Changes in student perceptions over the first year of high school form the basis of this study. Self- and task-perceptions as well as affect and utility judgements are measured in relation to mathematics, since the transition to high school has been found to impact negatively on students' self-concept in this domain. The impact of level of mathematical performance and gender on the nature of changes in student perceptions are also measured. Student judgements of parent and teacher perceptions are included, to examine whether changes in student perceptions are related to perceived changes in the attitudes of significant others. Participants (N=365) are from three coeducational
Government schools in metropolitan Sydney, matched according to socioeconomic status. Results are discussed within a developmental mismatch framework for contextual school factors and related parent and teacher influences for changes in student perceptions and performance over the course of the first year at high school. Analyses to determine change in perception and performance are ANOVAs with repeated measures, while relatedness of perceptions are established with Pearson correlations. Major implications derived relate to the stability or instability of varying perceptions over time for students of differing competence and genders.

Acknowledgements. Sincere thanks to my PhD main supervisor, Dr Ray Debus from The University of Sydney, for his comments on earlier drafts of the manuscript. Thanks also to my methodological supervisor, Dr Mike Bailey, for his pertinent criticisms of analyses employed.

There is a growing body of research into the effects on students of the transition from primary to secondary school. These studies have addressed a range of student-level variables including self-esteem (eg: Seidman, Allen, Aber, Mitchell, & Feinman, 1994; Simmons, Blyth, Van Cleave, & Bush, 1979), self-concept of ability (eg: Wigfield, Eccles, Maclver, Reuman, & Midgley, 1991), perceptions of competence (eg: Harter, Whitesell, & Kowalski, 1992), liking for school subjects (eg: Wigfield et al., 1991), and school grades (eg: Anderman & Midgley, 1997; Kavrell & Petersen, 1984). The majority of these studies have
found the impact of transition to high school to be negative in nature, leading to decreased self-esteem (Seidman et al., 1994), lower self-concept of ability in specific school subject domains (Wigfield et al., 1991), declines in perceptions of competence (Anderman & Midgley, 1997), decreased liking in specific school subject domains (Wigfield et al., 1991), and lowered school grades (Anderman & Midgley, 1997).

Some theorists have suggested that such negative changes are inevitable due to physiological and psychological pubertal changes occurring at this time (eg: Blyth, Simmons, & Carlton-Ford, 1983; Hill & Lynch, 1983; Rosenberg, 1986; Simmons et al., 1979). This view has been challenged by research showing that declines in students' expectancies and values in mathematics relate to differences in the classroom environment pre- and post-transition (Eccles & Midgley, 1989; 1990). These analyses have been interpreted in the form of a model of person-environment fit (Eccles & Midgley, 1989; 1990), in which it is suggested that lack of fit between the secondary school environment and the needs of young adolescents impacts negatively on student attitudes.

The present study is located within this theoretical perspective and seeks contextual explanations for negative changes in student perceptions where these occur.

Domain Specificity

The importance of assessing transitional impact on separate school subject domains has been recognised since not all domain-related perceptions are affected in the same way (eg: Wigfield et al., 1991),
and domain-specific findings differ from general student perceptions.

For example, Harter (1982) found general perceptions of competence to be stable from grades 3 to 9. Clearly these general measures mask domain-specific changes over this time period.

The present study examines the effects of the first year at high school on students’ perceptions and performance in relation to mathematics, since this is a domain in which transition has been found to impact negatively on students’ self-concept (e.g., Wigfield et al., 1991). It is also a domain which is regarded as being of substantive importance, since students’ mathematics-related attitudes impact strongly on school mathematics course selections (e.g., Eccles & Jacobs, 1986; Watt & Bornholt, 1994) and mathematical career relatedness (Watt, 1995), participation in both of which is considered socially important.

Important Subgroups
It cannot be assumed that all students will be affected similarly by the transition to high school. Gender and ability have been identified at two salient dimensions along which to examine group differences (Anderman & Midgley, 1997). It has been found for instance, that boys on average have more positive attitudes and self-perceptions than girls in mathematics (Eccles, Adler, & Meece, 1984; Marsh, 1989; Wigfield et al., 1991). It has been suggested that such gender differences may be artifactual effects produced by a response bias (Wigfield et al., 1991), wherein boys tend to be more self-congratulatory than girls on self-report measures (Maehr & Nicholls, 1980). An earlier study by the
author (Watt, 1996) suggests this is not the case however, since boys scored higher than girls on both their ipsative judgements of mathematical talent (i.e. relative to each of their other school subjects) and also on traditional rating measures of their talent at mathematics. There is some research to suggest gender intensification occurs (Hill & Lynch, 1983), wherein gender-role activities become more important to young adolescents as they try to conform more to behavioural gender-role stereotypes (Eccles, 1987; Hill & Lynch, 1983). Thus, girls become more negative about male-stereotyped domains, for example mathematics, while boys become more positive. Not all research has found this to be the case (eg: Wigfield et al., 1991). For mathematics, discrepant findings have been explained by suggesting mathematics is no longer perceived as a male domain.

Ability has also been identified as a determinant of attitudinal adjustment to the high-school setting. One study found high-ability students' self-concept to be the most affected by the transition, with lower ability students' self-concept actually increasing post-transition (Wigfield et al., 1991). It is likely that the streaming or ability-grouping that occurs in high-school leads to homogeneous reference comparison groups, such that high-ability students no longer outperform the majority of their classmates, and conversely low-ability students no longer perform relatively poorly. This may result in students' self-perceptions becoming more homogeneous, as high-ability students' perceptions become less positive, and low-ability students' less negative (Wigfield et al.,
1991). The author of the present study, which uses standardised achievement tests as indicators of student mathematical ability, feels that 'ability' is too strong an inference to make from these data. Instead, performance on the tests is interpreted as level of mathematical achievement.

Student Beliefs
Most studies of domain-specific student beliefs have examined perceptions of ability for different activities (eg: Cauce, 1987; Harter, 1982), with one study including subject liking as a value-indicator in addition to perceived ability (Wigfield et al., 1991). The present study examines self-perceptions (perceived talent, expected success and effort exerted), task-perceptions (perceived difficulty and effort required), affect (liking or interest) and utility-value (perceived usefulness) in relation to mathematics, to see whether the first year of high school, gender, level of competence and interactions among these produce differential changes for various student perceptions.

Student Performance
The transition to high-school has been found to result in a decline in school grades. However, this decline has not been accompanied by decreased achievement on standardised achievement tests (Kavrell & Petersen, 1984; Schulenberg, Asp, & Petersen, 1984). Lowered school performance may be gender-related, since one study found a moderate correlation (r=.44) between boys' pre- and post-transition school
mathematics grades, but no significant relation for girls (Anderman & Midgley, 1997). It is noteworthy that the same study found strong correlations for both boys \( (r=.77) \) and girls \( (r=.81) \) on standardised mathematics basic skills tests. It is possible then that changes in school grades may reflect new assessment procedures rather than a real drop in student performance.

Influences of Significant Others

Past studies have found parents to exert strong effects on their child's perceptions (e.g., Eccles, Jacobs, & Harold, 1990; Jacobs & Eccles, 1992). Studies in the area of parental influence have typically focused on the mother. In studies including data concerning both mothers and fathers, there is little indication that children perceive their mothers as more influential than their fathers (Grolnick, Ryan, & Deci, 1991, p. 514). Following recent calls for increased research on fathers' roles in adolescent development (Phares & Compas, 1992), and research suggesting the influence of fathers on motivational development may be complex and merits further study (Grolnick, Ryan, & Deci, 1991, p. 515), this paper explores relations between both student-reported maternal and paternal perceptions and student perceptions.

The majority of studies have obtained parent reports of parent perceptions. It has been suggested, however, that individuals filter their experience through a net of expectations and attributions such that similar phenomena are reported differently by different people.
(Sameroff & Feil, 1985). This seems to imply that a child's understanding of parent perceptions may differ from parent-reported perceptions, and it has indeed been found that especially before adolescence, children tend to project their own perceptions onto their parents (Goodnow, 1988).

The impact of child-reports of parent perceptions on the child's own perceptions has been largely unexplored (Grolnick, Ryan, & Deci, 1991), even though some theorists (e.g. Blyth, 1982; Bronfenbrenner, 1977) have suggested children's phenomenal view of their socialising environment is of considerable importance. Goodnow (1988) goes so far as to say the critical feature may not even be the 'actual' parent variables, but rather the child's interpretation of them. There is a sizeable body of data demonstrating that children's views on several issues are better predicted by their perceptions of parent positions than by the positions parents report for themselves (Goodnow, 1988, p. 311).

Teachers are of course another obvious group to include in a study examining students' high-school mathematics-related perceptions. There have been a large number of studies examining the impact of teacher judgements on student perceptions and behaviour, mostly in the form of self-fulfilling prophecies (e.g. Jussim & Eccles, 1992), establishing that teacher attitudes exert strong influences on students. As for mothers and fathers, student-report data are obtained for teacher perceptions.
The Present Study

The present study examines changes in students' mathematics-related perceptions over the course of the first year at high school. Although this is not strictly a test of the impact of the transition to high school, since students are assessed at the very beginning (i.e. post-transition) and the very end of Year 7, the study does capture changes that occur over this year. There is a major advantage to this design, in that the problem of confounding change in school setting with change in grade level is circumvented (Anderman & Midgley, 1997; Harter, Whitesell, & Kowalski, 1992). Also, since it has been suggested that motivational perceptions may stabilise soon after the beginning of the new school year (Deci, Schwartz, Sheinman, & Ryan, 1981), changes within the first year of high school warrant investigation. The study by Wigfield and colleagues (Wigfield et al., 1991) does this, having two waves of data collection in each of grades 6 and 7, but investigates only perceived competence and liking in relation to mathematics.

Student mathematics-related perceptions on which the impact of time, gender and level of competence are measured include self-perceptions (perceived talent, expected success and effort exerted), task-perceptions (perceived difficulty and effort required), affect (interest) and utility judgements (perceived usefulness). It is expected that changes will overall be negative where they occur, that boys will have more positive perceptions than girls, and that high-achieving students will have more positive perceptions than lower
achieving students. Moreover, it is anticipated that high-achievers will be most negatively affected over the year (as an achievement x time interaction effect would indicate), and that girls may be more negatively affected than boys (as would be indicated by a gender x time interaction effect). Changes in students’ mathematical performance are also of interest, as are relations between changes in student perceptions, and perceived changes in the perceptions of significant others, since strong relations may imply causal change-producing mechanisms.

METHOD

Design

The study aimed to investigate the nature and extent of changes in student self-, task-, affect and utility related perceptions in relation to high school mathematics, as well as mathematical performance over the course of the first year at high school. It was also of interest to measure the nature and extent of changes in student-reported teacher, mother and father perceptions over the same period, and the relation between these and changes in student perceptions. Whether student gender and level of mathematical achievement interacted with time effects or exerted independent effects on student perceptions and performance were also foci of the study.

Participants

Participants were Year 7 students (N=365) from three government coeducational schools in an upper-middle class metropolitan area of
Sydney matched for socioeconomic status (ABS Index for Education and Occupation, 1995). Distribution of students by school and gender is shown in Table 1. None of these schools streamed students at the beginning of the year, although School 3 streamed their Year 7 students halfway through the year (after the mid-year examinations) into each of a top (n=26), middle (n=24) and bottom (n=16) class.

Materials

Questionnaires measured student perceptions in relation to mathematics at high school, and corresponding student-reported teacher, mother and father perceptions. Student perceptions were self-perceptions (perceived talent, expected success, effort exerted), task-perceptions (perceived difficulty, effort required), affect (interest) and utility judgements (perceived usefulness) for both mathematics and English. Student-reported teacher, mother and father perceptions for each of these with the exception of effort exerted and perceived usefulness were also measured. These items were measured on 7-point Likert-type scales anchored at both ends, and formed part of a much larger study investigating a broader range of student perceptions and related influences in relation to both mathematics and English, which are not the focus of the present study. Students also completed standardised mathematics and English tests at both time points, to obtain measures of student performance.

Table 1

Distribution of Students by School and Gender
School 1
School 2
School 3

Boys (n=210)
74
103
33

Girls (n=155)
67
61
27

Totals (N=365)
141
164
60

Student Perceptions. Confirmatory factor analyses using LISREL determined which questionnaire items best defined each of the seven constructs under investigation for mathematics, and eliminated items with high cross-loadings. One-factor congeneric models were then used to determine the relative contributions of items to each construct, and
create composite variables for each. The result is high construct validity for each variable in both administrations (T1 and T2) as shown in Table 2.

Table 2
Construct Validity of Mathematics Variablesa

Perception:

Time:

GFI:

RMSR:

Reliability and Chi-Square fit:

Perceived Talent
T1
T2
1.000
1.000
0.001
0.000
R=.930, c2(3)=.06 p=.997
R=.917, c2(3)=.01 p=1.000
### Expected Success

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>2</td>
<td>0.001</td>
<td>0.001</td>
</tr>
</tbody>
</table>

R = .913, c2(3) = .02 p = 1.000  
R = .921, c2(3) = .06 p = .996

### Perceived Difficulty

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>2</td>
<td>0.000</td>
<td>0.002</td>
</tr>
</tbody>
</table>

R = .958, c2(3) = .02 p = 1.000  
R = .892, c2(3) = .04 p = .998

### Interest

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Student-Reported Teacher, Mother and Father Perceptions. For teachers, mothers and fathers, each perception was measured by a single item. These are shown in Table 3.

Mathematical Performance.

Students' academic performance in mathematics was measured on standardised Progressive Achievement Tests (ACER,
Alternate items were chosen so that each test could be administered along with the questionnaire in a 50 minute lesson. Internal consistency for the February test (PAT 2A) was Cronbach alpha .83, and for the December test (PAT 3B) was .75, indicating that both versions of the mathematics tests were reliable. Test performances were equated via Rasch modelling statistics normed on a representative Australian sample1 (ACER, 1984), enabling comparisons of student performance at the beginning and end of Year 7.

Table 3
Items Measuring Student Perceptions of Significant Others' Views

Perception:

Item:

Scale Anchors:

talent
How talented does your *** think you are at maths?
1 (not at all) - 7 (very talented)

expected success
How well does your *** expect you to do at maths in high school?
1 (not at all well) - 7 (very well)
task difficulty
How difficult does your *** think you find maths?
1 (not at all) - 7 (very difficult)

effort required
How much effort does your *** think you need to put into maths in order
to do well?
1 (none) - 7 (a lot)

interest
How interested does your *** think you are at maths?
1 (not at all) - 7 (very interested)

Procedure
Students completed questionnaires asking about their perceptions in
relation to mathematics at high school, and also completed standardised
mathematics tests. This procedure was carried out at the beginning of
the school year (February 1996) and repeated at the end of the school
year (December 1996). This circumvented the problem identified by
Harter and colleagues of confounding change in school setting with
change in grade level (Harter, Whitesell, & Kowalski, 1992).

The study was conducted with informed student and parent consent, and
the approval of the School Principals and formal University and
Departmental ethical bodies. Administration was in the regular
classroom to maximise ecological validity. The researcher was present at each administration to clarify or answer questions where necessary. Administration at each time point was spread over two days, the first for mathematics tasks and second for English, in order not to overburden respondents.

Analyses
After forming valid and reliable composite variables for each student mathematics-related perception, repeated-measures ANOVAs with time as the within-subject and gender and performance level as between-subjects factors enabled detection of change in student perceptions and performance over time, as well as gender and achievement-level effects and interaction effects of time, gender and level of achievement. Level of achievement was determined according to initial performance on the standardised mathematics test, with the highest-performing third of students forming one group, the middle third forming a second group, and the lowest-performing third forming the last group. Similarly to student-level analyses, repeated-measures ANOVAs tested for time, gender, achievement and interaction effects for the student-reported teacher, mother and father perceptions. Paired t-tests measured differences between student-reported mother and father perceptions at both time points, while Pearson correlations established the strength of relation between student, teacher, mother and father perceptions at both time points. The extent to which changes in student perceptions were related to changes in student-reported teacher and parent perceptions was measured by Pearson correlations of discrepancy scores.
formed by subtracting time 1 from time 2 data.

RESULTS

Results are presented in five main sections. The first describes effects on students' mathematical performance. The second, third and fourth sections respectively report the effects of time, mathematical achievement and gender on student perceptions and student-reported teacher, mother and father perceptions. Finally, differences between student-reported mother and father perceptions are presented, and relations between student perceptions and those of significant others described.

Effects on Student Mathematical Achievement

There was a small but highly significant increase in student mathematical achievement across Year 7 (F(1,310)=38.84 p<.001, T1 mean=54.15 s.d.=5.11, T2 mean=55.20 s.d.=4.19), as determined by Rasch scaled scores for the two standardised achievement tests (ACER, 1984). There was also a main effect of initial mathematical level of achievement (F(2,310)=337.42 p<.001), with initially high, middle and low level achieving students maintaining this rank order at T2 for both girls and boys (Tukey's HSD). There was, however, a highly significant interaction effect of achievement and time, with initially low-achieving students exhibiting the greatest gains in mathematical performance, followed by middle-achieving students, and initially
high-achieving students actually exhibiting a minimal drop (see Figure 1). There was also a significant interaction of achievement and gender (F(2,310)=3.33 p=.037), with high-achieving girls having a slightly greater decrease in performance than their male counterparts (F(1,112)=5.59 p=.02), resulting in more homogeneous levels of T2 performance for girls of varying achievement levels than for boys (see Figure 1).

Figure 1. Changes in mathematical performance for students of varying levels of achievement.

The Effect of Time in Year 7
Student Perceptions. Changes in students' mathematics-related perceptions occurred on expected success (F(1,285)=15.96 p<.001), effort exerted (F(1,296)=54.98 p<.001), perceived difficulty (F(1,293)=25.53 p<.001), interest (F(1,310)=26.08 p<.001) and perceived usefulness (F(1,289)=8.41 p=.004). At the end of Year 7, students expected to do less well in mathematics, exerted less effort, perceived it as more difficult, were less interested, and thought mathematics less useful. However, perception of mathematical talent and effort required remained stable (refer Figures 2 to 4).

Perceived Teacher Attitudes.
Student-reported teacher perceptions changed significantly across Year 7 for perceived talent (F(1,290)=9.00 p=.003), expected success (F(1,290)=9.76 p=.002), perceived difficulty (F(1,297)=18.39 p<.001)
and interest ($F(1,289)=5.38 \ p=.021$). At the end of Year 7, students perceived their teachers as thinking them less talented, expecting them to do less well, finding mathematics more difficult, and being less interested in mathematics (refer Figure 5).

Perceived Parent Attitudes. For both mothers and fathers, student-reported parent attitudes changed significantly across Year 7 for perceived difficulty ($F(1,301)=11.08 \ p=.001$ for mothers, $F(1,289)=5.65 \ p=.018$ for fathers) and interest in mathematics ($F(1,299)=8.43 \ p=.004$ for mothers, $F(1,287)=3.90 \ p=.049$ for fathers). Again the changes were negative, with students perceiving both their mothers and fathers as thinking they found mathematics more difficult, and were less interested in mathematics by the end of Year 7. For student-reported father data only, there was a significant change in perception of talent ($F(1,288)=6.08 \ p=.014$), with students perceiving their fathers as thinking them less talented by the end of the year (refer Figures 6 and 7, respectively for mothers and fathers).

Effects of Level of Mathematical Achievement on Student Perceptions and Reported Perceptions of Significant Others

Student Perceptions. Students of high, middle and low mathematical achievement differed significantly on their perceptions of mathematical talent ($F(2,286)=32.54 \ p<.001$), expectations for success ($F(2,285)=28.40 \ p<.001$), perceived difficulty of mathematics ($F(2,293)=23.17 \ p<.001$), perceived effort required ($F(2,294)=9.47 \ p<.001$), interest ($F(2,310)=15.49 \ p<.001$), and perceived utility of
mathematics (F(2,289)=4.52 p<.012). The direction of effect was as expected in each case with high-performers scoring highest and low-performers lowest on perception of talent, expected success, effort exerted, interest, and perceived utility of mathematics. Conversely, low-performers scored highest and high-performers lowest on perception of the difficulty of mathematics and effort required for success.

There was an interaction effect of achievement and time on both perception of mathematical talent (F(2,286)=5.58 p=.004) and expected success (F(2,285)=3.97 p=.02). For high-achievers, perception of mathematical talent increased over Year 7, while middle-achievers' talent perceptions decreased slightly, and low-achievers had a greater drop in perceived talent. Expectation of success also changed differentially for the three levels of achievement, with high-achievers exhibiting very minimal gain, middle-achievers showing a slight decrease, and again the low-achievers having the greatest drop in expected mathematical success, even though these low-achievers showed the greatest gains in performance. Student perceptions at both time 1 and time 2 are depicted in Figures 2 to 4, respectively for high achievers, middle achievers and low achievers.

Figure 2. Changes in high-achievers' perceptions across Year 7.

Figure 3. Changes in middle-achievers' perceptions across Year 7.
Figure 4. Changes in low-achievers' perceptions across Year 7.

Perceived Teacher Attitudes. Students with varying levels of achievement in mathematics thought their teachers regarded them differently with respect to perception of talent (F(2,290)=24.67 p<.001), expected mathematical success (F(2,290)=9.78 p<.001), perceived difficulty (F(2,297)=19.69 p<.001), effort required (F(2,293)=4.93 p=.008), and interest in mathematics (F(2,289)=15.24 p<.001). High achievers perceived their teachers as thinking them the most talented, most expecting of success and most interested in mathematics, followed by middle achievers, with low achievers scoring lowest on these three variables. Conversely for perceived difficulty and effort required, low achievers scored highest, followed by middle achievers, with high achievers thinking their teachers perceived them as finding mathematics the least difficult, and needing to exert the least effort. Figure 5 shows mean changes in student-reported teacher perceptions for students of high, middle and low achievement levels.

Figure 5. Changes in student-reported teacher perceptions across Year 7 for students of varying achievement levels.
Perceived Parent Attitudes. Students of varying mathematical achievement perceived their parents’ attitudes differentially for perception of talent (F(2,302)=30.68 p<.001 for mothers, F(2,288)=23.45 p<.001 for fathers), expected success (F(2,299)=10.75 p<.001 for mothers, F(2,288)=6.84 p=.001 for fathers), perceived difficulty (F(2,301)=25.03 p<.001 for mothers, F(2,289)=15.87 p<.001 for fathers), and interest in mathematics (F(2,299)=12.32 p<.001 for mothers, F(2,287)=9.60 p<.001 for fathers). As with teachers, differences were in the expected direction, with high achievers having the most and low achievers the least positive perceptions of their parents’ views. For mothers, there was also a difference for effort required (F(2,299)=3.21 p=.042), with the direction of effect less clear cut. At time 1, high achievers scored lowest and low achievers highest on the scale, indicating as expected that high achievers perceived their mothers as thinking they required least effort in mathematics, and conversely for low achievers. At time 2 however, although the three groups’ performances differed significantly (Tukey's HSD), the scores of middle and low achievers were closer together (T1 means: high=4.95, middle=5.20, low=5.51; T2 means: high=4.95, middle=5.35, low=5.23).

There were interaction effects of achievement and time for student-reported mother and father perceptions of child’s talent (F(2,302)=3.74 p=.025 for mothers, F(2,288)=4.74 p=.009 for fathers), and for father perception of child difficulty experienced (F(2,289)=3.19 p=.042). These are due to the greater homogeneity of
perceptions for students of varying performance levels at T1 than at T2. Figures 6 and 7 show mean changes in student-reported mother and father perceptions for students of high, middle and low achievement.

Figure 6. Changes in student-reported mother perceptions across Year 7 for students of varying achievement levels.

Figure 7. Changes in student-reported father perceptions across Year 7 for students of varying achievement levels.

Gender Effects on Student Perceptions and Reported Perceptions of Significant Others

Student Perceptions. Where gender effects on student perceptions occurred, these favoured boys. There was an effect of gender on students' perceptions of mathematical talent, with boys having consistently higher perceptions of talent than girls ($F(1,286)=6.58 p=.011$, boys' T1 mean=4.75 s.d.=1.23, boys' T2 mean=4.63 s.d.=1.31, girls' T1 mean=4.45 s.d.=1.02, girls' T2 mean=4.43 s.d.=1.19).

There were no interaction effects of time and gender. There were, however, interaction effects of gender and achievement on interest ($F(2,310)=3.77 p=.024$), expected mathematical success ($F(2,285)=3.78 p=.024$), and perceived difficulty of mathematics ($F(2,293)=3.13 p=.045$). Separate repeated measures ANOVAs conducted within each
achievement level, with time as the within-subject and gender as the between-subject factors clarify these interactions. The only gender differences occurred between high-achieving boys and girls, with these boys on average being more interested (F(1,114)=7.88 p=.006) and expecting to be more successful (F(1,106)=10.07 p=.002) in mathematics than their female counterparts. Low-achieving students remained more consistent over time on these variables than other students, with the only significant change occurring on expected success (F(1,77)=14.58 p<.001). Middle-achieving students exhibited change on each of interest (F(1,108)=12.94 p<.001), expectation of success (F(1,102)=5.66 p=.019), and perceived difficulty of mathematics (F(1,102)=10.95 p=.001).

High-achieving students' perceptions changed across the year for both interest (F(1,114)=18.93 p<.001), and perceived difficulty of mathematics (F(1,111)=14.35 p<.001).

To further clarify these interaction effects, separate ANOVAs were conducted for each gender by achievement level, on each of interest, expected success and perceived difficulty at both time points, using Tukey’s HSD post-hoc multiple range test to determine where differences between the three levels of achievement occurred for boys and girls. For interest, there was more differentiation according to achievement level for boys than for girls, with all groups being significantly different for boys at T1, and mid- and low-achieving boys having similar interest at T2. For girls at T1, only the lowest and highest achievers had significantly different levels of interest, and at T2, all girls had similar levels of interest regardless of mathematical
achievement. For expected success, only high- and middle-achieving boys had similar perceptions at T1, with the three groups differing significantly by T2. Girls' expectations of success at T1 differed only for the highest and lowest achievers, and at T2 were similar for mid- and low-achievers. Perceived difficulty of mathematics for boys at T1 differed for each achievement group, with mid- and low-achievers having similar perceptions at T2. For girls at T1, mid- and low-achievers had similar perceptions of the difficulty of mathematics, with only high- and middle-achievers differing significantly by the end of the year. Figures 8 and 9 depict these interaction effects on the three student perceptions where significant interactions of gender and level of achievement occurred.

Perceived Parent Attitudes. Although there were no gender effects on student-perceived teacher attitudes, there was an effect of gender on student-reported parent perception of child's talent for both mothers and fathers (F(1,302)=23.93 p<.001 for mothers, F(2,288)=20.66 p<.001 for fathers). In both cases, boys perceived their parents as thinking them more talented than did girls (T1 boys: mother talent mean=5.46, father talent mean=5.49; T2 boys: mother talent mean=5.30, father talent mean=5.29; T1 girls: mother talent mean=4.91, father talent mean=4.97; T2 girls: mother talent mean=4.81, father talent mean=4.80). For mothers, there was also a gender effect on interest (F(2,299)=5.69 p=.018), with boys perceiving their mothers as thinking them more interested in mathematics (boys' T1 mean=4.71, T2 mean=4.41; girls' T1 mean=4.32, T2 mean=4.05).
The obtained interaction effect of gender and achievement on student-reported father perceptions of child's difficulty experienced (F(2,289)=3.10 p=.046) can be accounted for by the greater homogeneity of girls' as compared with boys' scores. The drop in high achieving boys' reported father perceptions of their difficulty with mathematics is accompanied by an increase in corresponding girls' scores (F(1,112)=4.48 p=.036), as reflected in the performance by time interaction for student-reported father data reported earlier. This contributes to the greater homogeneity of girls' scores on this measure, as shown in Figure 10.

Figure 8. Boys' expected success, perceived difficulty and interest in maths according to level of achievement.

Figure 9. Girls' expected success, perceived difficulty and interest in maths according to level of achievement.

Figure 10. Gender by achievement level interaction for student-reported father difficulty perceptions.

Differences Between Student-Reported Mother and Father Perceptions

Student perceptions of parent attitudes differed for mothers and fathers at both time points for interest in mathematics (t(332)=2.33 p=.02 T1; t(301)=2.88 p=.004 T2), with students perceiving their fathers in both instances as considering them more interested in mathematics (mother T1 mean=4.55 s.d.=1.52; father T1 mean=4.67
Relation Between Student Perceptions and Student-Reported Perceptions of Significant Others

The strength and nature of relationship between student and corresponding student-reported perceptions of significant others was measured for both time points. Correlations were highly significant (p<.001) in each instance, and appear similar for teachers, mothers and fathers. Table 4 shows Pearson correlations between student and student-reported teacher, mother and father perceptions at T1, and Table 5 shows the strength of these relations at T2.

Table 4
Correlations Between Student and Student-Reported Teacher, Mother and Father Perceptions T1
(all correlations significant at p<.001)
talent
r = .52
r = .60
r = .60

expected success
r = .50
r = .60
r = .48

perceived difficulty
effort
r = .55
r = .66
r = .59
r = .55
r = .62
r = .58

interest
r = .60
r = .69
Table 5

Correlations Between Student and Student-Reported Teacher, Mother and Father Perceptions T2

(all correlations significant at p<.001)

student-reported

teacher perceptions

student-reported

mother perceptions

student-reported

father perceptions

perceived

talent

r= .62

r= .65

r= .64

expected

success

r= .57

r= .56
Relation Between Changes in Student Perceptions and Changes in Student-Reported Perceptions of Significant Others

The relationship of change in student and student-reported teacher, mother and father perceptions was established by Pearson correlations of discrepancy scores calculated by subtracting time 1 from time 2.
data. Table 6 shows the strength of relation for amount of change in
student perceptions and amount of change in teacher, mother and father
perceptions, which were significant (p<.01) in each case. Clearly
changes in student talent perceptions are most related to changes in
student-reported father talent judgements (r=.48), similarly for
difficulty (r=.28) and effort required (r=.39). Changes in student
expected success and interest are most closely allied to changing
student-reported mother perceptions, however (r=.39, .41 respectively).

Table 6
Correlations Between Changes in Student and Student-Reported Teacher,
Mother and Father Perceptions (all correlations significant at p<.01)
change in perceived talent
\[ r = 0.36 \]
\[ r = 0.40 \]
\[ r = 0.48 \]

change in expected success
\[ r = 0.31 \]
\[ r = 0.39 \]
\[ r = 0.28 \]

change in perceived difficulty
\[ r = 0.24 \]
\[ r = 0.23 \]
\[ r = 0.28 \]

change in effort needed
\[ r = 0.33 \]
\[ r = 0.36 \]
\[ r = 0.39 \]
interest
\[ r = .36 \]
\[ r = .41 \]
\[ r = .34 \]

DISCUSSION

As hypothesised, changes in student perceptions over the first year of high school were negative where they occurred. Also as hypothesised, boys had more positive mathematics-related perceptions than girls where gender effects were evident, and high-achieving students had overall the most positive perceptions, and low-achieving students the least. There was some support for the prediction that high achievers would experience the most negative changes in perceptions, but only in the case of girls. With regard to changes in mathematical performance, however, the reverse was true. Here, low achieving students demonstrated the greatest gains in achievement, followed by students of middling achievement, with high achievers actually suffering a minimal decline. The gender intensification hypothesis had no support, with no gender by time interactions occurring. An unexpected interaction of gender and achievement was identified, indicating that high-achieving girls' perceptions become more negative than boys' over the year. As anticipated, student perceptions were moderately related to perceived teacher, mother and father attitudes, with the relations being somewhat
stronger at the beginning than at the end of the year.

Student Performance

Student performance as measured by standardised mathematics achievement tests increased slightly from the beginning to the end of Year 7. While this seems a logical result, given that learning should have increased over a year's schooling, it is at odds with research reporting declines in student performance as assessed by school grades post-transition to high school. It is possible that the achievement tests used are dissimilar in content or structure to school assessments, and that school-based measures would have identified a drop in mathematical performance. Other studies have in fact found that decreases in school grades are not reflected in lowered performance on standardised tests (Kavrell & Petersen, 1984; Schulenberg, Asp, & Petersen, 1984). It seems plausible that assessment procedures are sufficiently different in high school from in primary school to produce this discrepancy.

Consistent with the notion of high-achieving students being most negatively affected by the high-school experience, the high achievers suffered a slight decline in mathematical performance, while both middle and low achieving students' performance improved, with the low group showing the greatest improvement. In view of the nature of the Year 7 mathematics curriculum, which is largely consolidation of material learned in primary school, it seems plausible that low-achievers' performance should exhibit the largest gains, as the opportunities to further practise and consolidate their existing
knowledge continue across the year. There was an unexpected interaction
effect of gender and achievement, however, indicating that
high-achieving girls show a slightly stronger decline in performance
than their male counterparts. Despite the use of standardised
achievement tests in this study, as compared with school grade
measures, the finding reported by Anderman and Midgley (1997) wherein
girls' performance was negatively affected across the transition to
high school was identified in the present study for the high-achieving
group.

Student Perceptions
All but two of the measured student perceptions were negatively
affected across Year 7. Students' expectation of success, interest and
perceived usefulness were lower at the end of the year, while their
perceived effort exerted and task difficulty became higher. Clearly,
high school experiences impact negatively upon student perceptions.

As seems obvious, high-achieving students had more positive perceptions
than those with lower achievement levels for perceived talent, expected
success, task difficulty, effort required, interest, and perceived
utility of mathematics. It is possible that these consistent effects of
achievement level on student perceptions are due to the fact that
students in this study (with the exception of School 3 halfway through
the year) were unstreamed throughout Year 7. Thus the homogeneous
reference groups posited to result in similar perceptions regardless of
performance level (Wigfield et al., 1991) are not relevant, such that
differential perceptions according to level of achievement remain. The larger longitudinal study which comprises these data will examine the effects of streaming in Year 8 on student perceptions. The only variable on which there was no effect of level of achievement was effort exerted. It seems that all students, regardless of achievement level, expend a similar amount of effort in mathematics. This may be related to the high-school work ethic, wherein students are repeatedly told to expend maximal effort.

Gender impacted only on perception of talent, with boys rating their mathematical talent consistently more highly than girls. This is consistent with a large number of previous studies into boys’ and girls’ ability perceptions in relation to mathematics. Contrary to expectation, all level by time interactions on student perceptions favoured high-achieving students, occurring for perceived talent and expected success. This finding seems to conflict with changes in mathematics performance favouring low-achievers. For perceived talent, the high-achieving group showed a marked increase in their self-perceptions of talent, while the middle group exhibited a slight decline, and the low group had the greatest drop. For expected success, the high-achievers showed a slight increase in expectation, the middle students a slight decrease, and the lowest group again exhibited the sharpest decline.

There was no evidence of gender intensification, supporting the findings of Wigfield and colleagues (Wigfield et al., 1991). It was not
the case that girls became more negative than boys in their attitudes to mathematics. An unexpected interaction between gender and achievement revealed that high-achieving girls have less positive perceptions than their male counterparts for interest and expected success. It is possible these girls may be more susceptible than other girls to negative effects, since they are high-achievers in what is often stereotyped as a male domain.

Student-Reported Teacher Perceptions

Student-reported teacher perceptions changed negatively across the year for all measured teacher variables excepting effort required to succeed. There was thus a negative change for perceived talent, expected success, perceived difficulty and interest. These changes parallel those in students' own perceptions, except for perceived talent which remained stable for students.

Students with varying levels of mathematical achievement perceived their teachers' attitudes differently for perceived talent, expected success, perceived difficulty, effort required, and interest in mathematics. These parallel students' own perceptions exactly, where high-achieving students had the most, and low-achieving students the least positive perceptions for each of these variables.

Student-Reported Parent Perceptions

For both mothers and fathers, student-reported parent attitudes changed negatively across Year 7 for perceived difficulty and interest. For
fathers there was also a decrease in perception of child's mathematical
talent. There is greater stability for student-reported parent
perceptions than for either student-reported parent perceptions or
students' own perceptions. It is possible that this could be due to
students recognising their role as gatekeepers on information conveyed
to parents about their mathematical progress and attitudes, thereby
being able to control or influence their parents' views to a certain
extent. Of course, school data such as parent-teacher evenings and
bi-yearly school reports independently inform parents of their child's
progress. If students perceive themselves as controlling parent
attitudes, one might expect a strong consistency in parental views,
whereas in fact there was a significant difference in student-reported
mother and father perceptions of students' interest at both time
points, with students considering their fathers to regard them as less
interested in mathematics. It is unclear what the explanation for this
might be. Perhaps students, regarding fathers as more knowledgeable and
experienced with regard to career paths, particularly in the 'hard'
sciences, may discuss value judgements about mathematics more
frequently with them. If parent-data corresponding to the student
variable of utility value had been collected and also resulted in
mother versus father differences, this may have shed more light on the
issue.

Students of varying mathematical achievement regarded both parents as
perceiving them differentially for all measured parent variables
excepting effort required. These differ from student perceptions only
in that students perceived amount of effort required differentially according to achievement level, whereas they concurrently believe their parents hold similar views of how much effort they require in mathematics, regardless of level of mathematical achievement.

Gender effects on student-reported parent perceptions occurred for perceived talent, with boys believing both parents regarded their talent more highly than girls, consistent with the gender difference on students' own perceptions of mathematical talent. For mothers, there was also an effect of gender on interest, with boys perceiving their mothers to regard them as more interested in mathematics. It is possible that the parental difference on interest may be interpreted in light of this finding, such that it is for mothers and girls that scores are low. This may imply that mothers do not believe girls are interested in mathematics, or that girls perceive their mothers as regarding mathematics as being in some way unsuited to girls.

For both maternal and paternal student-reported perceptions of their child's talent, and also for reported father perceptions of child difficulty experienced, there was an interaction effect of achievement and time. This is due to the greater homogeneity of parent perceptions on these variables at the beginning than at the end of Year 7. The perceived talent finding here reflects the same interaction in students' own perceptions. The father difficulty finding is somewhat
more complex, being coupled with a gender by level interaction effect. It seems that fathers of high-achieving boys come to regard mathematics as less difficult for their sons over the course of the year, while fathers of high-achieving girls come to regard mathematics as more difficult for their daughters. At the same time, for girls and boys of middling achievement, there is a marked increase in the extent to which fathers regard mathematics as difficult for their children. There is a slight increase also for fathers of sons with low mathematical achievement, while perception remains similar for fathers of low-achieving girls.

It is possible that students are projecting their own beliefs onto their parents here, but if this were the case, one would expect parent data to reflect student data. The complicated pattern for student-reported paternal perception of child's difficulty in no way fits this pattern, however. Discounting the projection hypothesis implies fathers increasingly regard mathematics as more difficult for their daughters, and also have sharper increases in the extent to which they regard mathematics as difficult for children of middling achievement than for those of low achievement. Perhaps it is due to a recognition in the light of normative assessment procedures and reporting, that these students are not as able as fathers might have hoped, particularly for sons. It is possible that the opposing directions of effect for high-achieving boys and girls may be due to fathers believing girls have trouble with 'real' mathematics, which is what students will increasingly experience at high school.
Relations Between Student Perceptions and Those of Significant Others

Student-reported teacher, mother and father perceptions corresponding to students' own mathematics-related perceptions were measured for perceived talent, expected success, perceived difficulty, effort required and interest. At both time points, there was a highly significant relationship between each student perception and the corresponding student-reported teacher, mother and father perception. At the beginning of the year, reported mother perceptions were most closely allied with students' own perceptions overall, which the common view would seem to predict, but reported father perceptions were equally related for the two variables of perceived talent and interest. Reported teacher perceptions were the least related to student perceptions, except in the case of expected success, on which the relation exceeded that of fathers with students. The teachers were, although the least strongly related to student perceptions, still surprisingly strongly related considering the data were gathered right at the beginning of the school year. Anecdotal data frequently heard during the data collection process for the study help explain this finding, since students in the sample largely regarded their teachers as authorities regarding the students' own progress in mathematics.

At the end of the year, relations overall were less strong. Perhaps this is as students become increasingly independent, and consequently less dependent on the views of others for their own self-perceptions. Alternatively, students may be less likely to project their own beliefs
onto significant others as they mature at puberty (Goodnow, 1988).

Perception of talent was an exception, with relations for reported teacher, mother and father views all stronger than at the beginning of the year. Also, for expected success, although relations with reported mother perceptions had decreased, the relations increased for both teachers and fathers. For all other variables, however, relations were less strong at the end of the year. Reported mother perceptions were no longer those consistently most related to student perceptions. For both perceived talent and difficulty, reported mother and father views were equally related. Also, in the case of expected success, the relations of reported teacher, mother and father views with student perceptions were equivalent. It was only for effort required and interest that it was possible to identify a significant other with views most associated with students', being teachers for effort required and mothers for interest.

The relation between extent of change in student perceptions and reported perceptions of significant others was significant in each case. While it is not sensible to examine these relations for perceptions that remained stable across the year, namely perceived talent for students, effort required for teachers, expected success and effort required for mothers, and effort required and interest for fathers; relationships are interpreted for perceptions on which change did occur. Reported teacher perceptions are thus the only ones relevant to changes in students' expectation of success, with there being a moderate relation in the extent of change for the two groups ($r=.31$).
For perceived difficulty, all the reported teacher, mother and father views changed across the year, with the extent of change being most related to change in student perceptions for fathers \( (r=0.28) \), and similarly for teachers \( (r=0.24) \) and mothers \( (r=0.23) \). For interest, both teachers’ and mothers’ reported attitudes changed across the year, and the relation between amount of change for them and students was stronger for mothers \( (r=0.41 \text{ for mothers, } r=0.36 \text{ for teachers}) \). Hence, although reported teacher perceptions were the least stable across the year, the relation between changes in these and changes in student' own perceptions was relatively weak. The strength of all these correlations was modest, implying other operative factors responsible for changes in student perceptions across Year 7. Contextual school variables are a likely explanation, which the work of Midgley and colleagues using indices of perceived school environment, would seem to support. Other possibilities relate to changing social behaviours and values as students reach adolescence.

Conclusion

The major contribution of this study lies in its examination of the impact of time in Year 7 and student characteristics on a range of mathematics-related perceptions. Previous studies have not addressed the range of variables that this study has, involving self-perceptions, task-perceptions, affect and utility judgements. By including these additional dimensions of students' mathematics-related perceptions, the present study has been able to identify which are negatively affected over the first year of high school and which remain stable. Moreover,
the differential changes in perceptions for students of varying levels of mathematical achievement was able to be identified across this range of perceptions, showing that differential change by no means occurs on the majority of student-related perceptions.

Secondarily, the information gathered on student-related perceptions of significant others enabled identification of whether similar patterns of causation occurred here as for students' own perceptions. Further, causal factors were able to be contrasted for reported teacher, mother and father perceptions, and relations between these and student perceptions established.

Finally, the effects of Year 7 experience are captured through the design. All students are in the same school setting and in the same grade level for the duration of the study. Hence, there is no confounding of changes in grade level with changes experienced through commencing high school. This has been an acknowledged weakness of research into the impact of transition to high school (eg: Anderman & Midgley, 1997; Harter, Whitesell, & Kowalski, 1992). Some studies have circumvented this problem by obtaining beginning and end of year measures in both the final primary and initial high school years (eg: Wigfield et al., 1991), but these typically have addressed a limited number of mathematics-related perceptions.

In summary, the study has identified changes on a range of mathematics-related student perceptions and performance across Year 7,
as well as the effects of gender and level of mathematical achievement on these. The idea of gender intensification (Hill & Lynch, 1983) could be tested across a range of perceptions, but was not supported. The notion of most able students being most negatively affected over time could similarly be tested across these perceptions, but was not generally supported, although it may be true for one gender group only, since high-achieving girls were more affected on some perceptions, as well as mathematical performance, relative to their male counterparts. This may suggest that high-achieving girls are most susceptible to negative effects from early high school experiences.

Helen M. G. Watt
PhD Candidate
School of Educational Psychology, Measurement & Technology
Faculty of Education
The University of Sydney
tel: 02 9351 6390
fax: 02 9351 2606
e-mail: h.watt@edfac.usyd.edu.au
References


Psychology, 81, 417-430.


a Note. These statistics could not be computed for effort exerted and effort required, since one item had to be discarded from the former due
to its large associated error of measurement resulting in a 2-item scale, and the latter consisted of only 2 items to begin with.

1 The Rasch-scaled PATMATHS Scale scores express student attainment on any of the tests in the series on an achievement scale which relates attainment to the difficulties of the items using the same units and the same scale for both measures (ACER, 1984, p. 7).

b Note. *** represents teacher/mother/father, since students were asked the same question in relation to each of these people.