# Perceived parental influence on students' mathematical achievement, inclination to mathematics and dispositions to study further mathematics

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This paper explores perceived parental influence on students' achievement in mathematics, inclination to mathematics and dispositions to study further mathematics among 563 students in Cyprus. The reliability of the scale designed to measure perceived parental influence was investigated using the Rasch model. It was found that perceived parental influence had a statistically significant effect on students' inclination to mathematics, but it did not have a statistically significant effect on students' mathematics achievement and dispositions to study further mathematics in Higher Education. The effect of parental influence on students' dispositions towards mathematics is discussed.

**parental influence, parental aspirations, mathematics achievement, dispositions**

## Introduction

A considerable number of studies have investigated the role that parents play in their children's mathematical learning. Previous research results suggest that parental involvement has a significant impact on students' mathematics achievement and attitudes towards mathematics (Fan and Chen 2001; Aunola et al. 2003). Parental aspirations and parents' attitudes towards mathematics have been identified as having a significant impact on students' participation in advanced level mathematics and students' achievement in mathematics (Ma 2001).

Despite the vast research on parental involvement in primary mathematics (Campbell and Mandel 1990) there is a scarcity of research on parental aspirations and their impact on adolescent students' dispositions towards mathematics. Notably, although parental influence has been investigated to some extent in relation to mathematics education, there is still some inconsistency in the terminology used in the literature to define parental aspirations. Jacobs and Harvey (2005) define parental aspirations as the amount of education that parents would like for their children to have, ranging from secondary education to postgraduate university degree.

It is generally well documented that higher family socioeconomic status (SES) is related to higher educational expectations for their youths (Wentzel 1998). The concepts of habitus and capital, suggested by Bourdieu and Passeron (1990) have become prominent for investigating and understanding social inequalities among parent groups and crucial for understanding parents' choices and involvement in educational contexts. We conceptualise students' dispositions to study further mathematics in the field of Higher Education as part of their habitus. Students' dispositions towards mathematics might partly be a result of the habitus their families have inculcated.

> "Pedagogic work accomplished by the family is a function of the distance between the habitus it tends to inculcate, and the habitus inculcated by all previous forms of pedagogic work" (Bourdieu and Passeron 1990: p.72).

Undoubtedly, cultural beliefs have an influence on the value parents place on their children's education. Mau (1997) remarks that the degree of parental expectation which is perceived by students differs between cultural/ethnic groups and has a direct impact on children's academic performance. Cross-cultural research on perceived parental influence has attracted the interest of many researchers. Specifically Cao, Bishop and Forgasz (2006) compared Chinese and Australian students' perceptions of parental influence, and concluded that Chinese students have stronger perceived parental influence than Australian students.

In a comparative study of Asian and Caucasian Americans parents, Campbell and Mandel (1990) divided parental influence into four elements: parental pressure, psychological support, parental help and parental monitoring. Furthermore Cao, Bishop and Forgasz (2006) distinguish between direct and indirect parental influence. They argue that direct parental influence, such as helping children with mathematics difficulties, has a less important impact on students' mathematics performance. Indirect parental influence such as parental encouragement, parental expectation and parents' attitudes towards mathematics have been identified as having a significant impact on students' attitudes towards mathematics.

Due to the complexity of parental influence, there is not a standardised scale in the literature for measuring perceived parental aspirations. The aim of the present study is to develop and validate a scale for measuring perceived parental aspirations and to investigate their impact on students' dispositions towards mathematics. A working definition of parental aspirations which underpins the development of the items for this scale, is the extent to which parents value education and urge their children to do well in school and the strength of the parents' expression of the importance of their children's social advancement through education (in this case as perceived by their child). We hypothesise the impact of parental aspirations on students' formation of habitus and decision making to study further mathematics in Higher Education (HE) is crucial.

## Methodology

A questionnaire was designed to measure students' perceived parental aspirations (PAR), prior maths achievement (MACH), inclination to mathematics (MINC), maths self-efficacy (MSE) and dispositions to study further mathematics (DISP.MATHS). The questionnaire was distributed to 563 students in Cyprus, aged 16-17 attending four different upper secondary schools (*lyceums*).

The PAR scale consisted of 14 items, seven items measuring perceived parental aspirations for school mathematics (PAR-SC) and seven items measuring perceived parental aspirations for studying mathematics in HE (PAR-HE). Some items for the PAR-SC scale were adopted from Marchant et al. (2001) i.e. "*My parents encourage me to do my best at school"* and were paraphrased in order to be included in the PAR-HE scale i.e. "*My parents encourage me to study at university*".

Students self-reported their prior maths achievement (MACH) and inclination to mathematics (MINC). An indicative item for measuring students' inclination (MINC) to mathematics is *"Mathematics is my favourite subject"*. The DISP.MATHS scale was adopted from the ESRC-TLRP project "Keeping open the door to mathematically demanding programmes in further and higher education" (Williams et al. 2008). A four point Likert-type response format was used for the scales. For each item students were asked to indicate whether they Strongly Agree=4, Agree=3, Disagree=2 or Strongly Disagree=1.

The items for the maths self-efficacy (MSE) scale were designed according to the mathematics curriculum for each year group. These were contextualised questions with mathematics problems drawn from the national textbooks of mathematics and from the ESRC-TLRP project (Williams et al. 2008). Students were asked to rate their confidence in solving each maths problem ranging from 1=Not confident at all to 4=Very confident.

## Results

The reliability of the two subscales of PAR, PAR-SC and PAR-HE was investigated separately using the Rasch model for Rating scales. According to Bond and Fox (2007) Rasch analysis provides indicators of how well each item fits within the underlying construct, in this case perceived parental aspirations. Model fit statistics and item analysis was carried out for each subscale using Winsteps. There were no statistically significant misfitting items in any of the subscales. The Cronbach alpha for the PAR-SC scale was $\alpha$=0.54 and for the PAR-HE scale $\alpha$=0.58.

The two subscales were subsequently merged into one scale measuring perceived parental educational aspirations (PAR). The new PAR scale's validity was also investigated using the Rasch model. Table 1 provides information on the INFIT MSNQ and OUTFIT MNSQ which are expressions of the fit of the item to the model. Infit MSNQ values that range from 0.7 to 1.3 are generally deemed to be acceptable infit statistics. As with the previous scales, none of the fit values posed a serious threat to construct validity. The Cronbach alpha for the PAR scale was $\alpha$=0.72.

Table 1. PAR scale items fit statistics

ITEM STATISTICS: MISFIT ORDER

| INFIT | | OUTFIT | | | |
|---|---|---|---|---|---|
| MNSQ | ZSTD | MNSQ | ZSTD | ITEM | ITEM description |
| 1.14 | 1.7 | 1.36 | 3.6 | PAR-SC1 | My parents encourage me to do my best at school. |
| 1.16 | 2.3 | 1.23 | 3.2 | PAR-HE6 | My parents allow me to decide on my own what courses to choose at university. |
| 1.09 | 1.3 | 1.2 | 2.9 | PAR-SC6 | My parents allow me to decide on my own what subjects to choose at school. |
| 1.12 | 1.7 | 1.10 | 1.3 | PAR-HE1 | My parents encourage me to study at university. |
| 1.11 | 1.1 | 1.01 | .2 | PAR-HE2 | My parents think that obtaining a degree is important. |
| 1.09 | 1.6 | 1.08 | 1.4 | PAR-HE7 | My parents stress the importance of mathematics more comparing to other courses at university. |
| 1.07 | 1.3 | 1.06 | 1.1 | PAR-SC7 | My parents stress the importance of mathematics more comparing to other subjects. |
| 1.00 | .0 | .94 | -.6 | PAR-SC2 | My parents think that succeeding in school is important. |
| .97 | -.6 | .97 | -.5 | PAR-SC4 | My parents don't pressure me about my school work. |
| .97 | -.6 | .97 | -.5 | PAR-SC5 | My parents think it is more important to be happy than worry about grades. |
| .95 | -.9 | .95 | -1.0 | PAR-HE5 | My parents think it is more important to be happy than worry about studies. |
| .85 | -3.0 | .86 | -2.7 | PAR-HE3 | My parents are demanding to study at university. |
| .86 | -2.8 | .86 | -2.9 | PAR-HE4 | My parents don't pressure me to study at university. |
| .84 | -3.0 | .84 | -3.1 | PAR-SC3 | My parents are demanding about my school work. |

Figure 1 shows the item-person map. Bond and Fox (2007) note that the logit scale is the measurement unit common to both person ability and item difficulty. The Rasch analysis produces a single difficulty estimate for each item ($\delta$) and an ability estimate for each student ($\alpha$). Persons and items are located on the map according to their ability and difficulty estimates respectively. The numbers on the left represent the logit scale on which items and cases are calibrated. The symbol # presents the distributions of the cases (pupils) according to their 'ability' estimate.

Figure 1. Item-person map for the PAR scale

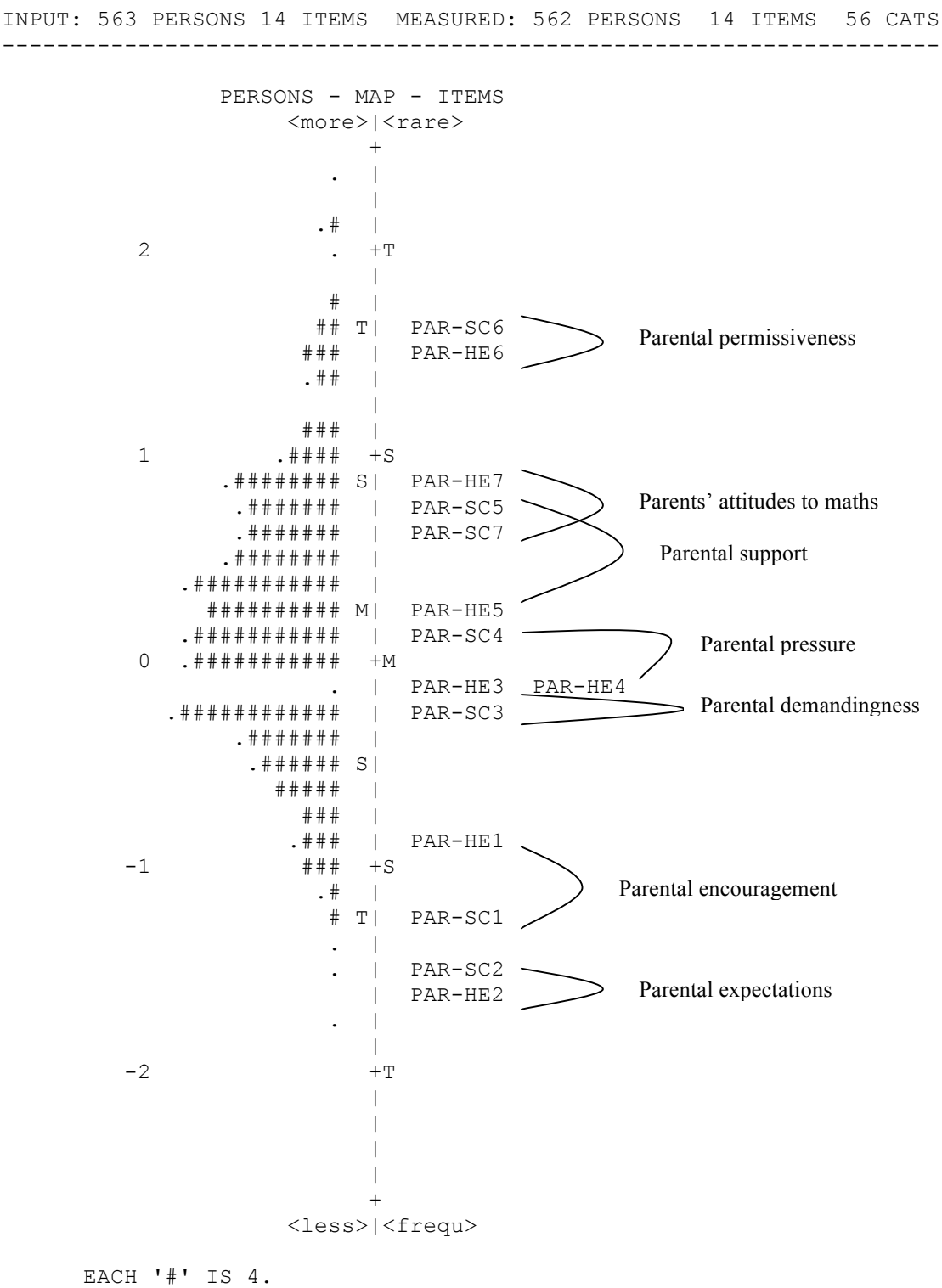


Figure 1 shows good spread of the items and how the items rank in terms of difficulty. Apparently item 6 is the hardest item and item 2 is the easiest item to agree with. A possible explanation why item 6 is the hardest item to agree with, could be students' reluctance to report their parents' influence on their decision making about school subjects and university courses. The items of the two subscales for each category of parental influence behaved similarly, as the grouping of the items indicates.

### *Regression models for MINC, DISP.MATHS and MACH*

Once the Rasch analysis was conducted to check the validity of the new PAR scale, a step-wise model selection procedure was adopted to build generalised linear models (GLM) in the statistical software R. PAR was used as an explanatory variable to model students' inclination to mathematics (MINC), dispositions to study further mathematics (DISP.MATHS), and mathematical achievement (MACH).

Other variables which were used for these models were background variables such as gender, socio-economic status (SES), maths self-efficacy (MSE) and mathematics course (Advanced or Core mathematics). Perceived parental aspirations (PAR) had a statistically significant effect on students' MINC as can been seen in table 2, but it was not statistically significantly related to students' DISP.MATHS and MACH as can be seen in table 3 and 4.

Table 2. The GLM model for students' inclination to mathematics (MINC)

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      MINC ~ MACH + Gender + Maths.course + SES + MSE + PAR
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| | Estimate | Std.Error | t-value | p-value | |
|---|---|---|---|---|---|
| (Intercept) | -3.65224 | 0.47560 | -7.679 | 7.95e-14 | *** |
| MACH | 0.28492 | 0.02318 | 12.294 | < 2e-16 | *** |
| Gender[T.Male] | 0.51347 | 0.14531 | 3.534 | 0.000446 | *** |
| Maths.course[T.Core] | -1.04515 | 0.15312 | -6.826 | 2.44e-11 | *** |
| SES[T.low] | -0.25459 | 0.23453 | -1.086 | 0.278186 | |
| SES[T.medium] | -0.10846 | 0.22084 | -0.491 | 0.623545 | |
| MSE | 0.10594 | 0.05423 | 1.953 | 0.051304 | . |
| PAR | 0.16539 | 0.07881 | 2.099 | 0.036336 | * |

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Multiple R-Squared: 0.3706,   Adjusted R-squared: 0.3621
F-statistic:  43.9 on 7 and 522 DF,  p-value: < 2.2e-16
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Apparently the F-value (F=43.9, p=0.00) shows the model is statistically significant and it can predict 36% of the variance of MINC ($R^2$= 0.36). Students' mathematics achievement (MACH), gender, mathematics course and perceived parental aspirations (PAR) are statistically significant explanatory variables for this model, whereas MSE and SES are not statistically significant.

Table 3. The GLM model for students' dispositions to study further mathematics (DISP.MATHS)

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            DISP.MATHS ~ MACH + PAR + Maths.course + MINC
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Coefficients:
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| | Estimate | Std.Error | t-value | p-value | |
|---|---|---|---|---|---|
| (Intercept) | 0.97657 | 0.34252 | 2.851 | 0.00452 | ** |
| MACH | -0.06132 | 0.02148 | -2.855 | 0.00447 | ** |
| PAR | 0.02024 | 0.08567 | 0.236 | 0.81327 | |
| Maths.course[T.Core] | -1.53449 | 0.13250 | -11.581 | < 2e-16 | *** |
| MINC | 0.50507 | 0.03754 | 13.454 | < 2e-16 | *** |

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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Multiple R-Squared: 0.508,    Adjusted R-squared: 0.5044
F-statistic: 139.2 on 4 and 539 DF,  p-value: < 2.2e-16
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Clearly the F-value (F=139.2, p=0.00) shows the model is statistically significant and it can predict 50% of the variance of DISP.MATHS ($R^2$= 0.50). Students' inclination to mathematics (MINC), Mathematics course and MACH are statistically significant explanatory variables for this model. PAR is not statistically significant for predicting students' dispositions to study further mathematics (DISP.MATHS), but since PAR influences MINC it could be argued that it influences DISP.MATHS indirectly.

Table 4. The GLM model for students' maths achievement (MACH)

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      MACH ~ Maths.course + MINC + MSE + PAR + Gender + SES
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Coefficients:
                     Estimate  Std.Error  t-value   p-value
(Intercept)          16.44156    0.41508   39.610   < 2e-16 ***
Maths.course[T.Core] -0.01069    0.26837   -0.040    0.9682
MINC                  0.78390    0.06435   12.182   < 2e-16 ***
MSE                   0.07055    0.09067    0.778    0.4368
PAR                  -0.14396    0.16549   -0.870    0.3847
Gender[T.Male]       -1.71009    0.23368   -7.318  9.55e-13 ***
SES[T.low]           -0.78448    0.38955   -2.014    0.0445 *
SES[T.medium]        -0.14056    0.36803   -0.382    0.7027
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Multiple R-Squared: 0.325,    Adjusted R-squared: 0.3159
F-statistic:  35.9 on 7 and 522 DF,  p-value: < 2.2e-16
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This model is also statistically significant (F-value=35.9, p=0.00) although it can only predict 32% of the variance of MACH ($R^2$= 0.3159). Students' inclination to mathematics (MINC), gender and SES were statistically significant predictors of MACH in this model. Although perceived parental aspirations (PAR) were not statistically significantly related to students' mathematics achievement (MACH), PAR might influence MACH indirectly through its influence on MINC.

## Discussion

A surprising finding of the present study was that perceived parental aspirations did not have a statistically significant effect on students' achievement in mathematics. This finding contradicts other researchers (Fan and Chen 2001; Aunola et al. 2003) who found that parental aspirations have an impact on students' mathematics achievement. This contradictory result might be due to the fact that in the present study parental aspirations were reported by students. If parents had self-reported their aspirations for their children, parental aspirations could have been proven statistically significant as the literature suggests.

Another plausible explanation why students' perceived parental aspirations were not statistically significant can be attributed to the students' age. Bearing in mind that the sample consisted of adolescent students, it could be argued that parental influence was 'denied' and students reported low parental aspirations which might not represent their parents' actual aspirations. This finding adds additional support to Neuenschwander's et al. (2007) argument that "as students seek more autonomy from their parents in adolescence they begin to reflect upon and to disagree with their parents' attitudes and beliefs. We expect that parents' expectations may lose some of their predictive power across adolescence" (p.601).

Our statistical analysis showed that there are different ways in which students perceive parental influence which is consistent throughout their educational career (school or HE). The items of the two subscales of PAR, which measure the same category of parental influence, such as parental pressure, parental encouragement and parental support, appear to behave similarly (see figure 1). Other researchers have also noted different forms of parental influence such as behavioural control and pressure in contrast to psychological support (Campell and Mandel, 1990). The diverse ways students perceive parental influence might therefore explain why parental aspirations did not have a statistically significant effect on their mathematics achievement, as the statistical analysis showed.

On the other hand however, perceived parental aspirations were statistically significantly related to students' inclination to mathematics. Students who are positively disposed towards mathematics reported higher perceptions of parental aspirations. This finding further supports the notion that parental aspirations have a significant effect on students' attitudes towards mathematics (Ma, 2001). Surprisingly perceived parental aspirations were not statistically significantly related to students' dispositions to study further mathematics in HE. Previous research findings have also noted that students make their choices for future studies autonomously whilst they feel that their parents approve of their choices. Beyers and Goossens (2008) stress that "parents might react positively when the adolescent makes an autonomous choice of his or her study or career, rather than actively encouraging the adolescent to make such a choice" (p.169).

We suggest that the concept of 'symbolic violence' suggested by Bourdieu (1977) can be useful for understanding students' perceptions of parental influence. Bourdieu (1977) argues that symbolic violence is at the heart or every social relationship. He defines symbolic violence as 'the gentle invisible form of violence, which is never recognised as such, and is not so much undergone as chosen' (p.192). We argue that students' perceptions of parental influence might not correspond to their parents' actual aspirations or influence, which remain hidden but are all the more powerful because they are relatively invisible. If so parental influence is subconscious and therefore misrecognised by the students and perhaps even by their parents.

## Conclusion

The present study has developed and validated a scale for measuring perceived parental aspirations (PAR) with the use of the Rasch model. The calibration of the two subscales of PAR indicates that there are different categories of parental influence which are perceived by students in similar ways. Whether students reported perceived parental aspirations for school mathematics or for studying mathematics at university, they perceived different forms of parental influence in the same manner. Thus we argue that parental educational aspirations are the same underlying construct cross educational levels (school or HE). The ways parents communicate their educational aspirations to their children and the influence of parental aspirations on students' dispositions towards mathematics still deserves further investigation.

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