those who were in the highest quartile group scores on the PAT reading comprehension test at age 8 achieved at or below the median at age 14. Around half of this 6 percent fell below the median at age 10, and half between ages 12 and 14. Most of those who fell below the median for the first time at age 12 had picked up again to achieve above the median at age 14.

Figure 26 **Standardised PAT reading comprehension scores, ages 8 to 14 for those in the highest quartile group at age 8 (*n* = 108)**



Fifteen percent of those in the lowest quartile group for reading comprehension at age 8 had scores above the median at age 14. Note again that steep improvements do not always translate into sustained gains.

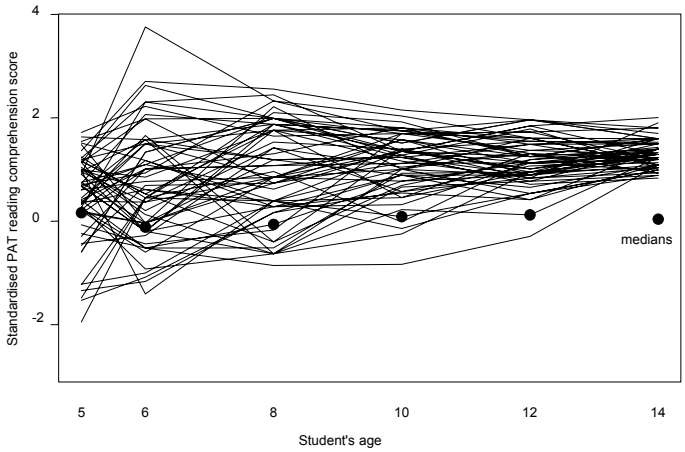
Figure 27 **Standardised PAT reading comprehension scores, ages 8 to 14 for those in the lowest quartile group at age 8 (*n* = 131)**



Consistency of performance at age 14—looking back

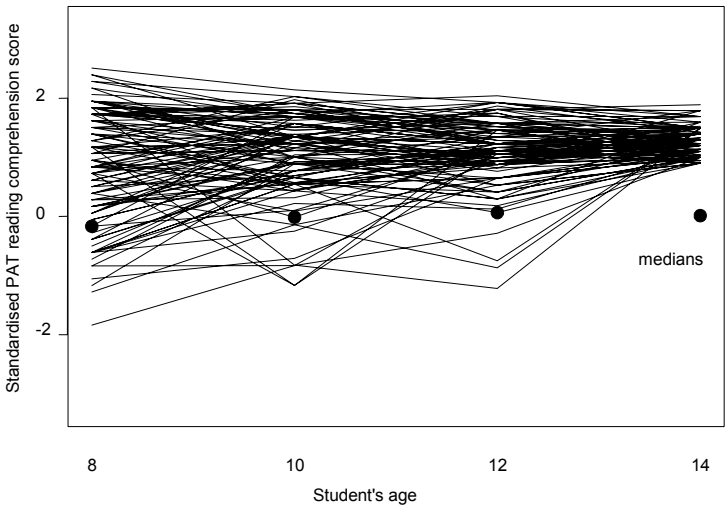
Twenty-four percent of those who were in the highest quartile group at age 14 for reading comprehension were at or below the median at age 5 for the early literacy measure. Most of these had improved their performance above the median by age 8. A few show some volatility in the early years—marked rises between 5 and 6, marked declines at 8, but then followed by steadier upward movement.

Figure 28 **Standardised PAT reading comprehension scores, ages 5 to 14 for those in the highest quartile group at age 14 (*n* = 59)**



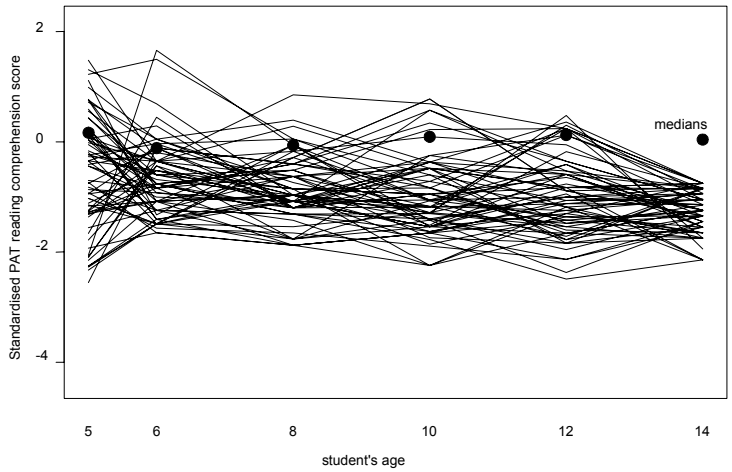
When we look back from age-14 quartile groups to age 8, we find that 17 percent of those in the highest quartile group at age 14 had been performing at or below the median at age 8. Most of these were above the median at age 10. It is interesting to see some steep descents followed by steep ascents for some who were performing above the median at age 8; we plan to investigate these and other volatile patterns to see if they correspond with transitions between schools, or other marked changes in young people's lives.

Figure 29 **Standardised PAT reading comprehension scores, ages 8 to 14 for those in the highest quartile group at age 14 (*n* = 115)**



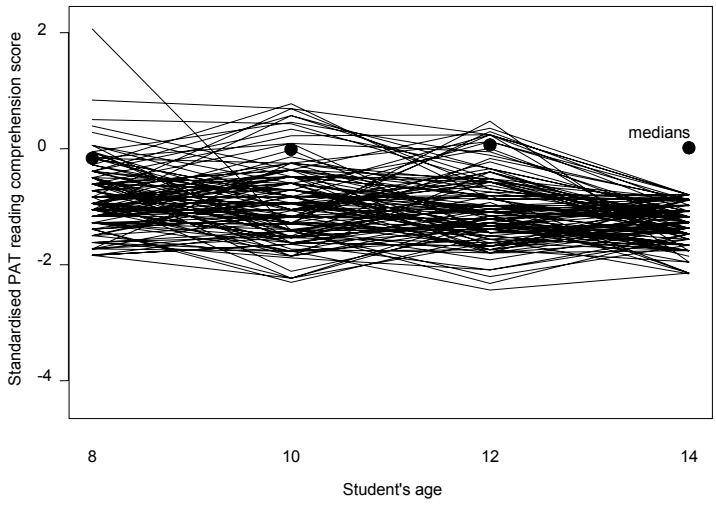
Twenty-four percent of those whose age-14 score put them in the lowest quartile group had been above the median for the age-5 early literacy measure; most of these however were scoring at or below the median by age 6.

Figure 30 **Standardised PAT reading comprehension scores, ages 5 to 14 for those in the lowest quartile group at age 14 (*n* = 67)**



Ten percent of those who were in the lowest quartile group at age 14 had scores above the median at age 8. On the whole, their declines are relatively steady, with most occurring by age 10. Again we see notable rises which are not sustained, some occurring between ages 8 and 10, and some between 10 and 12.

Figure 31 **Standardised PAT reading comprehension scores, ages 8 to 14 for those in the lowest quartile group at age 14 (*n* = 122)**

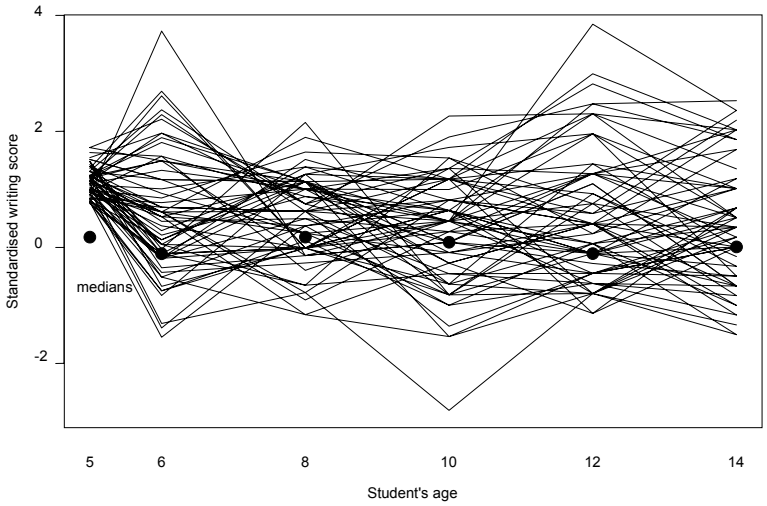


WRITING

Predictability of performance from age-5 performance level

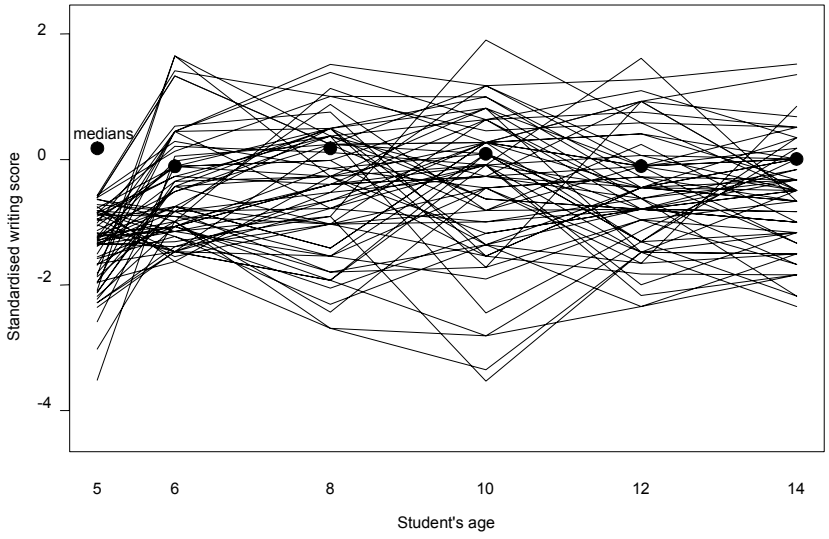
Forty percent of those who were in the highest quartile group at age 5 on the early literacy measure (which included the child writing their own name) scored at the median or below at age 14 for the writing task. Quite a few of these had scored above the median at age 12. There was some volatility evident in the patterns, with those who scored below the median at one age often improving their score at the next age.

Figure 32 **Standardised writing scores, ages 5 to 14 for those in the highest quartile group at age 5 (*n* = 62)**



There is also some volatility evident in the patterns of progress between ages 5 and 14 for those who were in the lowest quartile group at age 5, but only 19 percent scored above the median at age 14 for the writing task. Most of these were performing above the median by age 10.

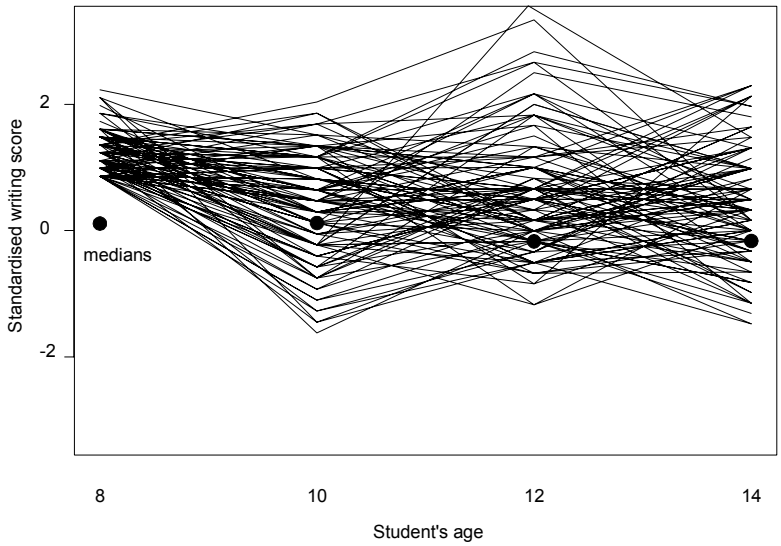
Figure 33 **Standardised writing scores, ages 5 to 14 for those in the lowest quartile group at age 5 (*n* = 63)**



Predictability of performance from age-8 performance level

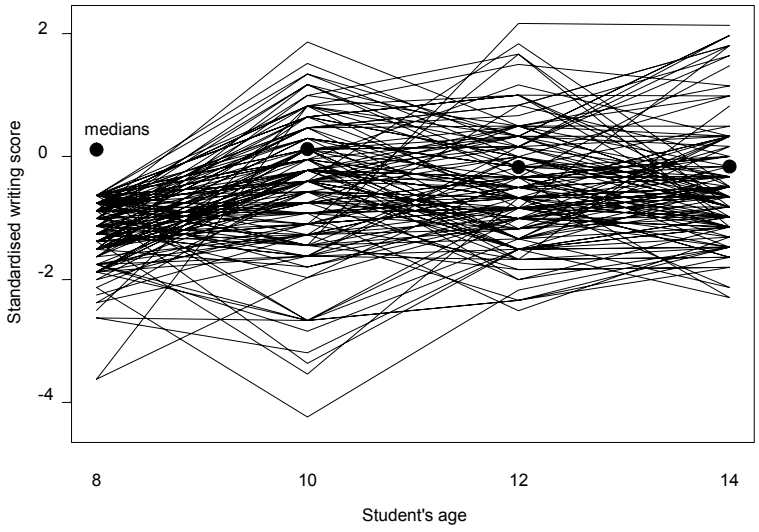
Twenty-eight percent of those whose scores on the writing task at age 8 put them in the highest quartile group had scores at the median or below at age 14. Some showed some slippage of performance between ages 8 to 10; while their scores remained above the median at age 10, they continued downwards. There is continued volatility, with noticeable descents at one age followed by recovery at the next age, and quite a number of those whose scores did slip below the median at age 10 had relatively higher scores at age 12.

Figure 34 **Standardised writing scores, ages 8 to 14 for those in the highest quartile group at age 8 (*n* = 106)**



Twenty-seven percent of those whose age-8 scores put them in the lowest quartile group were performing above the median at age 14. Many of these began to improve their performance from age 10; those whose scores were highest however at this age were not the ones whose level of performance was sustained.

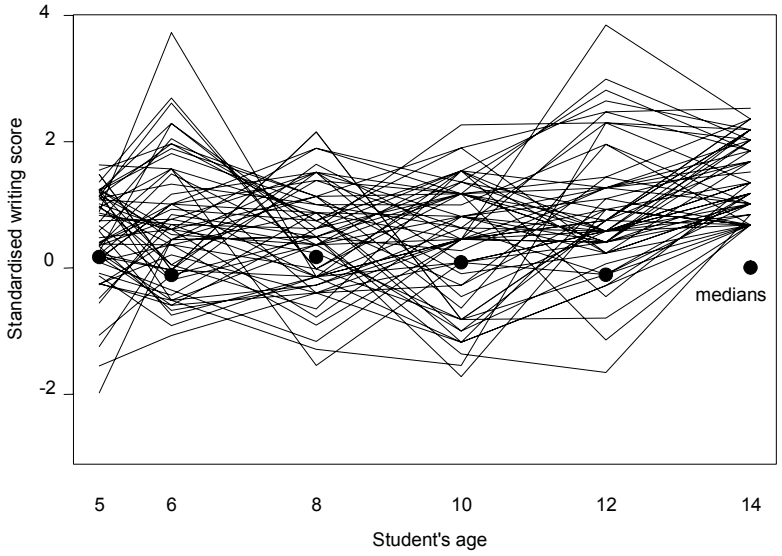
Figure 35 **Standardised writing scores, ages 8 to 14 for those in the lowest quartile group at age 8 (*n* = 133)**



Consistency of performance in writing at age 14—looking back

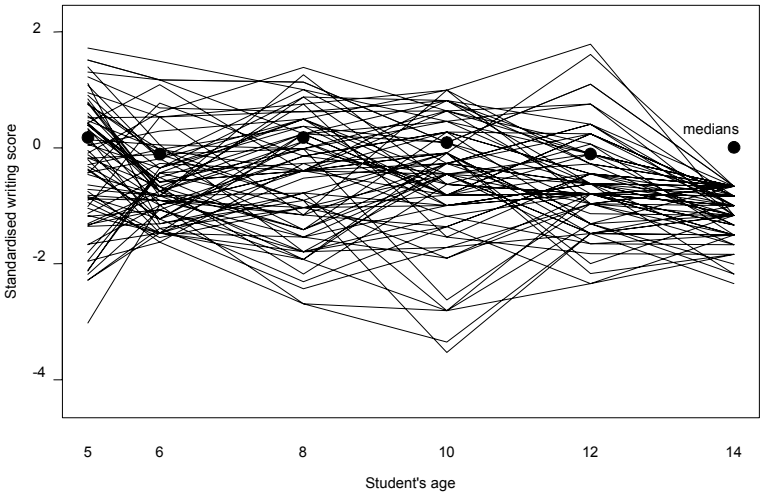
Twenty-eight percent of those who scored in the highest quartile group at age 14 on the writing task had scores at or below the median on the early literacy measure at age 5. Most were scoring above the median by age 10. Some made marked progress between ages 10 and 12.

Figure 36 **Standardised writing scores, ages 5 to 14 for those in the highest quartile group at age 14 (*n* = 58)**



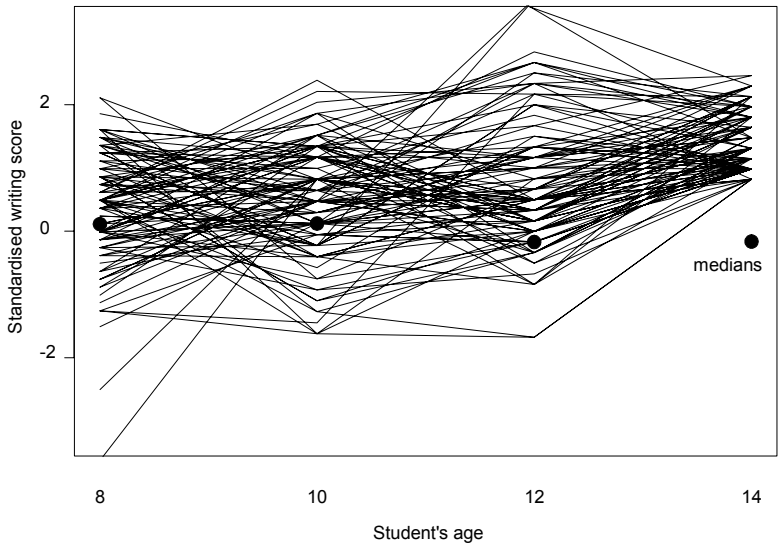
Thirty-seven percent of those who scored in the lowest quartile group at age 14 on the writing task had scores above the median for early literacy at age 5. Most of these had slipped to the median or below by age 8. Some who were on an upward trajectory from age 10 had not progressed to the median or above by age 14.

Figure 37 **Standardised writing scores, ages 5 to 14 for those ending in the lowest quartile group at age 14 (*n* = 73)**



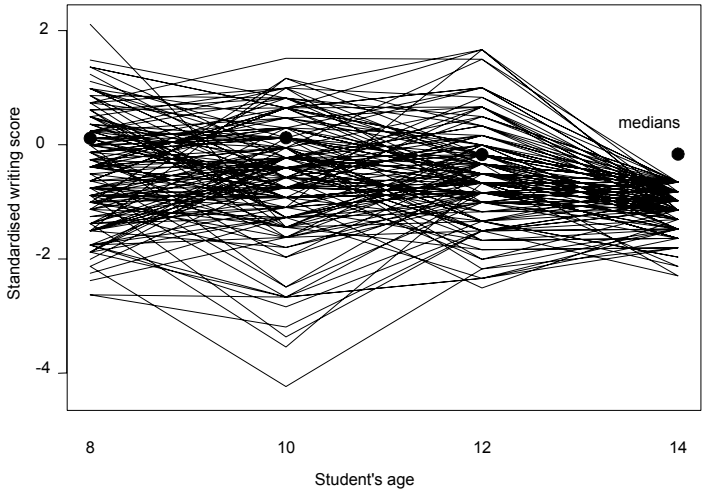
Looking at the highest quartile group at age 14 in terms of their age-8 scores, we find that 38 percent had been at or below the median. Most of these were above the median at age 10, and continued an upward or stable trajectory. Some who had been above the median at age 8 did fall below the median at age 10, but most had recovered their previous performance level by age 12.

Figure 38 **Standardised writing scores, ages 8 to 14 for those in the highest quartile group at age 14 (*n* = 107)**



Twenty-six percent of those who scored in the lowest quartile group at age 14 had scored above the median at age 8. Their scores mainly declined below the median by age 10. There was also a group whose scores did rise from below the median to above it at age 12, but then slipped back again.

Figure 39 **Standardised writing scores, ages 8 to 14 for those in the lowest quartile group at age 14 (*n* = 148)**

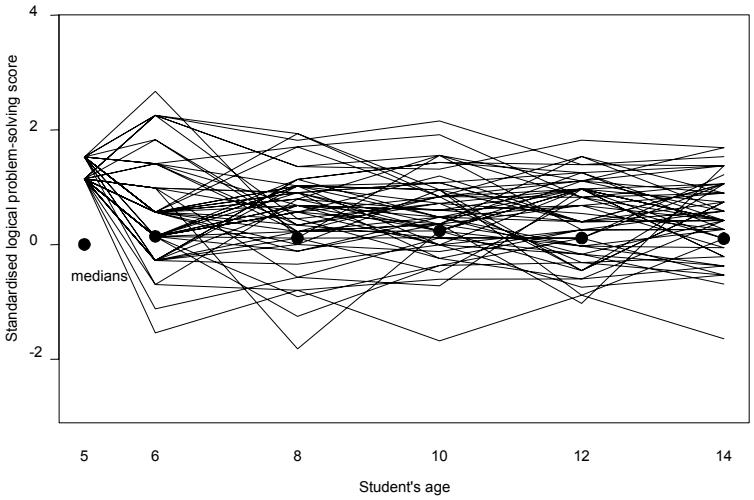


LOGICAL PROBLEM-SOLVING

Predictability of performance from age-5 performance level

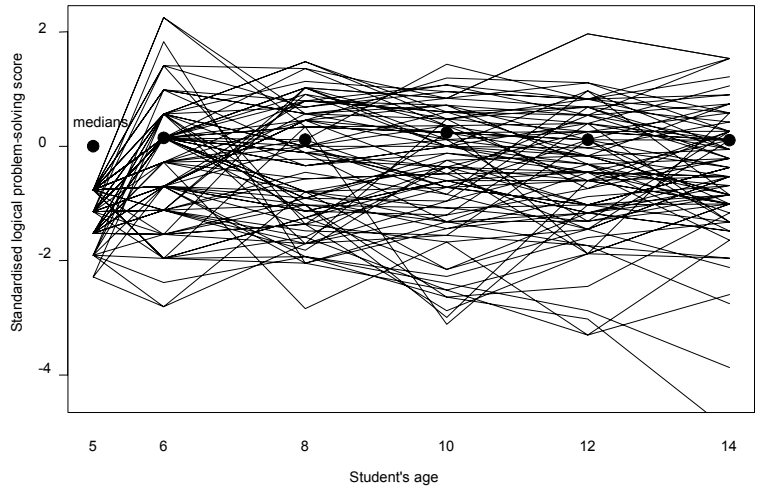
Twenty-eight percent of those who performed in the highest quartile group on the short version of the Standard Progressive Matrices that we used at age 5 scored at the median or below at age 14. Most of these were performing below the median or tracking toward it by age 10.

Figure 40 **Standardised logical problem-solving scores, ages 5 to 14 for those in the highest quartile group at age 5 (*n* = 57)**



Twenty-six percent of those who performed in the lowest quartile group at age 5 scored above the median at age 14. Most of those who did so were performing above the median or close to it by age 8.

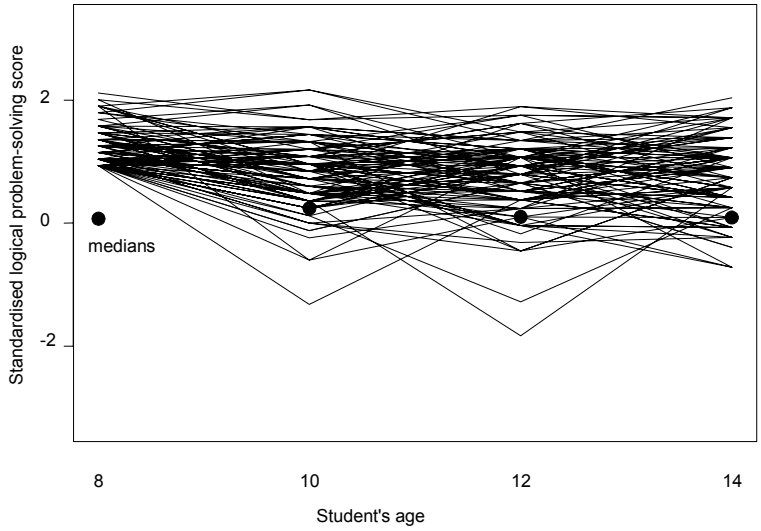
Figure 41 **Standardised logical problem-solving scores, ages 5 to 14 for those in the lowest quartile group at age 5 (*n* = 86)**



Predictability of performance from age-8 performance level

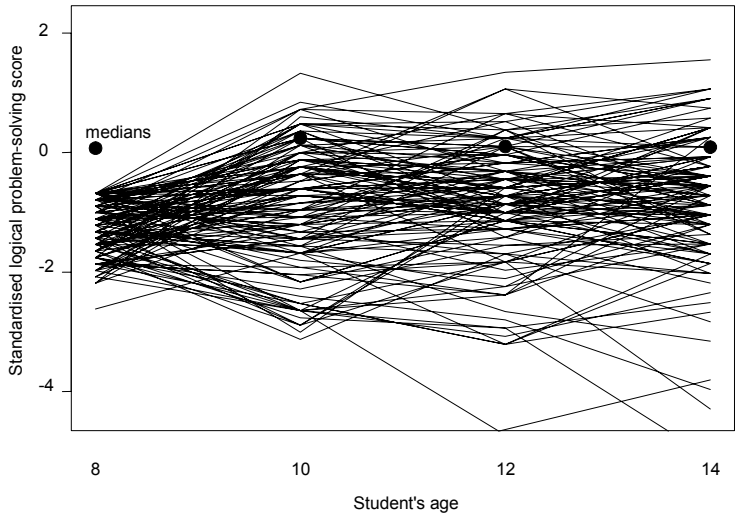
Sixteen percent of those who were in the highest quartile group at age 8 were performing at the median or below at age 14. Most of the downward movement started or was evident at age 10.

Figure 42 **Standardised logical problem-solving scores, ages 8 to 14 for those in the highest quartile group at age 8 (*n* = 106)**



Nineteen percent of those who were in the lowest quartile group at age 8 had scores above the median at age 14. Most of these had scored at the median or above by age 10, or were on an upward trajectory.

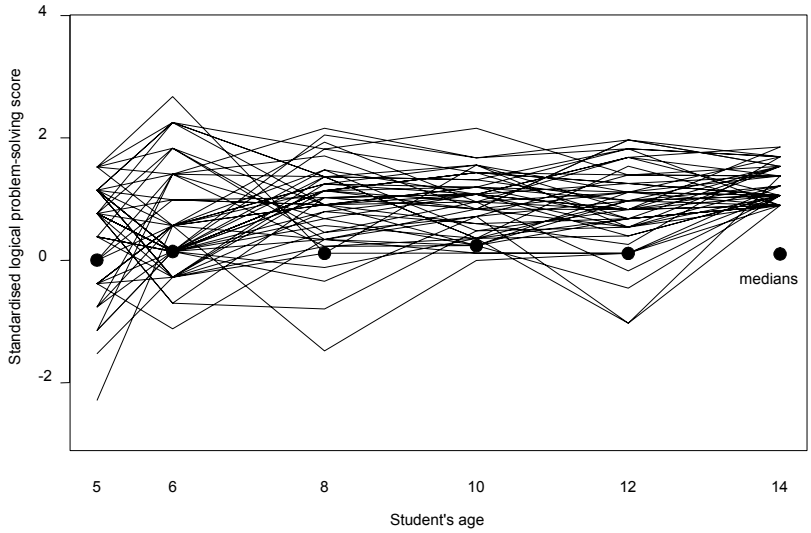
Figure 43 **Standardised logical problem-solving scores, ages 8 to 14 for those in the lowest quartile group at age 8 (*n* = 134)**



Consistency of performance at age-14—looking back

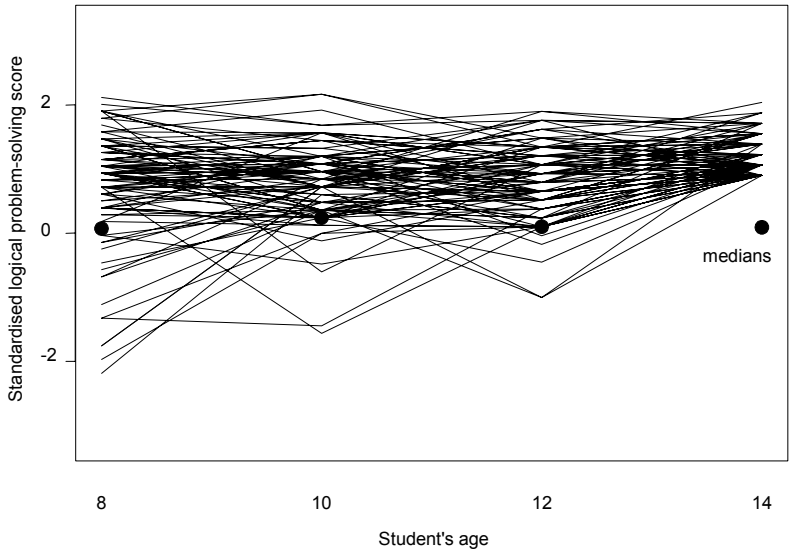
Thirty-two percent of the young people in the sub-sample whose scores put them in the highest quartile for logical problem-solving at age 14 scored at the median or below at age 5. Most had improved their performance at age 6.

Figure 44 **Standardised logical problem-solving scores, ages 5 to 14 for those in the highest quartile group at age 14 (*n* = 50)**



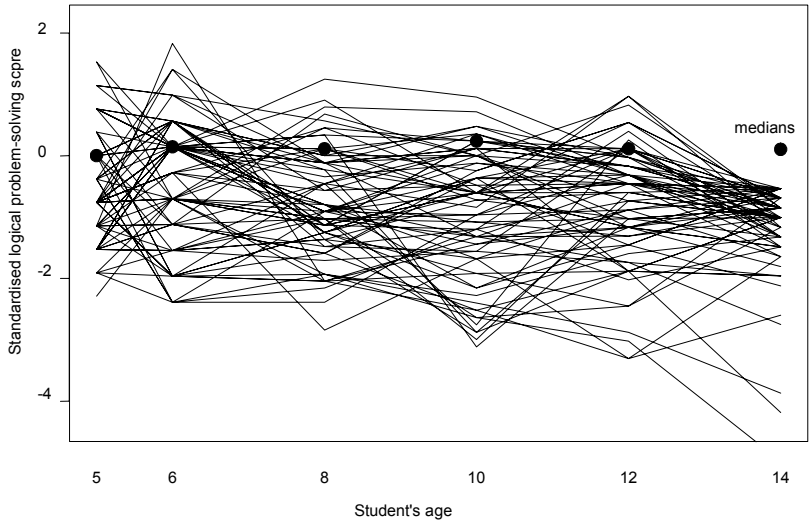
Fifteen percent of the young people whose scores at 14 for logical problem-solving put them in the highest quartile had scored at or below the median at age 8. Most of these were at the median, or on an upward trajectory, at age 10.

Figure 45 **Standardised logical problem-solving scores, ages 8 to 14 for those in the highest quartile group at age 14 (*n* = 98)**



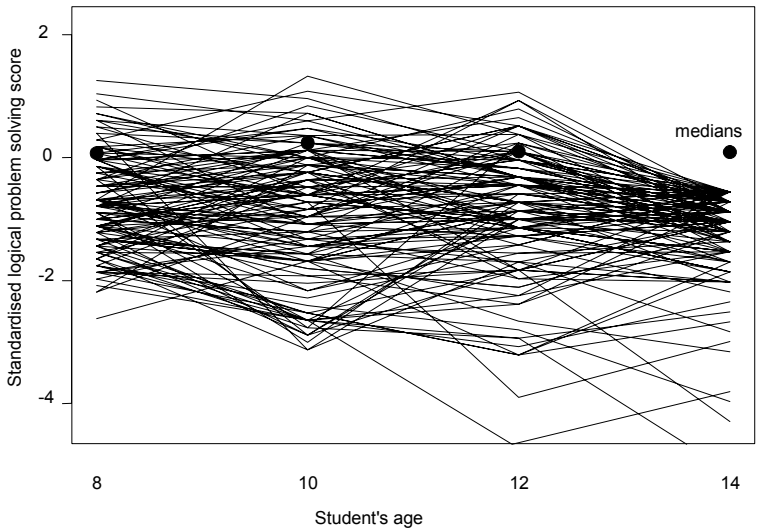
Focusing on those whose score put them in the lowest quartile group at age 14, we see that 22 percent were above the median at age 5. Many of these had lost ground by age 6, and most by age 8.

Figure 46 **Standardised logical problem-solving scores, ages 5 to 14 for those in the lowest quartile group at age 14 (*n* = 73)**



Fifteen percent of those in the lowest quartile group at age 14 had scores above the median at age 8. Some slipped between ages 8 and 10; others show more gradual declines by age 12. A number whose scores had been below the median at age 8 improved their scores at either ages 10 or 12, but these improvements were not sustained.

Figure 47 **Standardised logical problem-solving scores, ages 8 to 14 for those in the lowest quartile group at age 14 (*n* = 130)**



ATTITUDINAL COMPOSITE

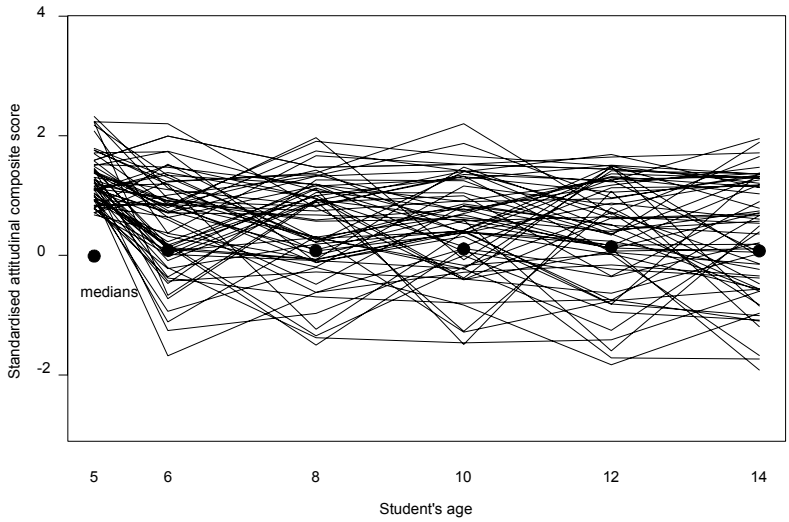
Because of the high correlation of the attitudinal competencies at age 14, we use a composite measure here to summarise the trends evident in relation to the individual competencies.

Earlier performance levels on the study attitudinal measures are a less solid guide to age-14 performance, for both those who had initially scored highly, and those who initially had low scores.

Predictability of performance from age-5 performance level

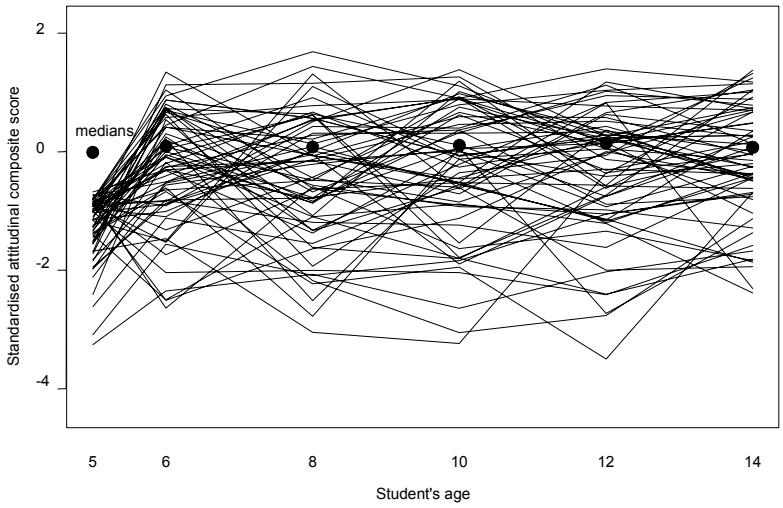
Thirty-nine percent of those whose scores at age 5 put them in the highest quartile group for the attitudinal composite had scores at or below the median at age 14. There is a range of patterns across time. Many of those who have lost ground were on downward trajectories by age 10. There is also some sharper declines from age 12, indicating young people who may have experienced a difficult transition to secondary school, or be experiencing other changes in their lives. Quite a lot of early downward movement is recovered by age 8, perhaps indicating that some children who were comfortable in the early childhood education environment took time to accommodate themselves to the school environment.

Figure 48 **Standardised attitudinal composite scores, ages 5 to 14 for those in the highest quartile group at age 5 (*n* = 64)**



Forty-two percent of those who were in the lowest quartile group at age 5 had scores on the attitudinal composite that put them above the median at age 14. While most in this group were above the median or on an upward trajectory by age 10, some show marked increases between the ages of 12 and 14, perhaps indicating a positive transition to secondary school, and some show some decline between ages 12 and 14, which may indicate the reverse.

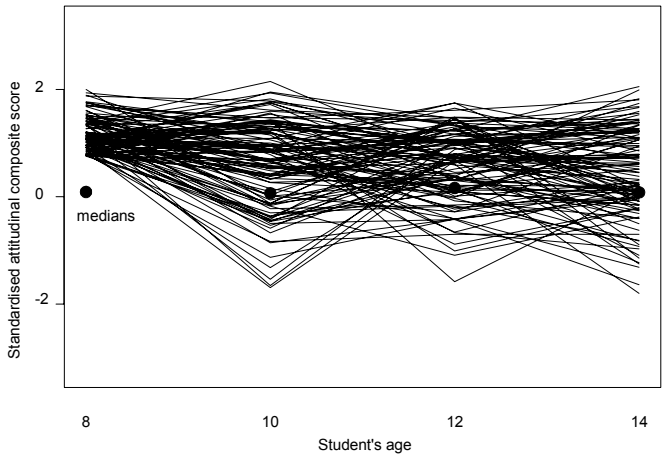
Figure 49 **Standardised attitudinal composite scores, ages 5 to 14 for those in the lowest quartile group at age 5 (*n* = 65)**



Predictability of performance from age-8 performance level

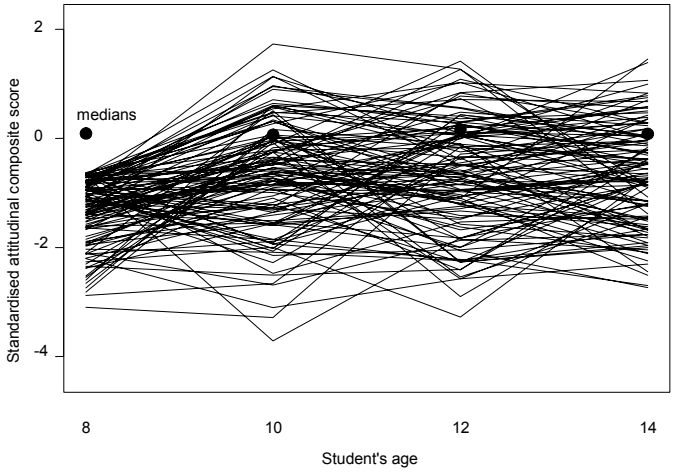
While age-8 performance was a closer guide than age-5 performance to age-14 performance for the cognitive competencies, we do not see the same trend for the highest quartile of the attitudinal composite. Thirty-three percent of those whose scores at age 8 put them in the highest quartile at age 8 were scoring at or below the median at age 14. Much of this appears to reflect downward trajectories that were evident at age 10, with some steeper downward movement between ages 12 and 14.

Figure 50 **Standardised attitudinal composite scores, ages 8 to 14 for those in the highest quartile group at age 8 (*n* = 118)**



By contrast, only 23 percent of those whose age-8 scores put them in the lowest quartile group were achieving above the median at age 14. There is a mix of patterns here, though the most sustained improvement seems to be from those whose upward trajectory was steady from age 8, and who were not necessarily above the median until age 12.

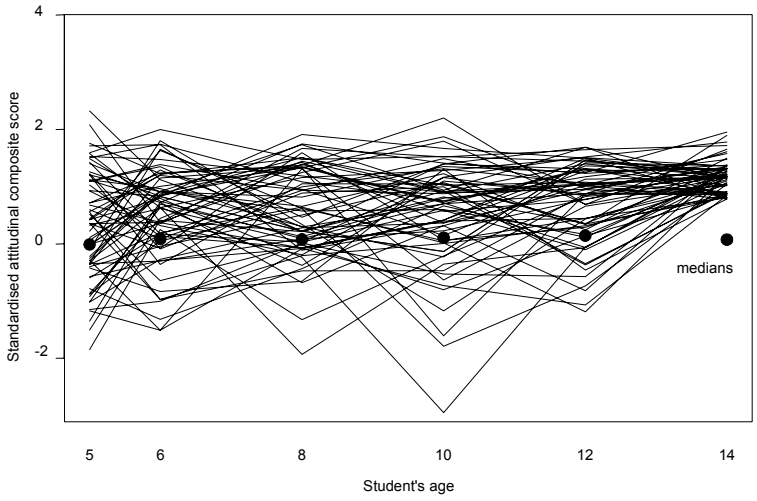
Figure 51 **Standardised attitudinal composite scores ages 8 to 14 for those in the lowest quartile group at age 8 (*n* = 119)**



Consistency of performance at age 14—looking back

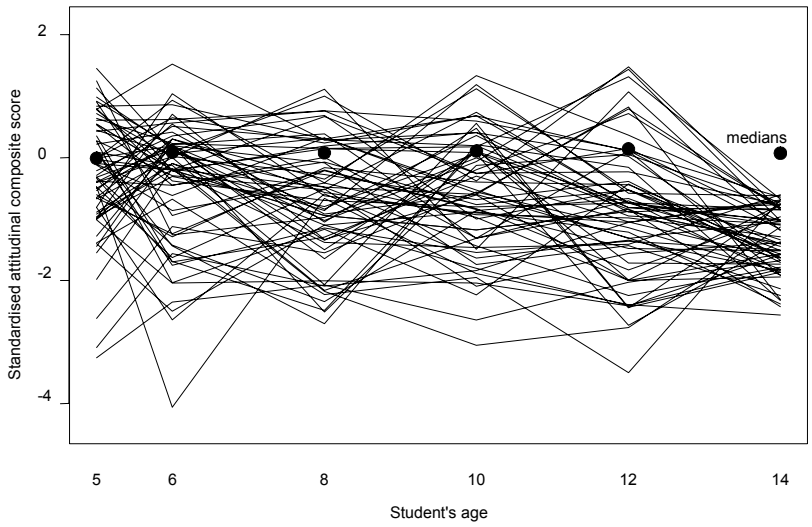
Thirty-eight percent of the age-5 sub-sample who scored in the highest quartile group at age 14 had scored at or below the median at age 5 on the attitudinal composite. Many improved their performance in the first year of school, though some took a more gradual pathway.

Figure 52 **Standardised attitudinal composite scores, ages 5 to 14 for those in the highest quartile group at age 14 (*n* = 65)**



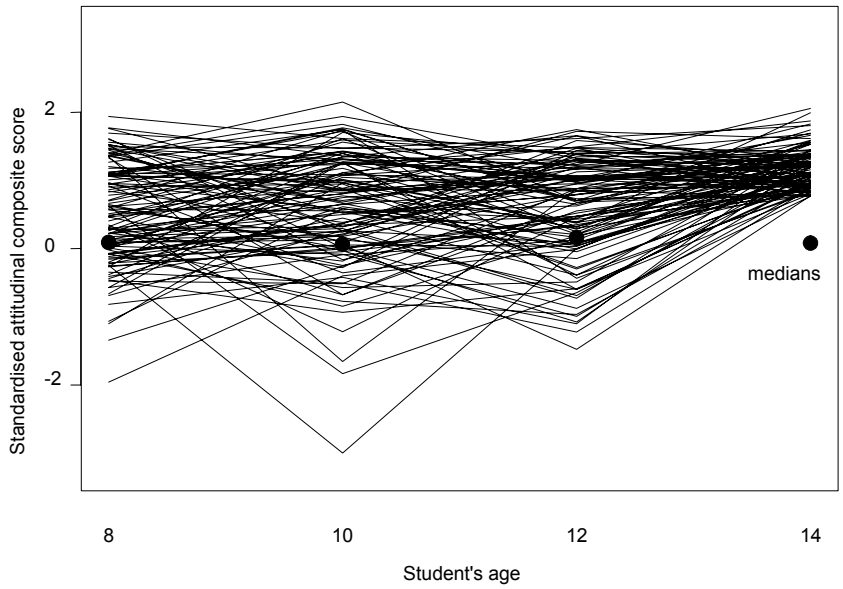
Thirty-eight percent of the age-5 sub-sample whose scores at age 14 placed them in the lowest quartile had scored above the median at age 5. Many of these had scores that declined by age 8, but some show one-off improvements that were not sustained.

Figure 53 **Standardised attitudinal composite scores, ages 5 to 14 for those in the lowest quartile group at age 14 (*n* = 65)**



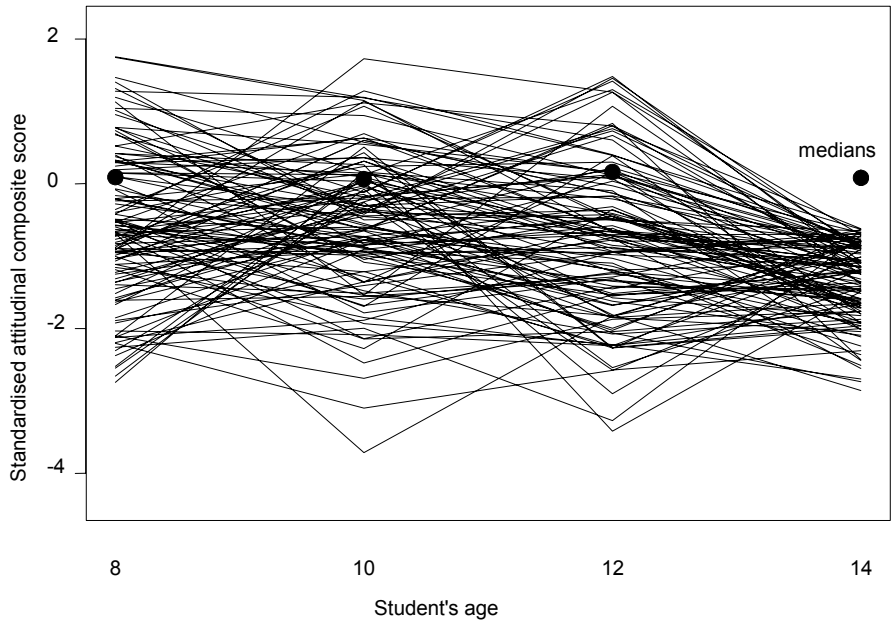
Thirty-two percent of those whose scores at age 14 put them in the highest quartile group had scores at or below the median at age 8. The patterns behind this vary. Some had moved above the median by age 10; others show a more gradual transition. Some who had scored above the median at age 8 were on downward trajectories until age 12; the transition to secondary school or some other change in the period between age 12 and age 14 appears to have been positive for them.

Figure 54 **Standardised attitudinal composite scores, ages 8 to 14 for those in the highest quartile group at age 14 (*n* = 118)**



Twenty-nine percent of those whose scores placed them in the lowest quartile group at age 14 had scored above the median at age 8. Most were below the median by age 10. There is a mix of patterns: consistency of below median scores; declines from age-8 scores; and some gains from below the median to above it that were not sustained.

Figure 55 **Standardised attitudinal composite scores, ages 8 to 14 for those in the lowest quartile group at age 14 (*n* = 119)**



SOCIAL CHARACTERISTICS AND MOVEMENT RELATED TO INITIAL AND AGE-14 QUARTILE

We also graphed these patterns of progress in relation to initial quartile and quartile at age 14 in terms of the four social characteristics of family income at age 5, maternal qualification, gender, and ethnicity. The graphs are not included in this report (if they were, the report would be around 800 pages long).

The numbers for each social group within each quartile are small, so though we see trends, they are not always statistically significant.

Quartile movements, social characteristics, and the cognitive competencies

Quartile groups at ages 5 and 8, and performance at age 14

The main differences are related to maternal qualification. Very few young people whose mothers have no qualification are among those who performed in the highest quartile group at ages 5 or 8, and conversely, very few whose mother had a university qualification were in the lowest quartile group at ages 5 or 8. Young people who performed in the highest quartile group at ages 5 or 8 for mathematics or logical problem-solving were more likely to remain above the median if:

- their mother had a university qualification; and
- their family income when they were near-age 5 was middle-high or high.

The trends in relation to reading comprehension indicate a positive relationship between levels of maternal qualification and family income, and improving performance from the lowest quartile groups. However, young people who were in the highest quartile groups tended to remain there, with no trends evident in relation to social characteristics.

On the whole, the patterns of progress for early high and low performers in mathematics show no differences related to gender or ethnicity.

There were indications that females from the lowest quartile group at age 8 for reading comprehension were more likely than males from the same group to improve their performance above the median (20 percent compared with 11 percent), and for Pākehā/European and Asian young people to be more likely to do so than Māori and Pacific young people (19 percent compared with none).

Females who had been in the lowest quartile group at age 8 for writing were more likely than males from that group to be scoring above the median at age 14 (42 percent compared with 18 percent). However, we also found that females in the lowest quartile group at age 14 were more likely to have slipped from above-median performance at age 8 (38 percent compared with 20 percent for males).

Quartile at age 14, and earlier performance

When we look "backwards", using age-14 performance as our starting point, we find that the four social characteristics we looked at are unrelated to patterns of previous progress for those who were in either the highest or lowest quartile groups for the cognitive competencies at age 14. This may be because a hindsight picture is more likely than a prospective picture to pick up changes related to personal or one-off experiences, such as the effect of very good teaching followed by not-so-good teaching, transitions between schools, or changes in families, friends, or interests.

ATTITUDINAL COMPETENCIES

On the whole, the young people's social characteristics do not show any differences in patterns related to quartile group.

Gender is an exception, and only in relation to looking back from age 14 to age 8. Fifty-four percent of the females in the lowest quartile group at age 14 had scored above the median at age 8, compared with 17 percent of the males. This indicates more consistency for males at the lower end of performance for the attitudinal competencies. The same pattern was not evident for the highest quartile group of performance at age 14.

SUMMARY

Following the progress of initially high and low performers, and looking back from those who were in the highest and lowest quartile groups of performance at age 14, shows some commonalities, and some differences.

The majority of those whose scores at age 5 or age 8 are in the highest quartile are also in the highest quartile at age 14. However, there is some volatility in these patterns—not all remain above the median at every age. Yet those whose scores do dip often recover their performance level, suggesting that they have a reasonably robust core of knowledge, skills, and support to fall back on.

The majority of those whose scores at age 5 or age 8 are in the lowest quartile are also in the lowest quartile at age 14. Of those who do progress above the median, the ones who make gradual improvements over some years are more likely to make sustained gains that put them above the median than do those who have rapid spurts. This is a different pattern from those who were initially in the highest quartiles, suggesting a less robust core of knowledge, skills, and support.

Table 30 gives the retention rates of each quartile group—that is, the proportion of those who were in the highest quartile groups at either ages 5 or 8 whose age-14 score was above the median, and the proportion of those who were in the lowest quartile groups at either ages 5 or 8 whose age-14 score was at or below the median. Mathematics has the highest retention rates, with less difference between the retention rates from age 5 compared to age 8. Writing has the lowest retention rates from age 8 of the cognitive competencies, and different patterns for the highest and lowest quartile groups when age 5–14 and age 8–14 retention rates are compared. The attitudinal competencies have the lowest retention rates from age 8 to 14 for the highest quartile group.

Table 30 **Retention of initially high and low performing quartile groups in relation to age-14 median**

Retention in relation to median at age 14	5–14 Highest quartile – above the median at age 14	5–14 Lowest quartile – at or below the median at age 14	8–14 Highest quartile – above the median at age 14	8–14 Lowest quartile – at or below the median at age 14
Mathematics	80	89	87	91
Reading comprehension	64	71	94	85
Writing	60	81	72	73
Logical problem-solving	72	74	84	81
Attitudinal competencies	61	67	58	77

When we look backwards, from the highest and lowest quartiles at age 14, the earlier findings about the importance of early school years for providing the basis for further cognitive learning are underlined: more of those in the top quartile at age 14 were scoring above the median at age 8 than at age 5, and vice versa. The picture in relation to the attitudinal competencies is less clear-cut.

Table 31 **Age-14 highest and lowest quartiles in relation to age-5 and age-8 performance**

Retention in relation to median at earlier ages	14–5 Highest quartile – above the median at age 5	14–5 Lowest quartile – at or below the median at age 5	14–8 Highest quartile – above the median at age 8	14–8 Lowest quartile – at or below the median at age 8
Mathematics	83	78	92	90
Reading comprehension	76	76	83	90
Writing	72	63	62	74
Logical problem-solving	68	78	85	85
Attitudinal competencies	62	62	68	71

6. Conclusion

The description and analysis presented here support previous findings from the study in relation to both the importance of early foundations for learning, and the possibilities that individual experiences over the years allow (both positive and negative). Early levels of achievement do count, but they are not fixed and unchangeable. The different patterns of progress over the years for high and low performers shown in this report both underlines the importance of early consolidation, and the need for steady rather than too-rapid change for those who started school as low performers, which suggests ongoing support rather than one-off time-limited interventions.

This report extends the Competent Children, Competent Learners project's previous findings by showing that attitudinal skills and knowledge do support the growth of knowledge and understanding in the cognitive areas—the "academic" areas of mathematics and literacy particularly—and that the latter in turn support attitudinal dispositions. These relationships underline the importance of providing students with learning experiences which offer interwoven opportunities for the development and expression of both the cognitive, and attitudinal domains of knowledge.

These learning experiences and early consolidation are more likely to occur for children whose families have social advantages of high parental education levels, and to a lesser extent non-poor family incomes in their early life. Females were more likely than males to perform highly in literacy and the attitudinal competencies, perhaps reflecting continued differences in gender expectations, social attitudes, and interests. What is important to note from our analysis in this report is that while the social characteristics alone account for a moderate amount of the variance in the young people's scores, they do not account for most of it.