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PERCEIVED PARENTAL INFLUENCE ON MATHEMATICS LEARNING: A COMPARISON AMONG STUDENTS IN CHINA AND AUSTRALIA

ABSTRACT. This paper explores the perceived parental influence (PPI) on mathematics learning among over 700 students across three year levels (Years 5, 7, 9) in China and Australia. It was found that the PPI of students was less strong as year levels increased in both countries. Students in China had stronger perceived parental encouragement and higher perceived parental educational expectation than students in Australia. The PPI of students from different home language backgrounds was also investigated. Students in China demonstrated stronger perceived parental encouragement and parental expectation than English speaking students and other language speaking students in Australia, and they also demonstrated stronger perceived parental expectation than Chinese speaking students in Australia, and similar perceived parental encouragement. Within the three groups of students in Australia, Chinese speaking students and other language speaking students demonstrated similar levels of perceived parental encouragement and expectation, but they both demonstrated a higher level of perceived parental encouragement and expectation than English speaking students. Possible reasons for the similarities and differences between the different groups of students were discussed.

KEY WORDS: perceived parental influence, mathematics learning, expectation, encouragement, cultural groups

INTRODUCTION

> My parents come from another country, so my mum makes me to do harder work than at school (A Year 5 Australian student's comment on mathematics learning) (Cao, 2004, p. 236).

Parents play an important role in influencing students' mathematics learning, but parents from different cultural backgrounds and in different societies may influence their students' learning differently. This paper explores the differences and similarities in parents' influence on students' mathematics learning as perceived by different groups of students in China and Australia. The issue explored is quite complicated, it might not be possible for a single piece of work to come to a sound conclusion on, and to have a thorough understanding of, the similarities and differences in the

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parental influence of students' mathematics learning among different cultural groups in the two cultures. A variety of factors, such as cultural and social forces, may interact in a myriad of ways with parents and children. However, this study tries to shed some light on this issue.

THE CONTEXT OF THE STUDY

This study took place in 2001 and 2002 in China and Australia, two countries which have different cultural traditions and education systems.

China is a society with a long and strong tradition. The vast majority of its population were born in China, with only very tiny proportion of people coming from other countries. Traditionally education was highly emphasised in society as it was considered the only path to success. Parents paid great attention to their children's education, and had high expectations for their children's achievements (Hess et al., 1987; Chen et al., 1996). The education system in China was highly centralised, with national wide unified curricula, textbooks and university entrance examination.

In the early 1980's China adopted the open door policy, a movement aimed at learning advanced technologies and administrative skills, mainly from the West. This has created the rapid economic growth seen over the past several years (Tian et al., 2000). With the development of the economy, the highly centralised education system has been in a process of change. For instance, one current endeavour in the system is to try to shift education from being examination-driven towards more quality-oriented education, in which instead of only paying attention to the students' results in examinations, the students' all-round development is emphasised (Yuan, 2001). In the particular case of mathematics education, the content and topics in the mathematics curriculum that were considered too difficult and out of date were removed, students' abilities to use knowledge to solve problems were highlighted, and the new *Mathematics Curriculum Framework* (*for trial*) was formed (Ministry of Education of People's Republic of China, 2003). Instead of designating the use of nationally unified textbooks, the government encourages schools in different regions to use different textbooks provided these are compiled according to the national curriculum frameworks and the quality is monitored. In the meantime, many universities merged into larger universities and the number of students enrolled has increased greatly in recent years (Tian et al., 2000). Consequently the gap between the number of students who have completed their secondary schooling and the number of places offered by universities has decreased. With all the changes that have happened in the society, as well as in the education system, it is not clear whether the practice of families' strongly emphasising children's education is still common.

Australia is a multicultural society with a large proportion of immigrants. Based on the figures of Australian Bureau of Statistics at 2001, approximately 23% of people were born overseas (Australian Bureau of Statistics, 2002). In terms of the student population in the State of Victoria, it was recently reported that 18.9% of the students were from language backgrounds other than English (Department of Employment, Education, and Training, 2002).

In Australia, education is also emphasised by society and has also experienced change over the past several years. Traditionally, each state has its own curriculum, these curricula were independent, and no unified framework existed to link them. However, in order to reduce unnecessary differences in curriculum among the states and to further strengthen the effective collaboration between them in sharing knowledge and resources, the states decided to set up national curriculum guidelines in several areas (Australian Educational Council, 1994). In mathematics education, for instance, *A National Statement on Mathematics for Australian Schools* (Australian Educational Council, 1991), and *Mathematics – A Curriculum Profile for Australian Schools* (Australian Educational Council, 1994) were published, in which commonly agreed goals of school mathematics were set up. In recent years, students' numeracy skills were stressed in the curriculum, and use of technology in teaching and learning was enhanced (Department of Employment, Education, and Training, 2002).

With all these changes taking place, little is known about how strong the parental involvement in students' learning is in comparison with other countries and within different cultural groups.

OVERVIEW OF PREVIOUS RESEARCH ON PARENTAL INFLUENCES ON MATHEMATICS LEARNING

A considerable number of studies have investigated the roles that parents play in children's mathematics learning. It has been suggested that parents' involvement has a significant impact on students' attitudes towards mathematics, students' achievement in mathematics (Stevenson and Newman, 1986; Tocci and Engelhard, 1991), as well as gender difference in mathematics (Eccles and Jacobs, 1986; Tiedeman, 2000).

Studies concerning parental influences on students' mathematics learning also try to reveal which types of parental involvement influence the students' learning outcomes. The types of parental involvement studied can be generally categorised into two: direct assistance and indirect assistance

(Cai et al., 1997). Direct assistance, such as helping children with mathematics difficulties and helping children with mathematics subject choice, was found to have a less important impact on students' mathematics performance (Cai et al., 1997; Wang et al., 1996). Indirect assistance, such as parental encouragement, parental expectation, and parents' attitudes towards mathematics, were frequently identified as having a significant impact on students' attitudes towards mathematics, students' participation in advanced level mathematics and students' achievement in mathematics (Ma, 2001; Poffensberg and Norton, 1959; Wang et al., 1996).

Researchers have also tried to theorise the process of parents' influencing students' learning. For example, Parsons et al. (1982) suggested that there were two processes involved in parental influence: parents as role models, and parents as expectancy socializers. The former, they maintained, assumes that "models, parents in particular, exhibit behaviours which children imitate and later adopt as part of their own behavioural repertoire" (p. 310), and the latter suggests that parents influence their children's achievement through expectations, as "parents may convey their expectations in the messages they give regarding their beliefs about their children's abilities, and the difficulty of various achievement tasks" (p. 311).

To conclude, a rich literature has been produced concerning parents' influence on students' mathematics learning, which includes whether parental involvement has an impact on students' learning, which types of parental involvement has an impact on students' learning, and how parental involvement impacts students' learning. However, to date, little has been known concerning how parental influence on students' learning of mathematics differs across different year levels of schooling. Clearly children gain greater independence and learn more and deeper levels of mathematics as their schooling proceeds, but will they consider their parents encouraging and helping them more, or just the opposite?

PARENTAL INFLUENCE IN THE INTERNATIONAL CONTEXT

Research on the differences in parental involvement in their children's mathematics learning among different cultural groups has also attracted the interest of many researchers. For example, Chen et al. (1996) compared students' achievements and their parental involvement in China and the USA, and found that Chinese parents had higher expectations of their children's performance and spent more time helping their children with school homework than did parents in the USA. Yao (1985) interviewed a group of Asian-American, and Caucasian-American students in the USA, and found that Asian-American parents expected their children to get 'A' grades more often, were less satisfied with their children's performance at school, and were more involved in their children's homework and projects. Mau (1997) investigated differences in parental influence on the academic achievement of Asian immigrants, Asian Americans, and White Americans by using a large representative sample of 10th grade students in the USA. The findings showed that both Asian immigrant and Asian American parents had higher educational expectations than did white American parents. However, white American students reported more parental involvement in school activities, such as helping with homework and attending school events, than did Asian immigrant and Asian American students. A recent study conducted by Cai (2003) among over 500 sixth grade students in China and the U.S.A. suggested that a larger percentage of Chinese parents reported that they checked their children's homework regularly than did US parents. In contrast, a larger percentage of US parents reported that they often provided their children with reference books and access to libraries. The parents in the two countries did not show significant differences in emotional support for their offspring (that is, encouraging students to work harder on their mathematics).

As the inconsistent findings above suggested, it seems necessary to re-examine aspects in which parents of different cultural groups differ in their involvement with their children's learning of mathematics. Another issue that has not been addressed adequately is the comparison of the parental influence of the same cultural group in different countries. A minority cultural group who has immigrated to another society, will perhaps experience two broad processes: culture-assimilating, the process of adopting the values and the practices of the mainstream society, and culture-keeping, the process of keeping its own values and practices. Which process dominates in the aspect of parental influence on mathematics learning? The current study also tries to reveal ideas concerning this issue.

THE STUDY

The purpose of this study was to investigate the levels of perceived parental influence on students' learning of mathematics learning at different grade levels of schooling, and also to compare the levels of perceived parental influence among different cultural groups of students in China and Australia. The research questions were:

1. What are the trends in the levels of perceived parental influence across three different year levels (Years 5, 7 & 9) in China and Australia?

2. Are there any differences in the levels of perceived parental influence among students from China and students from Australia?
3. Are there any differences in the levels of perceived parental influence among students from different cultural groups?

The participants in this study comprised 346 primary and secondary school students in China, and 406 primary and secondary school students in the State of Victoria, Australia. They were distributed over three year levels, Years 5, 7, 9. The reasons for choosing these three specific year levels were that Year 9 is the last year of compulsory education in China (even though the last year of compulsory of education is Year 10 in Australia), Year 7 is the first year of secondary schooling in both China, and the State of Victoria, Australia, and Year 5 is close to the end of primary schooling in both countries and is also one of the earliest year levels considered appropriate to use questionnaires. The students in China were from three primary schools and three secondary schools in Kaifeng, a middle-sized city in Henan Province. Of the three secondary schools, one was a key-school, the other two were non-key schools. Key schools in China are schools with better teaching facilities, higher proportions of quality teachers, and higher rates of graduated student enrolments in tertiary institutions or the next level of schooling. The students in Australia were from six primary schools and seven secondary schools, in metropolitan Melbourne. The participating primary schools were a mixture of schools from suburbs with higher and lower socio-economic levels. The selection of secondary schools was based on VCE (Victoria Certificate of Education – a two-year program for the final years of schooling) performance in the year 2000. Three of the schools' VCE performances were rated very good; the rest were rated average. All the participants in China were from Chinese speaking home backgrounds. Of the students in Australia, 259 were from English speaking families, 47 were from Chinese speaking families, and 99 from homes in which other languages were spoken. There were over 30 other languages, with the main ones being Vietnamese, Greek, Italian, Indonesian, Tamil, Arabic, Hindi, and Russian. The Vietnamese speakers, and the Greek speakers were the two largest groups, with 15 and 13 students respectively. There were fewer than five students in each of the other language speaking groups.

A questionnaire (see the detailed description in the next section) measuring perceived parental influence on children's mathematics learning was developed and was administered among the target population in China during October to December 2001, and in Australia during January to July 2002. Participants were asked to complete the questionnaire in terms of their own experiences and then return the completed questionnaire in a sealed envelope to the first author. The questionnaire was anonymous but participants were asked to indicate other information such as year level, gender and languages spoken at home.

THE INSTRUMENT

In order to measure the levels of perceived parental influences on students' learning of mathematics, a Perceived Parental Influence (PPI) scale was developed. The instrument consisted of 16 items, eight measuring mother's influence on mathematics learning as perceived by students, and eight measuring father's influence. It was assumed that parental influences could be categorised into direct involvement and indirect involvement, and the instrument was designed to measure students' perceptions of both. Based on context and the characteristics of the target student population, the dimensions of perceived direct parental involvement investigated included mother's and father's assistance with homework and help with difficult mathematics problems. The dimensions of perceived indirect involvement investigated included mother's and father's attitudes towards mathematics, encouragement, and expectations of students' achievement.

A four-point Likert scale response format was used. For each statement, students were asked to indicate whether they "Strongly Agree (SA)", "Agree (A)", "Disagree (D)", or "Strongly Disagree (SD)". For analysis purposes, the values of 4, 3, 2, 1 were assigned to "Strongly Agree", "Agree" (A), "Disagree" (D), and "Strongly Disagree (SD)" respectively.

The instrument was first written in Chinese and then translated into English. The translation was checked by colleagues who were familiar with both English and Chinese to ensure accuracy of translation.

The reliability analysis of the 16 items of the Perceived Parental Influence (PPI) scale showed that the reliability coefficient (Cronbach Alpha) was 0.876, a satisfactory level (Kline, 1986).

Factor analysis is a technique used often to examine the dimensions of a scale (Hair et al., 1995), and it was therefore performed on the total data collected in this study. Initial analysis suggested that there were four components with Eigenvalues greater than 1, explaining 66.6% of the total variance. A further Varimax rotation was undertaken to find out the clear structure of the scale. The results are indicated in Table I.

It can be seen that six items have their highest loadings on Component 1, four items on Component 2, four items on Component 3, and two items on Component 4. The four components explain 19.71%, 18.61%, 15.63%, and 12.60% of the total variance respectively.

By looking at the semantic meanings of the items on each component, we can see that Component 1 represents perceived mother's and father's

TABLE I
Rotated component matrix and eigenvalues of the items of the PPI scale

Item		Component 1	2	3	4
1.	My mother is good at maths			0.76	
2.	My mother checks my maths homework frequently			0.76	
3.	My mother asks me about my assessment results in maths	0.33		0.55	
4.	My mother helps me with some difficult maths problems			0.81	
5.	My mother makes me feel that I can do well in maths	0.61		0.39	
6.	My mother tells me that a person must do something carefully in order to do it well	0.76			
7.	My mother tells me a person must work hard in order to do something well	0.78			
8.	My mother expects me to be the best student in maths and other subjects in my class				0.86
9.	My father is good at maths		0.70		
10.	My father checks my maths homework frequently		0.74		
11.	My father asks me about my assessment results in maths		0.66		0.34
12.	My father helps me with some difficult maths problems		0.81		
13.	My father makes me feel that I can do well in maths	0.59	0.54		
14.	My father tells me that a person must work hard in order to do something well	0.70	0.39		
15.	My father tells me that a person must do something carefully in order to do it well	0.67	0.38		
16.	My father expects me to be the best student in maths and other subjects in my class				0.88
%	Variance explained	19.71	18.61	15.63	12.60

*Loadings less than 0.3 omitted.

encouragement for mathematics learning and was named the *Parent Encouragement* subscale (PEC). Component 2 represents perceived father's attitudes to mathematics and help given for mathematics learning, and was called the *Father's Attitudes and Help* subscale (FAH). Component 3 represents perceived mother's attitudes to mathematics and help given for mathematics learning and was called the *Mother's Attitudes and Help* subscale (MAH). Component 4 represents perceived mother's and father's expectations of their child's school achievement and was named the *Parent Achievement Expectation* (PAE) subscale.

RESULTS

The comparisons of PPI are first made among students within China and Australia, and then between China and Australia, and finally among the cultural groups.

Comparisons within China

The means and standard deviations for scores on the Perceived Parental Influence (PPI) scale at each of the three year levels among the students from China are shown in Table II. It can be seen that the mean score on the PPI scale (maximum possible score = 4) is strong at Year 5, and weaker, but still strong at Year 9.

One-way Analysis of Variance (ANOVA) indicated significant differences in the means [F (2, 343) = 42.30, $p < 0.001$], with a large effect size (η^2) of 0.198 (Cohen, 1988). Scheffe post-hoc tests showed that there were significant differences in the means between each pair of year levels: Years 5 and 7 [mean difference = 0.28, $p < 0.001$], Years 7 and 9 [mean difference = 0.22, $p < 0.001$], and Years 5 and 9 [mean difference = 0.50, $p < 0.001$]. The results suggest that although the levels of PPI at the three year levels are strong in general, among students in China there is a decrease in the level as the year level increases.

Table III shows the means and standard deviations for each subscale at the three year levels among the students from China. The data in Table III reveal a trend of decreasing mean scores on each subscale as the year level increases.

The results of one-way ANOVAs for each subscale by year level are displayed in Table IV. The data indicate that there are significant differences in the means on each of the subscales by year level, confirming that the levels

TABLE II
Means, Standard Deviations of the PPI scale by year level among students from China

Year level	*N*	Mean	SD
5	114	3.50	0.36
7	120	3.22	0.45
9	110	3.00	0.40

TABLE III
Means, Standard Deviations on each subscale of PPI by year level among the students from China

Subscale	Year level	*N*	Mean	SD
PEC	5	119	3.69	0.37
	7	123	3.47	0.50
	9	110	3.43	0.49
	Total	352	3.53	0.47
FAH	5	116	3.35	0.57
	7	123	3.03	0.64
	9	110	2.60	0.58
	Total	349	3.00	0.67
MAH	5	118	3.28	0.59
	7	124	2.89	0.58
	9	110	2.57	0.65
	Total	352	2.92	0.67
PAE	5	118	3.74	0.47
	7	122	3.49	0.57
	9	110	3.40	0.67
	Total	350	3.55	0.59

TABLE IV
ANOVA results: PPI subscale by year level among students from China

Subscale	df	*F*	η^2
PEC	(2, 351)	11.27***	0.06
FAH	(2, 348)	43.86***	0.20
MAH	(2, 351)	38.52***	0.18
PAE	(2, 349)	10.96***	0.06

*** $p < 0.001$.

of PPI for each of the four dimensions – parental encouragement, father's attitudes and help, father's attitudes and help, and parental achievement expectation – are all less strong as the year level increases.

Comparisons within Australia

Table V shows the means and standard deviations on the PPI scale among the Australian students at each year level. These values suggest a strong level of perceived parental influence at Year 5, but at Year 9 it is only slightly strong.

TABLE V
Means, Standard Deviations of the PPI scale by year level among students from Australia

Year level	*N*	Mean	SD
5	120	3.18	.45
7	137	2.94	.45
9	114	2.68	.57

When a one-way ANOVA was conducted, the results showed that there were significant differences in the mean scores at the three year levels, with a large effect size [F (2,370) $= 30.65$, $p < 0.001$, $\eta^2 = 0.142$]. Post-hoc Scheffe tests indicated that there were significant differences in the scale means between each pair of year levels (mean difference Years 5 and 7 $= 0.25$, $p < 0.001$; Years 5 and 9 $= 0.50$, $p < 0.001$; and Years 7 and 9 $= 0.26$, $p < 0.001$). The results show that the means on the PPI scale decrease significantly as year levels increase, with students at Year 9 having less strong levels of perceived parental influence than students at Years 7 and 5.

Table VI shows the means and standard deviations of the scores on each of the four subscales by year level for the Australian students. The means of the PEC, FAH and MAH subscales at higher year levels are generally lower than those at lower year levels with the exception of the PAE subscale.

One-way ANOVAs were conducted on the scores on each subscale by year level and the results are displayed in Table VII. It can be seen in Table VII that there are significant differences in the means of all four subscales by year level, with the effect sizes for the PEC, FAH, and MAH ranging from medium to large. However, the effect size for the PAE subscale is very small. Scheffe post-hoc tests conducted on the PAE subscale as indicated in Table VII suggest that there were significant differences in the means on the PAE subscale between students at Years 5 and 7 (mean difference $= 0.35$, $p < 0.001$), and Years 7 and 9 (mean difference $= -0.28$, $p < 0.01$). However, there was no significant difference between the means for Years 5 and 9.

The findings show that parental encouragement, father's and mother's attitudes and help, all became weaker with increasing year levels, although parental achievement expectation changes only slightly across Years 5 and 9 among the Australian students.

Comparisons between China and Australia

Independent sample *t*-tests by country were conducted on the means of the PPI scale for all students and for students at each of the three year levels.

TABLE VI
Means and Standard Deviations for each subscale of PPI by year level, among Australian students

Subscale	Year level	*N*	Mean	SD
PEC	5	123	3.36	0.50
	7	139	3.22	0.53
	9	116	3.00	0.68
	Total	378	3.20	0.59
FAH	5	126	3.13	0.69
	7	141	2.96	0.73
	9	117	2.53	0.85
	Total	384	2.88	0.79
MAH	5	129	3.22	0.57
	7	145	2.82	0.64
	9	120	2.41	0.73
	Total	394	2.82	0.73
PAE	5	127	2.67	0.93
	7	143	2.32	0.97
	9	118	2.60	0.99
	Total	388	2.52	0.97

TABLE VII
ANOVA results for each subscale of PPI by year level among Australian students

Subscale	df	*F*	η^2
PEC	(2, 377)	12.00***	0.06
FAH	(2, 383)	19.92***	0.09
MAH	(2, 393)	48.97***	0.20
PAE	(2, 387)	4.55**	0.02

***$p < 0.001$; **$p < 0.01$.

The results are shown in Table VIII. There were significant differences by country for students at each year level and for the whole sample, with students in China having a higher mean score in each case. Effect sizes were medium at Years 7 and 9, and large at Year 5 and overall. The results indicate that there are significant differences in the perceived levels of parental influence between students from the two countries. Overall, and at each year level, students from China considered that their parents had a stronger influence on their mathematics learning than did the Australian students.

TABLE VIII
PPI scale: Results of independent samples *t*-tests for each year level by country

	CHINA			AUSTRALIA					
Year	*N*	Mean	SD	*N*	Mean	SD	*t*	df	η^2
5	114	3.50	0.36	120	3.18	0.45	6.00***	226	0.13
7	120	3.23	0.45	137	2.94	0.45	5.11***	255	0.10
9	110	3.00	0.44	114	2.68	0.57	4.88***	222	0.09
All	344	3.25	0.45	371	2.94	0.53	8.33***	713	0.11

***$p < 0.001$.

TABLE IX
Results of independent sample *t*-tests for each subscale of PPI by country

	CHINA			AUSTRALIA					
Subscale	*N*	Mean	SD	*N*	Mean	SD	*t*	df	η^2
PEC	352	3.53	0.47	378	3.20	0.59	8.58***	713	0.09
FAH	349	3.00	0.67	384	2.88	0.79	2.22*	744	0.006
MAH	352	2.92	0.67	394	2.82	0.73	1.88	645	–
PAE	350	3.55	0.59	388	2.52	0.97	17.55***	645	0.295

*$p < 0.05$; ***$p < 0.001$.

Table IX shows the results of independent sample *t*-tests for each of the subscales by country. It can be seen on Table IX that there were significant differences in the means on the PEC, FAH, and PAE subscales, with the effect size for PEC being medium to large, and the effect size for PAE being very big; however, the effect size for FAH is very small, and there is no significant difference in the means on the MAH subscale.

The findings show that the level of perceived parental achievement expectations (PAE) was much stronger among students in China than among students in Australia, and the perceived level of parental encouragement (PEC) was also stronger among students in China than among students in Australia. However, there were no significant differences in the levels of perceived fathers' attitudes and help with learning of mathematics (FAH) or mother's attitudes and help with learning of mathematics (MAH) between the students in the two countries.

Comparisons by language group

Perceived parental influence scale. Table X shows the means and standard deviations for the PPI scale among the students from the four language groups, namely, the students in China [Chinese (CHN)], English speaking students in Australia [English (AUS)], Chinese speaking students in Australia [Chinese (AUS)], and other language speaking students in Australia [Other (AUS)].

The one way ANOVA results (PPI by language group) indicated that there were significant differences in the means on the PPI scale among the students from the four language groups [$F(3, 710) = 34.95$, $p < 0.001$, $\eta^2 = 0.127$]. The results suggest that the differences in the levels of perceived parental influence on mathematics learning by language group is quite large. The post-hoc Scheffe test results (Table XI) indicate significant difference between mean scores.

The results reveal that students in China, Chinese speaking students in Australia, and other language speaking students in Australia have stronger levels of perceived parental influence than English speaking students in Australia. However, the three groups of students, students in China, Chinese speaking students in Australia, and other language speaking students in Australia, do not demonstrate differences in their perceived levels of parental influence.

TABLE X
Means and Standard Deviations on the PPI scale by language group

Language group	*N*	Mean	SD
Chinese (CHN)	344	3.25	0.45
English (AUS)	235	2.83	0.52
Chinese (AUS)	47	3.11	0.44
Other (AUS)	88	3.13	0.52

TABLE XI
Post hoc tests on mean differences in the PPI scale by language group

Language group (I)	Language group (J)	Mean difference (I–J)
Chinese (CHN)	English (AUS)	0.42***
Chinese (CHN)	Chinese (AUS)	0.13
Chinese (CHN)	Other (AUS)	0.11
Chinese (AUS)	English (AUS)	0.28**
Chinese (AUS)	Other (AUS)	−0.02
Other (AUS)	English (AUS)	0.30***

*** $p < 0.001$; ** $p < 0.01$.

Subscales of the PPI scale. The means and standard deviations on each subscale of the PPI are displayed in Table XII for each language group of students.

It can be seen from Table XII that the students in China had the highest means on the PEC and PAE subscales, the other language speaking students in Australia had the highest means on the FAH and MAH subscales, while the English speaking students in Australia had the lowest means on all four subscales.

The one-way ANOVA results in Table XIII indicate that there were significant differences in the means on each subscale among the four groups of students, with a medium to large effect size for the PEC subscale, a very large effect size for the PAE subscale, and very small effect sizes for the MAH and FAH.

The results indicate that there are large differences in the levels of perceived parental encouragement (PEC) and expectation (PAE) among the four groups of students. The differences in the levels of perceived father's (FAH) and mother's (MAH) attitudes towards mathematics and help with mathematics learning among the four language groups of students are small.

TABLE XII
Means and Standard Deviations on each subscale of the PPI scale by language group

Subscale	Language group	*N*	Mean	SD
PEC	Chinese (CHN)	352	3.53	0.47
	English (AUS)	238	3.11	0.56
	Chinese (AUS)	47	3.36	0.55
	Other (AUS)	91	3.34	0.63
FAH	Chinese (CHN)	349	3.00	0.67
	English (AUS)	242	2.80	0.82
	Chinese (AUS)	47	3.01	0.65
	Other (AUS)	94	3.02	0.77
MAH	Chinese (CHN)	352	2.92	0.67
	English (AUS)	251	2.75	0.73
	Chinese (AUS)	47	2.91	0.68
	Other (AUS)	94	2.99	0.72
PAE	Chinese (CHN)	350	3.55	0.59
	English (AUS)	245	2.24	0.88
	Chinese (AUS)	47	2.94	0.87
	Other (AUS)	94	3.04	0.97

TABLE XIII
One-way ANOVA results for each subscale of the PPI by language group

Subscale	df	F	η^2
PEC	(3, 727)	30.29***	0.11
FAH	(3, 731)	4.06**	0.02
MAH	(3, 743)	4.07**	0.02
PAE	(3, 735)	139.39***	0.36

$^{***}p < 0.001$; $^{**}p < 0.01$.

TABLE XIV
Post hoc tests on mean differences in the PEC and PAE subscales by language group

Subscale	Language group (I)	Language group (J)	Mean difference (I–J)
PEC	Chinese (CHN)	English (AUS)	0.42***
	Chinese (CHN)	Chinese (AUS)	0.17
	Chinese (CHN)	Other (AUS)	0.19*
	Chinese (AUS)	English (AUS)	0.25**
	Chinese (AUS)	Other (AUS)	0.02
	Other (AUS)	English (AUS)	0.23*
PAE	Chinese (CHN)	English (AUS)	1.31***
	Chinese (CHN)	Chinese (AUS)	0.61***
	Chinese (CHN)	Other (AUS)	0.51***
	Chinese (AUS)	English (AUS)	0.70***
	Chinese (AUS)	Other (AUS)	−0.10
	Other (AUS)	English (AUS)	0.80***

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$.

Scheffe post-hoc tests were conducted for the PEC and PAE subscales among the four language group students. The results were shown in Table XIV.

The results suggest that students in China had stronger perceived parental encouragement and expectations than English speaking students and other language speaking students in Australia, while students in China showed similar levels of parental encouragement and a stronger level of parental expectations in comparison to the Chinese speaking students in Australia. Within the three groups of students in Australia, Chinese students and other language speaking students showed similar levels of perceived parental encouragement and expectation, while both of them demonstrated a higher level of parental encouragement and expectation than English speaking students in Australia.

CONCLUSIONS AND DISCUSSION

A few conclusions are drawn tentatively from the findings of the study.

(1) Perceived parental influence on mathematics learning is less strong as year level increases in both Chinese and Australian cultures.
(2) Generally perceived parental influence on mathematics learning among students in China is stronger than that among students in Australia, however, the major differences are in the parental encouragement and parental achievement expectation dimensions.
(3) There are cultural group differences in perceived parental influence. In general, students in China, Chinese speaking students in Australia, and other language speaking students in Australia show similar levels of perceived parental influence, but all demonstrate a higher level of perceived parental influence than English speaking students in Australia. However, the differences mainly exist in the dimensions of parental encouragement and parental expectation. Students in China demonstrate a significantly higher level of perceived parental expectation than Chinese speaking students in Australia and other language speaking students in Australia, but students in China and Chinese speaking students in Australia show a similar level of perceived parental encouragement. Chinese speaking students and other language speaking students in Australia demonstrate similar levels of perceived parental encouragement and expectation, but they both show significantly higher levels of perceived parental encouragement and expectation than English speaking students in Australia

Possible explanations for the findings

The year level differences. One explanation for students at higher year levels showing less strong levels of perceived parental influence than students at lower year levels in both countries, may be that when students move to higher levels of schooling they meet more and more difficult tasks in mathematics and other school subjects, and these may be beyond their parents' ability to provide help. Meanwhile, if parents see the more difficult problems that their children are unable to solve, they will lower their mathematics achievement expectations as well as providing less encouragement.

The different levels of students' perceived parental achievement expectation among students in Australia may be similarly explained. As Year 7 is the first year of secondary school, students may meet much harder tasks in mathematics and other subjects than they have met previously in their primary schooling. Their performance levels might drop, resulting in the lowering of their parental expectations. However, as students get used to the demands of secondary school mathematics learning, by Year 9 their school performances do not deteriorate further, and parents' expectations of their children's performances rise accordingly. Another possible explanation is that children gain more independence when they are growing up, and thus parents give them less assistance in their study. Perhaps other significant people, like peers, play a more important role in influencing their learning.

The country difference. The cultural factors may contribute to the between country differences in the levels of perceived parental influence. As has been mentioned earlier in this paper, education has always been considered the most important path to success in Chinese culture (Hess et al., 1987; Chao and Sue, 1996). This study tends to suggest that this value is still strongly held in the society, despite the implementation of more open and reforming policies over the past few years. This finding is consistent with those in previous studies (e.g., Yao, 1985; Chen et al., 1996) in which the parental expectation of Chinese students was higher than other comparison groups. However, this study did not find that students in China had stronger levels of perceived parental involvement with homework than the other groups of students, as was found previously by Chen et al. (1996) and Cai (2003), when comparing the U.S. and Chinese students. There might be a need for further investigation of this dimension.

The cultural group difference. The findings regarding the difference in the perceived parental influence among the different cultural groups of students are complicated to explain, however, the societal and cultural factors may both play a role. Firstly, the fact that Chinese students and other language speaking students in Australia show similar levels of perceived parental influence, but both show higher levels of perceived parental influence than English speaking students in Australia, may reflect an immigrant phenomenon, a strategy used for achieving upward social mobility by immigration groups (Goyette and Xie, 1999; Marjoribanks, 2002). That is, among immigrant families in Australia for whom English is not their first language, the parents realise the greater difficulties for them to achieve success in their new society. They recognise that education is vital for success, therefore they strongly encourage their children and have high expectations of them to fulfil their own dreams.

Secondly, the findings do reveal certain cultural variations when the same cultural groups live in different societies, which might be due to cultural assimilation, even though it tends to suggest that the culture-keeping process dominates for the Chinese speaking students in Australia. The two Chinese groups of students demonstrate similar levels of perceived parental influence in general, however, the perceived parental expectations of students in China are significantly higher than those of Chinese speaking students in Australia. This might reflect the fact that parents of Chinese speaking families in Australia have lowered their expectations for their students' school achievement compared with their counterparts in China, although they still encourage their children's learning as strongly as those parents in China. In fact, the effects of cultural variations and assimilation on migrant groups may be seen in earlier studies of mathematics learning. In a study exploring students' gender stereotyping of mathematics in Australia and Greece, Barkatatsas et al. (2001) found that students' gender stereotyping of mathematics of Australian Greek students were more similar to Australian students than they were to students in Greece.

Thirdly, this study suggests that parents' attitudes towards mathematics and their direct help with their children's mathematics are similar among the four groups of students in China and Australia. The generalizability of the finding needs further confirmation, as no similar studies have been undertaken. However, if such a finding is generally true, and if this result is related to the differences in students' mathematics performance in international studies (Lapointe et al., 1992; Lokan et al., 1996, 1997), it may be that parents' encouragement and expectations are the most critical elements affecting students' mathematics achievement among the various aspects of parental influence.

In conclusion, this study has revealed differences in the levels of perceived parental influence on mathematics learning among different groups of students in China and Australia, and has discussed some possible reasons for the differences. However, more work is needed to fully understand the complicated issue of parental influences on mathematics among different groups of students. Other techniques such as interviews with parents and students may be employed to assist with this task in future research, always bearing in mind the cultural differences associated with using different research approaches. Only when more studies adopting different research approaches are carried out will it be possible for people to better understand the phenomenon of differences in parental influences on students' learning among groups of students from different backgrounds.

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APPENDIX

The component matrix and the eigenvalues of the items for the Perceived Parental Influence scale

	Component			
Item	1	2	3	4
1. My mother is good at maths	0.40	0.43	0.51	
2. My mother checks my maths homework frequently	0.56	0.36	0.38	
3. My mother asks me about my assessment results in maths	0.64			
4. My mother helps me with some difficult maths problems	0.54	0.46	0.43	
5. My mother makes me feel that I can do well in maths	0.65			–0.36
6. My mother tells me that a person must do something carefully in order to do it well	0.65	–0.30		–0.33
7. My mother tells me a person must work hard in order to do something well	0.63	–0.34		–0.35
8. My mother expects me to be the best student in maths and other subjects in my class	0.48	–0.60		0.43
9. My father is good at maths	0.47	0.41	–0.38	
10. My father checks my maths homework frequently	0.64		–0.31	0.35
11. My father asks me the assessment results in maths	0.69			
12. My father helps me with some difficult maths maths problems	0.61	0.35	–0.46	
13. My father makes me feel that I can do well in maths	0.72		–0.30	
14. My father tells me that a person must work hard in order to do something well	0.72			
15. My father tells me that a person must do something carefully in order to do it well	0.73			
16. My father expects me to be the best student in maths and other subjects in my class	0.45	0.63		0.48
Eigenvalue	5.90	2.01	1.55	1.19
% Variance explained	36.86	12.65	9.68	7.45

*Extraction method: Principal component analysis; Loadings less than 0.3 omitted.

REFERENCES

Australian Bureau of Statistics: 2002, *2001 Census Basics*, the author, Canberra.

Australian Educational Council: 1991, *A National Statement on Mathematics for Australian Schools*, Australian Curriculum Corporation, Melbourne.

Australian Educational Council: 1994, *Mathematics – A curriculum profile for Australian schools*, Australian Curriculum Corporation, Melbourne.

Barkatsas, A.N., Forgasz, H.J. and Leder, G.: 2001, 'The gender stereotyping of mathematics: Cultural dimensions', in J. Bobis, B. Perry and M. Mitchelmore (eds.), *Numeracy and Beyond, Proceedings of the Twenty-Fourth Annual Conference of Mathematics Education Research Group of Australasia*, MERGA, Sydney, pp. 74–81.

Cai, J., Moyer, J.C. and Wang, N.: 1997 (March), *Parental Roles in Students' Learning of Mathematics: An Exploratory Study*, Paper presented at the annual meeting of the American Educational Research Association, Chicago, USA.

Cai, J.: 2003, 'Investigating parental roles in students' learning of mathematics from a cross-cultural perspective', *Mathematics Education Research Journal* 15(2), 87–106.

Cao, Z.: 2004, *An Investigation of Students' Attitudes Towards Mathematics in China and Australia*, Doctoral Dissertation, Monash University, Australia.

Chao, R.K. and Sue, S.: 1996, 'Chinese parental influence and their children's school success: A paradox in the literature on parenting styles', in S. Lau (ed.), *Growing up the Chinese Way: Chinese Child and Adolescent Development,* the Chinese University Press, Hong Kong, pp. 93–120.

Chen, C., Lee, S. and Stevenson, H.W.: 1996, 'Academic achievement and motivation of Chinese students: A cross-national perspective', in S. Lau (ed.), *Growing up the Chinese way: Chinese Child and Adolescent Development*, the Chinese University Press, Hong Kong, pp. 69–92.

Cohen, J.: 1988, *Statistical Power Analysis for the Behavioural Sciences*, Lawrence Erlbaum, Hillsdale, NJ.

Department of Employment, Education, and Training: 2002, *Annual Report 2001–2002*, the author, Melbourne.

Eccles, J.S. and Jacobs, J.E.: 1986, 'Social forces shape mathematics attitudes and performance', *Signs* 11, 367–380.

Goyette, K. and Xie, Y.: 1999, 'Educational expectations of Asian American youths: Dert-erminants and ethnic differences', *Sociology of Education* 72(1), 22–36.

Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C.: 1995, *Multivariate Data Analysis with Readings* (4th ed.), Prentice Hall, London.

Hess, R.D., Chang, C. and McDevitt, T.M.: 1987, 'Cultural variations in family belief about children's performance in mathematics: Comparisons among People's Republic of China, Chinese American, and Caucasian-American families', *Journal of Educational Psychology* 79, 179–188.

Kline, P.: 1986, *A Handbook of Test Construction*, Methuen, New York.

Lapointe, A.E., Mead, N. and Askew, J.M. (eds.): 1992, *The International Assessment of Educational Progress Report No. 22-CAPE-01: Learning Mathematics*, Educational Testing Service, NJ.

Lokan, J., Ford, P. and Greenwood, L.: 1996, *Maths and Science on the Line: Australian Junior Secondary Students' Performance in the Third International Mathematics and Science Study*, Australian Council for Educational Research, Melbourne.

Lokan, J., Ford, P. and Greenwood, L.: 1997, *Maths and Science on the Line: Australian Middle Primary Students' Performance in the Third International Mathematics and Science Study*, Australian Council for Educational Research, Melbourne.

Ma, X.: 2001, 'Participation in advanced mathematics: Do expectation and influence of students, peers, teachers, and parents matter?', *Contemporary Educational Psychology* 26, 132–146.

Marjoribanks, K.: 2002, 'Family background, individual and environmental influences on adolescents' aspirations', *Educational Studies* 28(1), 33–46.

Mau, W.C.: 1997, 'Parental influences on the high school students' academic achievement: A comparison of Asian immigrants, Asian Americans, and White Americans', *Psychology in the Schools* 34(3), 267–271.

Ministry of Education of People's Republic of China: 2003, *The Curriculum Standard for Mathematics* (*for trial*) [in Chinese], People's Educational Press, Beijing.

Poffensberg, T. and Norton, D.A.: 1959, 'Factors in the formation of attitudes towards mathematics', *Journal of Educational Research* 52, 171–176.

Parsons, J.E., Adler, T.F. and Kaczala, C.M.: 1982, 'Socialization of achievement attitudes and beliefs: Parental influences', *Child Development* 53, 310–321.

Stevenson, H.W. and Newman, R.S.: 1986, 'Long-term prediction of achievement and attitudes in mathematics and reading', *Child Development* 57, 646–659.

Tian, C., Ma, S. and He, P. (eds.): 2000, 'Yearbook 2000, People's Republic of China', Beijing, People's Republic of China Year Book.

Tiedemann, J.: 2000, 'Parents' gender stereotypes and teachers' beliefs as predictors of children's concept of their mathematical ability in elementary school', *Journal of Educational Psychology* 92(1), 144–151.

Tocci, C.M. and Engelhard, G.:1991, 'Achievement, parental support, and gender differences in attitudes towards mathematics', *Journal of Educational Research* 84(5), 280–286.

Wang, J., Wildman, L. and Calhoun, G.: 1996, 'The relationships between parental influence and student achievement in Seventh Grade Mathematics', *School Science and Mathematics* 96(8), 395–399.

Yao, E.: 1985, 'A comparison of family characteristics of Asian-American and Anglo-American high achievers', *International Journal of Comparative Sociology* 26(34), 198–208.

Yuan, G.: 2001, 'Quality-oriented education: The banner for education reform in the twenty-first century' [in Chinese], *Chinese Educational Journal* 5, 38–42.

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