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The Nature and Development of Boys' and Girls' Self-Perceptions and Value Judgements in Maths and English through Grades 7 to 11:

An Application of Latent Growth Modelling

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Abstract

The present study traces boys' and girls' developmental trajectories for key constructs within the Expectancy-Value Theoretical framework in relation to secondary school maths and English, using latent growth modelling. These trajectories are contrasted and explanations for gender and age effects suggested where these occur. Participants span grades 7 to 11 in a longitudinal cohort-sequential design comprising 1323 students in 3 cohorts drawn from three upper-middle class coeducational government secondary schools in metropolitan Sydney. The combined sample provides information on students from grades 7 to 11, with replication of grade effects across cohorts. Growth models were estimated for self-perceptions (perceived talent and success expectancies) and values (interest and utility judgements) in relation to maths and English. Declines were evident for all perceptions, with gender differences in each case excepting maths utility judgements, and English self-perceptions. Results are interpreted in terms of understanding how boys and girls differ and develop with respect to each of these key constructs with respect to operation of sex-typed or gender-differentiated socialisation influences. In addition, the critical intervention points for each attitudinal construct are identified from inspection of when changes occur. The contribution of this study lies first in its empirical clarification of constructs employed, and also in its examination of the development of constructs which have been identified as influential in predicting achievement-related choices and behaviours, and contrasting these developmental trajectories for boys and girls from junior through to senior high. A subsidiary contribution lies in the fact that the study sample comprises Australian students, who have been less prevalent in the expectancy-value literature than students from the United States.

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Theoretical Framework

Expectancy-value theory is one of the major frameworks for achievement motivation, beginning with Atkinson (1957), being further developed by Battle , Crandall and colleagues , and more recently by Feather and Eccles, Wigfield and colleagues ; ; . Broadly, these theorists see success expectancies and value for success as major determinants of motivation to perform achievement tasks. The most recent statement of the expectancy-value model of achievement motivation (Wigfield & Eccles, 2000) was developed as a framework for explaining students' achievement and choice in relation to maths. These researchers proposed that the most proximal influences on achievement and choice of achievement tasks are success expectations and subjective valuation of succeeding on those tasks. These expectancies and values are in turn predicted by other beliefs including ability perceptions and task difficulty, and goals and self-schemata respectively. These are in turn predicted by student interpretations of past performance, as well as perceptions of socialisers' perceptions. More distal influences are past performance, socialisers' perceptions and the broader cultural milieu (see Figure 1).

cultural child's perceptions of child's goals and expectation

milieu socialisers' attitudes general self-schemata, of success

and expectations, S-C ability, perceived

gender roles and task demands

activity stereotypes

socialisers'

beliefs and

behaviours

achievement-

related choices

differential

aptitudes

of child

previous child's interpretation child's affective subjective achievement- of experience: causal memories task value

related attributions, locus of

experiences control

Figure 1. The current form of the Expectancy-Value model. From Wigfield, A. & Eccles, J.S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology, 25*, 68-81.

Focus of the Present Study

To date, most research within the Expectancy-Value framework has focused on two main questions. The first, how do expectancies and values change through childhood and adolescence? Second, how do students' maths related expectancies and values predict future enrolment in high school maths courses? The present study is part of a larger study which addresses both these questions longitudinally. Data utilised for this study focus on the first of these questions within the NSW context, measuring key components of the model, and tracing their development longitudinally through secondary school in relation to maths and English, separately for boys and girls. Modelling the development of key predictors of achievement-related choices is important, in order to understand the nature and development of these attitudes which interventions should target. It is not enough to identify key factors influencing participation. It is important that once identified, the developmental pathways of these factors are understood, so that optimal intervention points may be determined.

Gender Within the Theoretical Framework

This study traces separate developmental trajectories for boys and girls, given that gender differences have been well documented in attitudes related to maths and English, both for differences in mean scores, as well as some suggestion of differential development for each gender group. In relation to mean differences in attitudinal constructs, it has been found that boys on average have more positive attitudes and self-perceptions than girls in relation to maths, while conversely girls have more positive English-related perceptions than boys (e.g., Eccles, Adler, & Meece, 1984; Marsh, 1989; Wigfield *et al.*, 1991). It has been suggested that such gender differences may be produced by a response bias (Wigfield *et al.*, 1991), wherein boys tend to be more self-congratulatory than girls on self-report measures of self-esteem (Maehr & Nicholls, 1980; Bornholt, Goodnow, & Cooney, 1994), rather than to genuine differences in perceptions. An earlier study by the author (Watt, 1996) suggests this may not be the case in maths 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 maths. Also, this notion is inconsistent with girls rating their English talent higher than boys (e.g. Wigfield *et al.*, 1991).

With respect to evidence for gender differentiated developmental trajectories, there is some research to suggest gender intensification occurs with age (Hill & Lynch, 1983), wherein gender-role activities become more important to young adolescents over time as they try to conform more to behavioural gender-role stereotypes (Eccles, 1987; Hill & Lynch, 1983). Thus, girls may become more negative about male-stereotyped domains, for example maths, while boys become more positive; and conversely for female-stereotyped domains such as English. Clearly estimation of separate gendered trajectories are required in order to assess the veracity of this view in relation to maths in the Australian secondary school context.

Definition of Key Predictive Variables within the Expectancy-Value Framework

Research within the Expectancy-Value framework indicates that students' success expectations and competence beliefs strongly predict maths achievement, even after controlling for effects of prior achievement; and that subjective valuation of maths is a strong predictor of maths course enrolment in high school ; ; ; ; . In Australian research examining influences on both senior high maths participation as well as mathematical career plans , it was also found that values strongly predicted career plans. However, after controlling for actual performance, high school maths enrolment was substantially explained by competence beliefs, more narrowly operationalised as perceptions of mathematical talent, as well as affect, but not values. As a result of these findings, it is suggested talent perceptions may also directly influence choices to participate in maths, along with expectancies and values. Wigfield states that "constructs such as *ability* seem to mean different things for children of different ages" , p.74). Consequently, talent, rather than ability perceptions are assessed, due to the acknowledged breadth of the latter term. Theoretical and empirical distinctions between the two constructs are outlined in a later section.

Success expectancies are defined by Eccles and colleagues as beliefs about how well one will perform on an impending task. Within the Expectancy-Value model of Eccles and colleagues, expectancy beliefs refer to an individual's expectation that s/he can produce a certain outcome. This relates to Bandura's self-efficacy framework which further distinguishes outcome from efficacy expectations, where the first relate to an individual's expectations that s/he can effect certain behaviours that will produce a certain outcome, and the second to an individual's expectation that s/he can produce the outcome. The model proposed by Eccles and colleagues also differs from that of Bandura in that the former systematically considers the influence of subjective values as well as expectancies, while Bandura focuses on efficacy beliefs, although acknowledging that individuals' subjective task valuation is also likely to affect their task involvement. Researchers working within other theoretical paradigms considering achievement behaviour have also included expectations regarding outcomes as key factors in their models. Expectancies for success are distinguished conceptually from ability beliefs which are defined as perceptions of one's current competence at a given activity. Eccles and colleagues have not, however, been able to distinguish empirically between the two ability and expectancies constructs in factor analytic work (Wigfield & Eccles, 2000).

Values have been specifically defined by Eccles and colleagues as relating to how a task meets individual needs . Four major components of values are proposed, being intrinsic value, utility, attainment value or importance, and cost. Intrinsic value is the enjoyment one gets from carrying out a given task, utility refers to how a task will be useful to an individual in the future, attainment value refers to the importance of doing well on the task, and cost is what the individual has to sacrifice doing to carry out the task, as well as the effort required to complete it. The present study considers the first two of these constructs, being the ones with which most empirical work has been carried out . Interest value is described as similar to the construct of intrinsic motivation as defined by Deci and colleagues ; and by Harter , being concerned with engaging in a task out of interest or enjoyment. Utility value resembles extrinsic motivation , in that it taps more extrinsic reasons for engaging in a task. These constructs have however developed from different intellectual roots, despite having some overlap in operationalisation .

In their 2000 article, Wigfield and Eccles focus on clarifying the primary constructs in their formulation of expectancy-value theory, being expectancy/ability perceptions, task difficulty and task value perceptions (Wigfield & Eccles, 2000). As a result of a combination of exploratory and confirmatory factor analyses they propose three higher order constructs of expectancies/self-concept of ability (where self-concept of ability is operationalised as perceived competence), subjective task value (attainment, interest and utility value) and perceived task difficulty (effort required and task difficulty). The present study addresses components of the first two of these dimensions, being the ones found to have most predictive utility in students' academic choices related to maths.

Modifying the Eccles et al Model: The Perceived Ability/Talent Distinction

Ability perceptions have been considered a key factor within various theoretical models related to achievement (e.g., Covington's self-worth theory , Weiner's attribution theory , Harter's self-concept approach (e.g., , and the self-concept models of Marsh and colleagues (e.g., . The breadth and generality of this term has been acknowledged by researchers such as Wigfield , p.74), who states that "constructs such as *ability* seem to mean different things for children of different ages". This may be due to some students interpreting ability items as aptitude, and others as capability or competence.

Ability perceptions have mostly been operationalised through broad questions asking students to rate their own performance in different areas. For example, Eccles and colleagues use the questions "How good at maths are you?", "If you were to order all the students in your maths class from the worst to the best in maths, where would you put yourself?" and "How have you been doing in maths this year?" to assess maths-related ability beliefs . Certainly the last of these items refers to performance evaluation, and the other items could be similarly construed. Marsh has operationalised perceived competence, through questions such as "Have you always done well in math?", "Do you get good marks in math?" and "Do you often need help in math?". It is likely that students' responses to such questions depend partly on evaluations of their performance and partly on evaluations of their aptitude.

The present study acknowledges the problems with *ability* as it has been operationalised and recognises the need to use terms which are interpreted consistently across students. Following Bornholt and colleagues, the term *talent* was adopted. These researchers state *natural talent* is a concept that best represents the notion of ability distinct from performance , basing this on early discussion about the distinction between aptitude and achievement . Ability perceptions operationalised as competence beliefs are clearly a different construct from talent perceptions, as the former refer to demonstrated ability, based on task performance, rather than aptitude. A student may well feel s/he performs successfully on a certain task, yet still not feel s/he has an aptitude for it. Bornholt's operationalisation of the natural talent construct was via a single item ("Do you consider yourself to be naturally talented at math?"), precluding the assessment of any measure of reliability. It was also not possible to assess construct validity via demonstration of empirical distinction between use of the current performance and talent terms. To date then, use of the talent terminology has been based largely upon speculation, without formal empirical investigation of whether (a) the construct differs from the perceived ability construct as operationalised in the literature (competence beliefs) or (b) construct items yield reliable and valid scores.

For the present study, the talent concept was expanded through consideration of the bases for students' talent perceptions. These bases were conceptualised as being *comparative* and *domain-specific*. That is, based on frames of reference related to other people (e.g., other students in the grade, class and friends), as well as different tasks within the domain (e.g., statistics, measurement and number, geometry, problem solving for maths). A pool of items was developed for each of these bases, the former based on salient social reference groups for school students (3 items in final analysis), and the second based on knowledge domains in the NSW Departmental Syllabi for maths and English (4 items each in final analysis). It was anticipated these two talent constructs would be empirically distinct yet fairly closely related, although it was certainly considered possible that these may contribute to a higher order general perceived talent factor. In order to investigate whether use of the talent term was distinct from ability perceptions as operationalised in the literature, Marsh's 5 items assessing perceived competence were included at the first administration, to permit empirical investigation of the distinction of these terms.

METHOD

Design

The present study traces boys' and girls' developmental trajectories for key constructs in the Expectancy-Value theoretical framework in relation to secondary school maths and English (grades 7-11), and suggests explanations for gender and age effects where these occur.

Participants

Participants span grades 7 to 11 in a longitudinal cohort-sequential design comprising 1323 students in 3 cohorts. Table 1 depicts the sample size for each cohort, the grade of participants at each year of data collection and the gender composition for each cohort. The combined sample provides information on students from grades 7 to 11, with replication of grade effects across cohorts. Participants were drawn from three upper-middle class coeducational secondary schools in northern metropolitan Sydney, matched for socioeconomic status according to the Index of Education and Occupation, based on 1991 census data .

Table 1

Cohort Sample Size, Grade and Gender Composition

	1995 grade	1996 grade	1997 grade	1998 grade	% girls
Cohort 1 (n=428)	7 (Dec)	8 (June)	9 (Feb)	10 (Feb)	44.9
Cohort 2 (n=436)	N/A	7 (Feb,Dec)	8 (June)	9 (Feb)	43.6
Cohort 3 (n=459)	N/A	9 (Feb)	10 (Feb)	11 (Feb)	42.9

Materials

Attitude Measures. Questionnaires assessed students' values (interest and utility judgements), as well as success expectations, and comparative and domain-specific talent in relation to maths and English. Items for values (interest and utility) and expectancies (expected success) were based on those used by Eccles and colleagues. For the present study, end-points for the 7-point scales were similarly and firmly anchored for all items in the present study from 1 (not at all) to 7 (extremely), while they differed across items in the original Eccles measures. In addition perceptions of talent were measured, rather than perceptions of ability operationalised as competence.

Table 2 shows all items for each of the attitudinal constructs, while Table 3 reports Cronbach alpha measures of internal consistency for each of the 3 cohorts at each administration point. Estimates are consistent over time, having good reliability, ranging from .72 to .94.

Table 2

Item Descriptions for Math-Related Attitudes

Student perception	Item	Stem	Anchors
Talent: comparative	61	Compared with other students in your class, how talented do you consider yourself to be at maths/English?	1(not at all) – 7(very talented)
	62	Compared with other students in your Year at school, how talenteddo you consider yourself to be at maths/English?	1(not at all) – 7(very talented)
	63	Compared with your friends, how talented do you consider yourself to be at maths/English?	1(not at all) – 7(very talented)
Talent: domain-specific	79	How talented do you think you are at problem solving/ creative writing in maths/English?	1(not at all) – 7(very talented)
	80	How talented do you think you are at geometry/ poetry in maths/English?	1(not at all) – 7(very talented)
	81	How talented do you think you are at measurement & number/ comprehension in maths/English?	1(not at all) – 7(very talented)
	82	How talented do you think you are at statistics/ essays on novels in maths/English?	1(not at all) – 7(very talented)
Success expectations	49	How well do you expect to do in your next maths/English test?	1(not at all) – 7(very well)
	51	How well do you expect to do in school maths/English tasks this term?	1(not at all) – 7(very well)

	52	How well do you think you will do in your school maths/English exam this year?	1(not at all) – 7(very well)
Interest	44	How much do you like maths/English, compared with your other subjects at school?	1(much less) – 7(much more)
	45	How interesting do you find maths/English?	1(not at all) – 7(very interesting)
	46	How enjoyable do you find maths/English, compared with your other school subjects?	1(not at all) – 7(very enjoyable)
Utility	73	How useful do you believe maths/English is?	1(not at all) – 7(very useful)
	74	How useful do you think maths/English is in the everyday world?	1(not at all) – 7(very useful)
	75	How useful do you think maths/English skills are in the workplace?	1(not at all) – 7(very useful)

Table 3

Scale Reliabilities at each Time Point for each Cohort

Student perception	alpha Cohort 1 maths T1 / T2 / T3 / T4 Eng T1 / T2 / T3 / T4	alpha Cohort 2 maths T1 / T2 / T3 / T4 Eng T1 / T2 / T3 / T4	alpha Cohort 3 maths T1 / T2 / T3 Eng T1 / T2 / T3
Talent: comparative	.88 / .77 / .74 / .72 .90 / .86 / .84 / .77	.91 / .88 / .76 / .77 .88 / .89 / .82 / .82	.75 / .74 / .72 .76 / .80 / .80

Talent: domain-specific	.88 / .87 / .84 / .85 .85 / .79 / .79 / .80	.87 / .86 / .82 / .85 .81 / .79 / .81 / .81	.85 / .78 / .82 .76 / .77 / .76
Success	--- / .93 / .93 / .89 --- / .88 / .86 / .84	.90 / .90 / .90 / .90 .85 / .88 / .91 / .88	.90 / .90 / .89 .88 / .89 / .92
Interest	.93 / .92 / .93 / .91 .93 / .93 / .89 / .90	.94 / .94 / .92 / .91 .93 / .92 / .92 / .91	.94 / .94 / .94 .93 / .93 / .93
Utility	.91 / .90 / .92 / .92 .89 / .89 / .92 / .92	.88 / .88 / .91 / .90 .82 / .91 / .92 / .91	.89 / .89 / .90 .90 / .90 / .93

--- indicates these data are not available at this time point

Confirmatory factor analyses were used to establish the construct validity of the latent constructs (including additional measures of task difficulty, effort required, effort exerted and status in relation to maths, which were part of the broader study), separately for each administration for each cohort. Table 4 shows the fit statistics (RMSEA, GFI, AGFI, NFI, NNFI, c^2(df)) for each analysis. Model fits are adequate for each analysis, providing evidence of construct validity for measures.

Table 4

Construct Validity for Attitudinal Variables [a]

	Occasion	RMSEA maths/Eng	GFI maths/Eng	AGFI maths/Eng	NFI maths/Eng	NNFI maths/Eng	Chi-sq[b] maths/Eng	df maths/Eng
Cohort 1	7b / 95 8 / 96 9 / 97 10 / 98	.058/.044 .060/.056 .059/.047 .056/.050	.90/.92 .89/.90 .89/.91 .90/.91	.86/.89 .85/.86 .85/.88 .86/.87	.93/.93 .91/.92 .91/.92 .91/.91	.95/.96 .93/.94 .94/.95 .94/.94	374.90/279.98 544.51/503.23 525.82/414.21 501.41/449.47	180/180 238/238 238/238 238/238

Cohort 2	7a / 96 7b / 96 8 / 97 9 / 98	.055/.040 .051/.043 .052/.052 .055/.053	.89/.91 .90/.91 .90/.90 .90/.90	.85/.88 .86/.87 .87/.86 .86/.86	.92/.92 .92/.92 .92/.92 .92/.92	.95/.96 .95/.96 .95/.95 .95/.95	454.46/345.15 432.57/365.72 453.30/436.60 486.52/466.88	238/238 238/238 238/238 238/238
Cohort 3	9 / 96 10 / 97 11 / 98	.046/.037 .048/.053 .057/.047	.92/.93 .91/.90 .90/.91	.89/.90 .88/.87 .86/.88	.93/.94 .92/.92 .91/.93	.96/.97 .95/.94 .94/.96	422.39/358.85 433.54/475.98 505.56/420.00	238/238 238/238 238/238

Note 1. Cohort 1 occasion 1 (7b95) omits success expectations construct

Note 2. RMSEA=root mean squared error of approximation, GFI=goodness-of-fit index,

AGFI=adjusted goodness-of-fit index, NFI=normed fit index, NNFI=nonnormed fit index

Note 3. Occasion references both the grade level of students and year of administration. Grade levels are: 7a (start of grade 7), 7b (end of grade 7), 8, 9, 10 and 11. Years span 1995 through to 1998.

The Talent Perceptions – Ability Beliefs Operationalisation Distinction. Exploratory factor analysis of first occasion talent and ability (competence) maths and English data revealed the existence of the three hypothesised underlying latent factors for maths (maximum likelihood extraction, oblimin rotation with Kaiser normalisation, eigenvalues=7.18, 0.94, 0.72 converged in 19 iterations), explaining a total 73.62% of the variance (59.81% factor 1, 7.81% factor 2, 6.01 factor 3). The first factor consisted of Marsh's 5 competence perceptions, the second the comparative talent perceptions and the third the domain-specific talent perceptions. As anticipated then, talent judgements for maths formed two empirically distinct yet interrelated constructs, being domain-specific and comparative talent perceptions. Also as expected, both these talent constructs were empirically distinct from competence perceptions. Table 5 shows the pattern matrix with factor loadings for the three-factor solution. Correlations were fairly high among the three constructs, with strongest relations between competence and each of comparative talent perceptions (.78) and domain-specific talent perceptions (.77), while the correlation between the two talent factors was slightly lower (.68). (Note that comparative talent item 62 did not load strongly on any factor, and only slightly more strongly on the comparative talent factor than the other factors. It is expected this may be due to students in grade 7 not having much knowledge of students in their grade outside their classes, with the Year group comparison hence being a less salient one than classmates and friends).

For English, unlike mathematics, domain-specific and comparative talent perceptions were empirically indistinguishable using exploratory factor analysis (refer Table 6). Plausible explanations for this lack of distinction in English versus mathematics relate to different assessment feedback in the two domains. In NSW secondary schools mathematics assessment is normative, with feedback consisting of a mark and often a rank. English feedback also consists of a mark, but with extensive written feedback and commentary, and almost never a rank. In addition, students are streamed into classes on the basis of demonstrated ability in mathematics, while this is not common in English. This is likely to lead to comparative judgements being a distinct and salient source for students' self-perceptions in mathematics, in addition to their perceptions about how talented they think they are in different aspects of mathematics. In English, comparative information is not made explicit and so is unlikely to separately inform student perceptions.

Ability beliefs operationalised as perceived competence were again distinct from talent perceptions as hypothesised. Exploratory factor analysis of first occasion talent / ability (competence) English data revealed the existence of two underlying latent factors (maximum likelihood extraction, oblimin rotation with Kaiser normalisation, eigenvalues=6.47, 1.03 converged in 6 iterations), explaining a total 68.12% of the variance (58.77% factor 1, 9.35% factor 2). The first factor contained Marsh's 4 English competence perceptions, and the second the comparative and domain-specific talent perceptions combined. The two factors were fairly highly correlated (.77), indicating similarity between the two constructs which are psychometrically distinct.

Consequently, for both mathematics and English, talent perceptions are related yet distinct from ability beliefs operationalised as competence perceptions. On this basis it is concluded that talent perceptions tap the aptitude rather than the demonstrated capability component of ability beliefs as intended.

Table 5

Pattern Matrix for Perceived Maths Talent and Ability (Competence) Items

#	Item stem	Competence perceptions	Comparative talent	Domain-specific talent
35	Have you always done well in math?	**.904**	-.002	-.006
36	Do you have trouble understanding anything with maths in it?	**-.475**	.005	-.005
38	Do you do badly in maths tests?	**-.765**	-.009	-.006
39	Do you get good marks in math?	**.832**	.002	.005
40	Do you often need help in math?	**-.599**	.133	.004
61	Compared with other students in your class, how talented do you consider	-.002	**-.975**	.001

	yourself to be at math?			
62	Compared with other students in your Year at school, how talented do you consider yourself to be at math?	.245	**-.342**	.322
63	Compared with your friends, how talented do you consider yourself to be at math?	.187	**-.523**	.175
79	How talented do you think you are at problem solving in math?	.130	-.147	**.475**
80	How talented do you think you are at geometry in math?	.003	-.001	**.741**
81	How talented do you think you are at measurement & number in math?	-.009	.002	**.983**
82	How talented do you think you are at statistics in math?	.213	-.007	**.645**

Table 6

<u>Pattern Matrix for Perceived English Talent and Ability (Competence) Items</u>

#	Item stem	Competence perceptions	Talent perceptions
36	Do you often have to read things several times before you understand them?	**.566**	.004
38	Do you do badly on tests that need a lot of reading ability?	**.656**	-.001
39	Do you get good marks in English?	**-.589**	.305
40	Are you hopeless in English classes?	**.788**	-.007
61	Compared with other students in your class, how talented do you consider yourself to be at English?	.106	**.948**
62	Compared with other students in your Year at school, how talented do you consider yourself	.001	**.865**

	to be at English?		
63	Compared with your friends, how talented do you consider yourself to be at English?	.004	**.880**
79	How talented do you think you are at *creative writing*in English?	-.191	**.548**
80	How talented do you think you are at *poetry analysis*in English?	-.232	**.468**
81	How talented do you think you are at *comprehensions*in English?	-.306	**.533**
82	How talented do you think you are at *essays on novels* in English?	-.380	**.460**

Invariance of Measurement Properties Across Cohorts and Gender. In order to determine whether measurement properties of constructs were invariant across cohort and gender subgroups (i.e. whether items were functioning in the same way for the different groups), multigroup models were fitted. Here, each item was allowed to load on only one factor, being specified as a perfect predictor of a corresponding latent construct, and correlations among constructs (items) constrained to be invariant, thereby providing a test of the invariance of the covariance matrix among items.

It was possible to test for invariance across cohorts three times. The first compared the covariance matrix at Year 9 for all 3 cohorts. The second compared cohorts 1 and 2 at Year 8, and the third compared cohorts 1 and 3 at grade 10. This process was performed separately for each of maths and English. Model fits in each case were excellent, indicating that relations among items did not vary across cohorts and that the measurement properties of items were structurally invariant across cohorts (see Table 7). Consequently it is valid to interpret item to scale relations similarly across cohorts.

Invariance across gender was established by stacking Year 9 data across cohorts, since it had been established measurement properties were similar across cohorts. In the same way as for the above cohort analysis, every item was specified as a perfect predictor of a latent construct, again resulting in excellent model fit as also shown in Table 7.

Table 7

Multigroup Fit Statistics for Cohort Comparisons of Covariance Matrices

Occasion	Cohort / gender	% Chi-sq contribution maths/Eng	RMSEA maths/Eng	GFI maths/Eng	NFI maths/Eng	NNFI maths/Eng

Year 8	Cohort 1 Cohort 2	46.1 / 43.3 53.9 / 56.7	.041/.036	.94/.94	.96/.96	.96/.97
Year 9	Cohort 1 Cohort 2 Cohort 3	34.4 / 34.5 32.4 / 30.9 33.2 / 34.6	.044/.040	.93/.93	.94/.94	.96/.97
Year 10	Cohort 1 Cohort 3	47.4 / 38.8 52.6 / 61.2	.039/.052	.94/.92	.95/.94	.97/.94
Year 9	boys girls	36.4 / 35.8 63.6 / 64.2	.040/.047	.93/.92	.96/.95	.96/.95

Procedure

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, with the exception of the final wave for each cohort, which was in each school's hall. It was considered that the greater organisational ease of mass administration did not sacrifice data integrity, since participants were by this wave accustomed to the instruments and procedure for the study. The researcher was present at each administration to clarify or answer questions where necessary, with a trained assistant to aid with disseminating and collecting instruments and answering questions.

Analyses

Growth models were estimated for each maths and English self-perception construct (perceived talent , success expectancies) and value judgements (interest and task utility). Hence, eight separate models were estimated, with three cohorts combined in an accelerated longitudinal design. Two level models were fitted in each case, with level 1 referring to the occasion level, and level 2 to the individual student level. Predictors at level 2 included linear slope, quadratic and cubic change, gender, and interactions of gender with linear, quadratic and cubic change. Each model was built initially from a baseline variance components model (fitting a constant only as an explanatory variable, random at both occasion and student levels), which partitions the total variance into two components: between students and between occasions within students. This model is not interesting in itself, but provides a useful baseline with which to compare more elaborate models. Explanatory variables were added to each model one at a time, to evaluate the improvement in model fit from each additional term. Models were estimated using full maximum likelihood, so that model fits could be compared using the likelihood ratio test, based on the fact that each model is nested within its preceding model.

First linear change was added (i.e. grade, using standard linear polynomial contrasts to represent grades 7 at the start of the year, 7 at the end of the year, 8, 9, 10 and 11 respectively). Next quadratic and then cubic change was added (using standard polynomial contrasts). These were entered as both fixed effects, and random effects at the student level, so as not to assume students follow change patterns at exactly the same rate. This was followed by gender (coded 1 for girls and 0 for boys), and the interaction of gender with linear, quadratic and cubic change, testing for improvement to model fit at each step. At any stage where the model fit was not improved at a statistically significant level by the addition of an explanatory variable, this variable was removed, excepting cases where for example, some quadratic but not linear term was significant, in which case the linear term was also retained. For parsimony and interpretability models were estimated omitting school and cohort effects, since initial analyses incorporating these showed overlapping 95% confidence intervals in all but one case (maths utility where there was a cohort difference at grade 8). As grade was centred about the grand mean grade (grade 9), intercept (Cons) parameters refer to estimates at grade 9, linear slope (Grade) refers to rate of change at grade 9, quadratic slope (Grade_q) refers to concavity at grade 9, and cubic slope (Grade_c) refers to cubic growth at grade 9.

RESULTS

Developmental trajectories for maths- and English-related self-perceptions and values were explained by different combinations of variables in each case. These are summarised in Table 8. Maths self-perceptions were both characterised by gender differences favouring boys, although in the case of success expectancies, 95% confidence intervals for gender groups overlapped at the initial and final time points. Talent perceptions exhibited a linear decline through secondary school, with boys maintaining consistently higher perceptions than girls through grades 7 to 11 (see Figure 2). In contrast, expectancies for success remained relatively stable for boys, while girls' expectancies displayed a curvilinear pattern, where their expectancies declined through junior high years, then 'recovered' in senior years, although not quite to the same level as on commencement of junior high (see Figure 3). The overlapping confidence intervals for boys and girls at commencement of junior high and at the final grade 11 administration show estimates for the gender groups do not significantly differ at $p<.05$ at these time points.

Value judgements in the form of interest in maths were also characterised by a consistent gender difference favouring boys. Interest in maths for all students declined through junior high and plateaued out in senior years (see Figure 4). In contrast, boys and girls had similar judgements about the utility of maths, with utility perceptions declining throughout secondary school, and the extent of decline becoming greater over time (see Figure 5).

English talent perceptions appeared to decline for girls and remain relatively stable for boys (see Figure 6), although overlapping 95% confidence intervals indicate boys' and girls' talent perceptions are similar through grades 7 to 11. English success expectancies declined for both boys and girls from the beginning to end of grade 7, remained relatively stable until grade 10, then declined again from grades 10 to 11 (see Figure 7), again with no significant gender differences in estimates.

English values in the form of interest and utility judgements also declines over the first year of junior high, and between grades 10 and 11 (see Figures 8 and 9). Gender differences favouring girls were statistically significant for English value perceptions. In the case of interest, girls suffered a greater decline than boys on commencement of junior high, while boys experienced a greater decline than girls between grades 10 and 11 (see Figure 8). Gender differences for utility perceptions relating to English were not gender differentiated, however (see Figure 9).

Table 8

Fixed and Random Effects for Maths and English Self-Perceptions and Value Judgements through Grades 7 to 11

	maths				**English**			
	Self-perceptions		**Value judgements**		**Self-perceptions**		**Value judgements**	
	Talent b est (se)	Success b est (se)	Interest b est (se)	Utility b est (se)	Talent b est (se)	Success b est (se)	Interest b est (se)	Utility b est (se)
Fixed Effects								
Cons[c]	4.806 (.032)	5.136 (.035)	3.877 (.051)	5.591 (.031)	4.555 (.033)	4.933 (.034)	4.076 (.043)	5.658 (.037)
Grade[b]	-.025 (.005)	-.010 (.008)	-.059 (.008)	-.089 (.007)	-.007 (.007)	-.031 (.008)	.016 (.011)	-.019 (.007)
Grade_q[b]	-	.000 (.006)	.023 (.006)	-.015 (.005)	-	-.015(.006)*	.000 (.008)	.013 (.005)*
Grade_c[b]	-	-	-	-.003 (.003)	-	-.010 (.003)	.017 (.004)	-.009 (.003)
Gender	-.490 (.047)	-.287 (.052)	-.377 (.075)	-	.067 (.049)*	.126 (.050)	.595 (.064)	.341 (.054)
GenderXgrade	-	-.015(.01	-	-	-.024 (.011	.000 (.012)*	-.022(.01	-

		3)*			)		5)*	
GenderXgrade_q	-	.021 (.009)	-	-	-	.019 (.008)	.032 (.012)	-
GenderXgrade_c	-	-	-	-	-	-	-	-
Random Effects								
Between-student variance								
Cons/Cons	.631 (.032)	.564 (.043)	1.450 (.084)	.900 (.086)	.676 (.034)	.531 (.031)	.941 (.056)	.638 (.079)
Cons/Grade	-.016 (.004)	-.015 (.005)	-.020 (.010)	.044 (.008)	-.009 (.005)	.005 (.005)	.000 (.000)	.027 (.007)
Cons/Grade_q	-	-.026 (.006)	-.027 (.010)	.004 (.019)	-	.000 (.000)	-.014 (.007)	-.021 (.017)
Cons/Grade_c	-	-	-	.005 (.004)	-	.000 (.000)	.013 (.004)	.007 (.004)
Grade/Grade	.008 (.002)	.009 (.004)	.014 (.005)	.003 (.010)	.007 (.002)	.002 (.002)	.000 (.000)	.012 (.010)
Grade/Grade_q	-	.005 (.001)	-.001 (.001)	.002 (.001)	-	.000 (.000)	.000 (.000)	.004 (.001)
Grade/Grade_c	-	-	-	-.005 (.002)	-	.000 (.000)	.000 (.000)	-.003 (.002)
Grade_q/Grade_q	-	.004 (.001)	.002 (.002)	.009 (.005)	-	.000 (.000)	.005 (.002)	.005 (.004)
Grade_q/Gra	-	-		-	-	.000	.000	.000

de_c				.001 (.001)		(.000)	(.001)	(.000)
Grade_c/Grade_c	-	-		.001 (.001)	-	.000 (.000)	.002 (.001)	.000 (.001)
Within-student variance								
Cons/Cons	.395 (.013)	.572 (.022)	1.067 (.038)	.738 (.033)	.408 (.014)	.558 (.019)	1.016 (.042)	.712 (.032)

Note. [a] Unless otherwise indicated (*) all b coefficients statistically significantly improve the model fit as indicated by the change in deviance test

[b] Random at the individual level. '_q' refers to quadratic and '_c' to cubic terms.

DISCUSSION

The present study has empirically clarified the expectancies/ability and values constructs proposed by Eccles, Wigfield and colleagues within the Australian NSW context in relation to both maths and English. The 'perceived talent' construct utilised instead of the perceived ability operationalised as perceived competence construct was able to be empirically distinguished from the expectancies construct, as theoretically emphasised by Wigfield, Eccles and colleagues (Wigfield & Eccles, 2000). It is likely due to their operationalisation of perceived ability that this distinction has not been able to be drawn in previous work. This study has also theoretically and empirically distinguished the perceived talent and ability constructs, showing them to be distinct.

Following confirmation of constructs employed, the study has traced the development of key constructs within the Expectancy-Value framework in relation to each of maths and English, utilising longitudinal data. Further, the contribution of gender has been established both in terms of difference scores at each grade, as well as developmental trajectories. Gender was found to be relevant for all constructs excepting the utility judgements component of maths values, likely due to the socially emphasised importance of maths for all students in schools; and English self-perceptions, perhaps due to boys' tendency to overrate their capabilities (e.g., . For talent perceptions and interest in maths, boys had consistently higher perceptions than girls, with no evidence of gender intensification. The converse was true for English utility perceptions, with girls consistently rating English as more useful than boys. This may imply the point of divergence for boys' and girls' perceptions may be at an earlier age, and hence intervention would be appropriate prior to grade 7. For maths success expectancies however, girls' perceptions dip through grades 7 to 9, then recover, although not to quite their initial levels, through grades 10 to 11. This suggests that around grades 8 and 9 teachers could fruitfully focus on fostering girls' success expectancies in maths. For English interest, the large drop in girls' ratings over grade 7 should be addressed at this point. In contrast, boys most lose interest in English over the transition to senior high. There was no support for the gender intensification hypothesis.

Implications in terms of gender differences are that the consistent differences favouring boys for maths talent self-perceptions, maths interest and English utility imply similar sex-typed messages are impacting on boys' and girls' perceptions. In contrast, the lack of gender difference for maths utility judgements and English self-perceptions implies there may be no sex-typed messages relevant to these judgements for adolescents. The dissimilar growth trajectories for boys' and girls' maths success expectancies and English interest, however, imply differential socialisation influences may be operating for gender groups resulting in these different developmental trends.

Implications in terms of age are that talent perceptions are age or grade independent through the grades sampled, as indicated by the linear growth trajectories for boys and girls. Success expectancies in maths appear to be unrelated to grade for boys but not for girls, who exhibit a dip in middle high school years. English expectancies are most vulnerable to declines over grade 7 and from grades 10 to 11. Interest in maths declines sharply in junior years but does not 'recover' in senior years, while conversely, maths utility judgements, while declining throughout secondary school, decline most in senior high. Optimal intervention points for value judgements would therefore be junior high for both maths interest and maths utility judgements, since the former begins a sharp decline at this point and the latter, while in decline, could be addressed before its exponential decline through senior years. English values both decline through grade 7 and between grades 10 and 11, following the same pattern as English expectancies, implying transitions to junior and senior high are points at which their interest and utility perceptions related to English are most vulnerable.

The contribution of this study lies in its examination of the development of constructs which have been identified as influential in predicting achievement-related choices and behaviours particularly in maths, from junior through to senior high. A secondary contribution lies in the fact that the study sample comprises Australian students, who have been less prevalent in the Expectancy-Value literature than students from the United States. Finally, empirical clarification particularly of expectancies from talent perceptions, and of talent from ability (competence) perceptions have been made.

Contributions to understanding how boys and girls differ and develop with respect to each of these key constructs are in terms of identifying which growth trajectories imply the operation of sex-typed or gender-differentiated socialisation influences, such that these can be further explored. In addition, the critical intervention points for each attitudinal construct can be identified through inspection of when changes occur. For example, talent perceptions for all students and maths success expectancies for boys appear to be unrelated to age, and consequently do not suggest specific points at which intervention may be most fruitful, although change points may occur at some earlier point than measured in the present study. In contrast, interest in maths declines sharply in junior high, maths success expectancies for girls dip in middle high, and maths utility judgements decline most sharply in senior high. English expectancies, interest and utility perceptions all decline most in junior high, and over the transition to senior high. In developing explanations for identified gender and age patterns, changes in the school environment as well as wider socialising influences should be considered.

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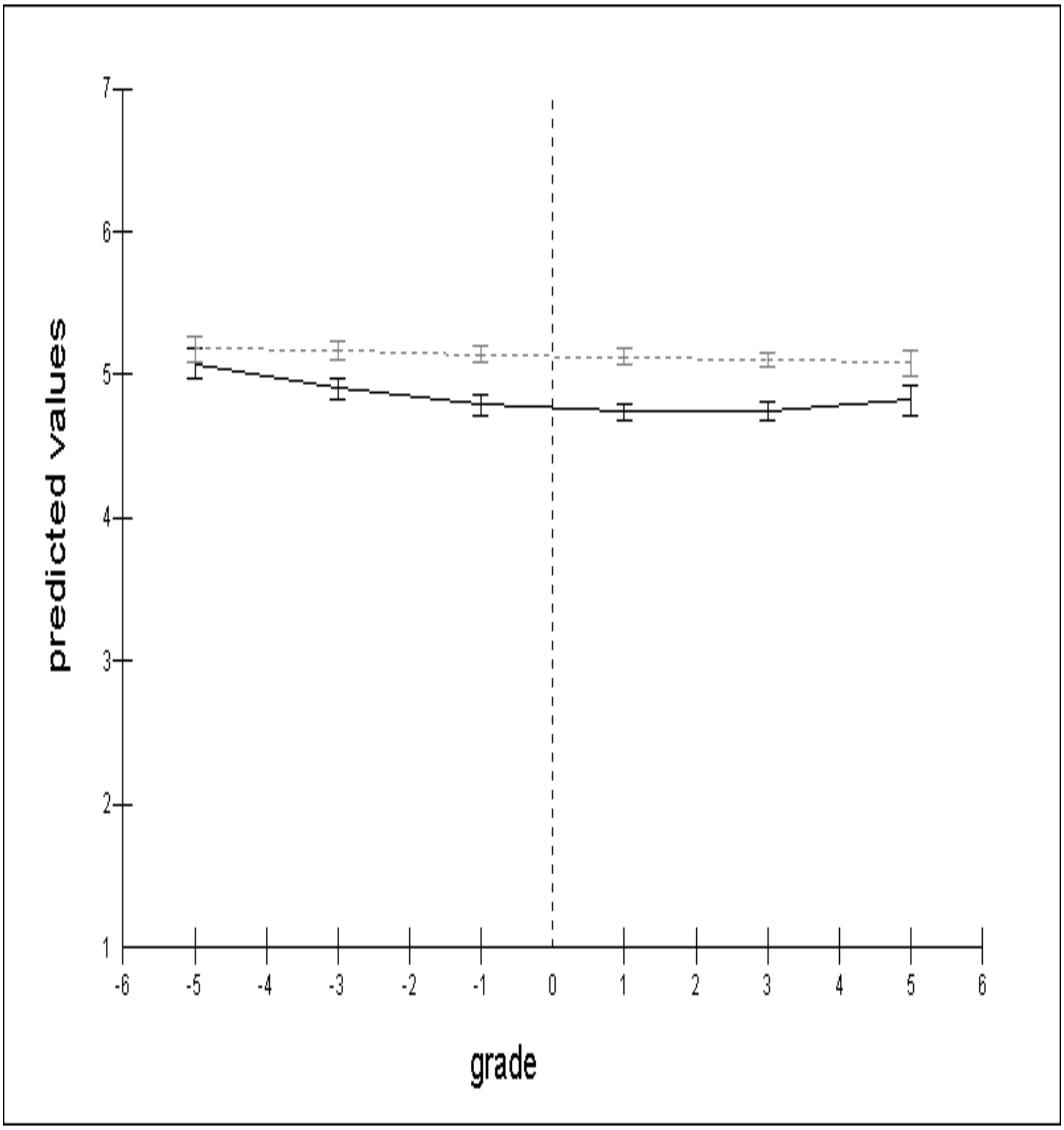
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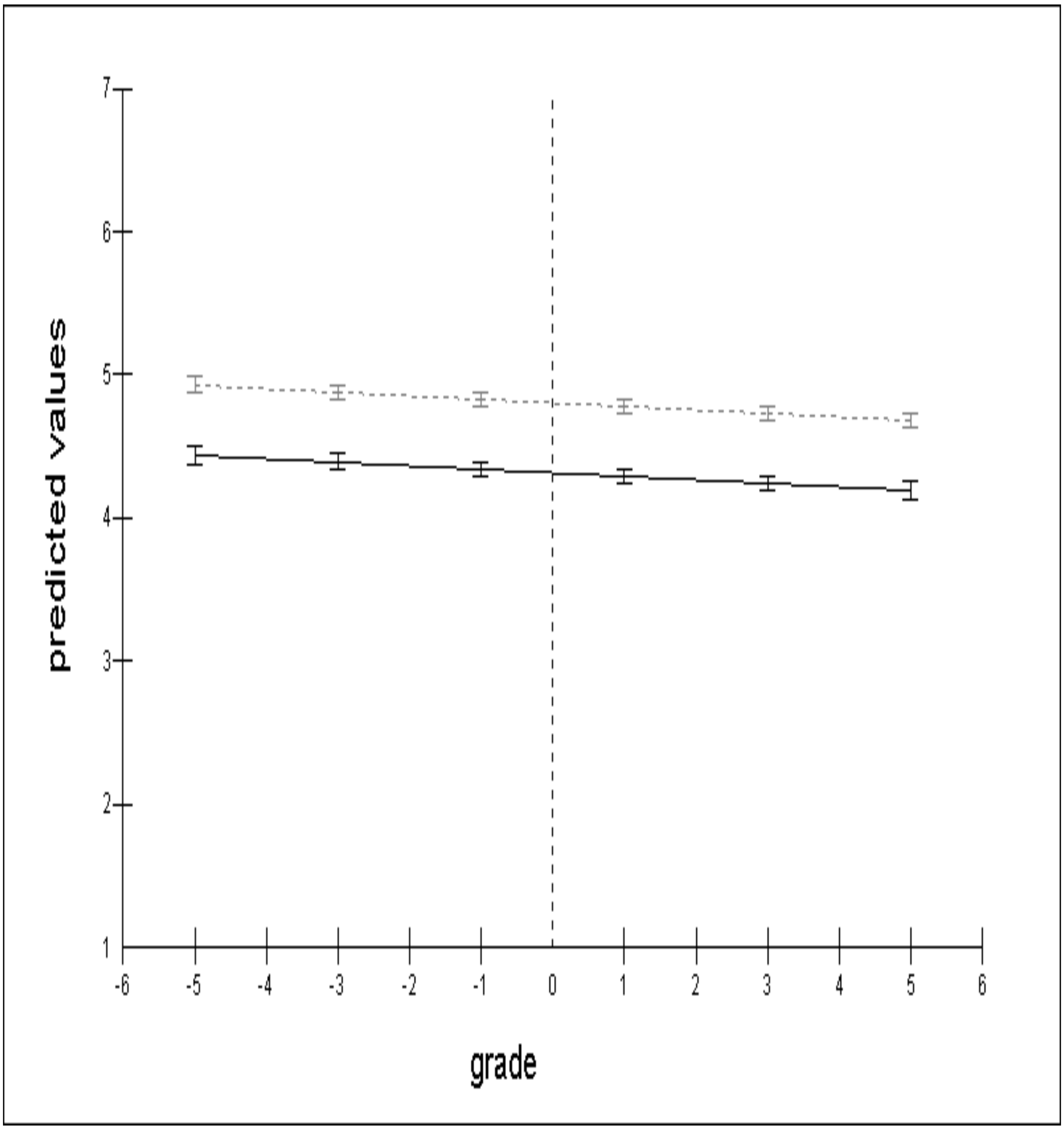
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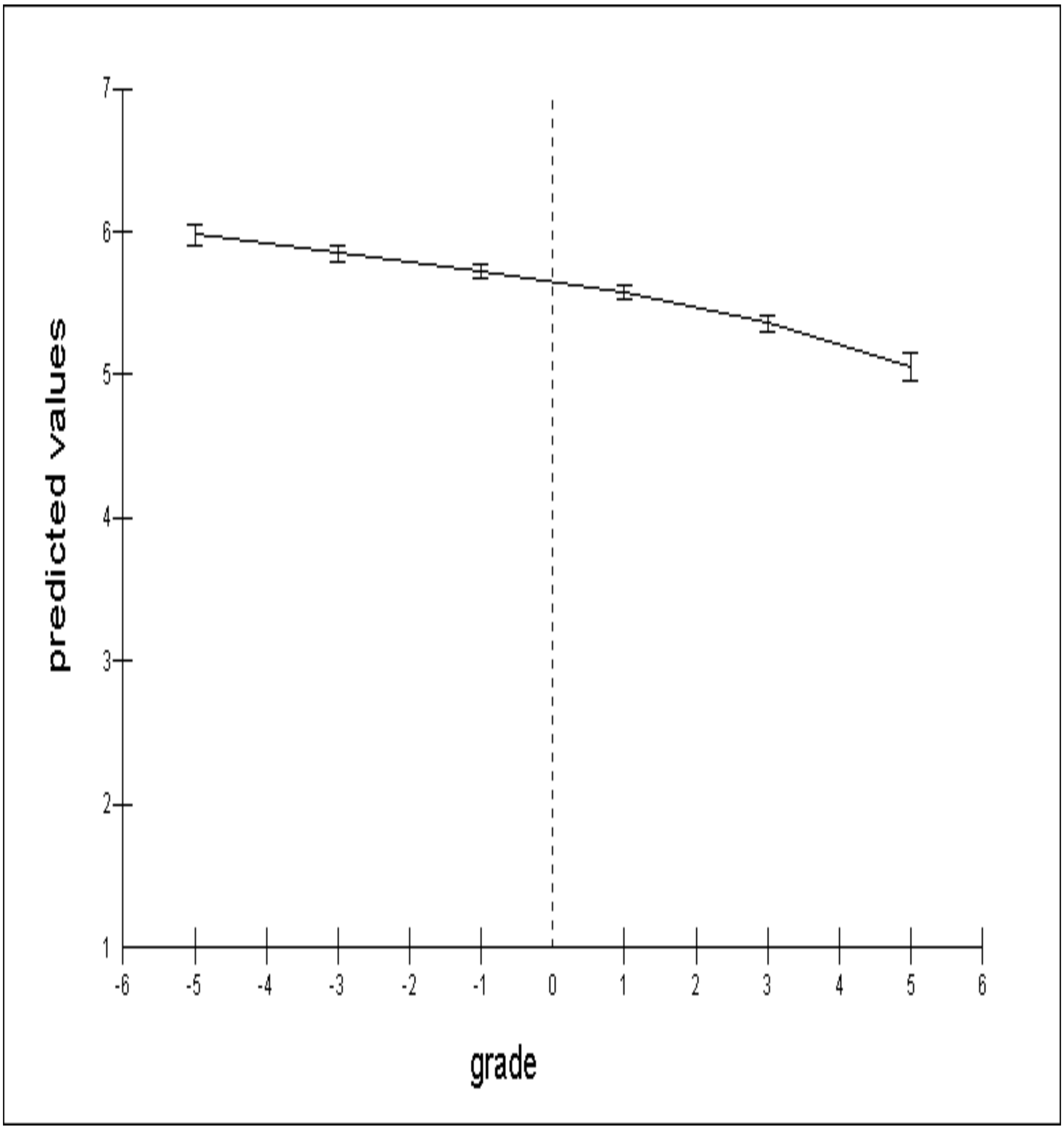
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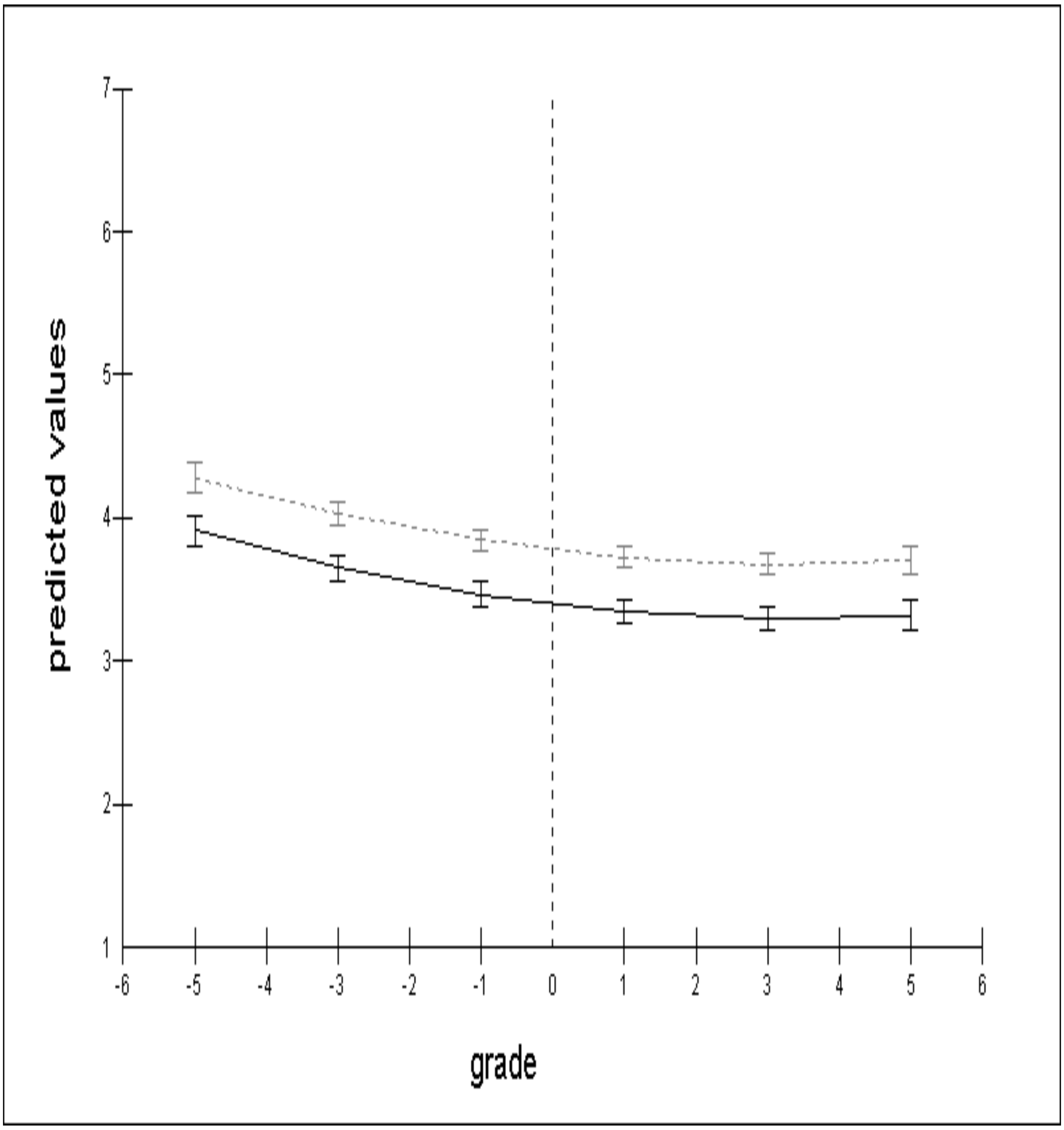
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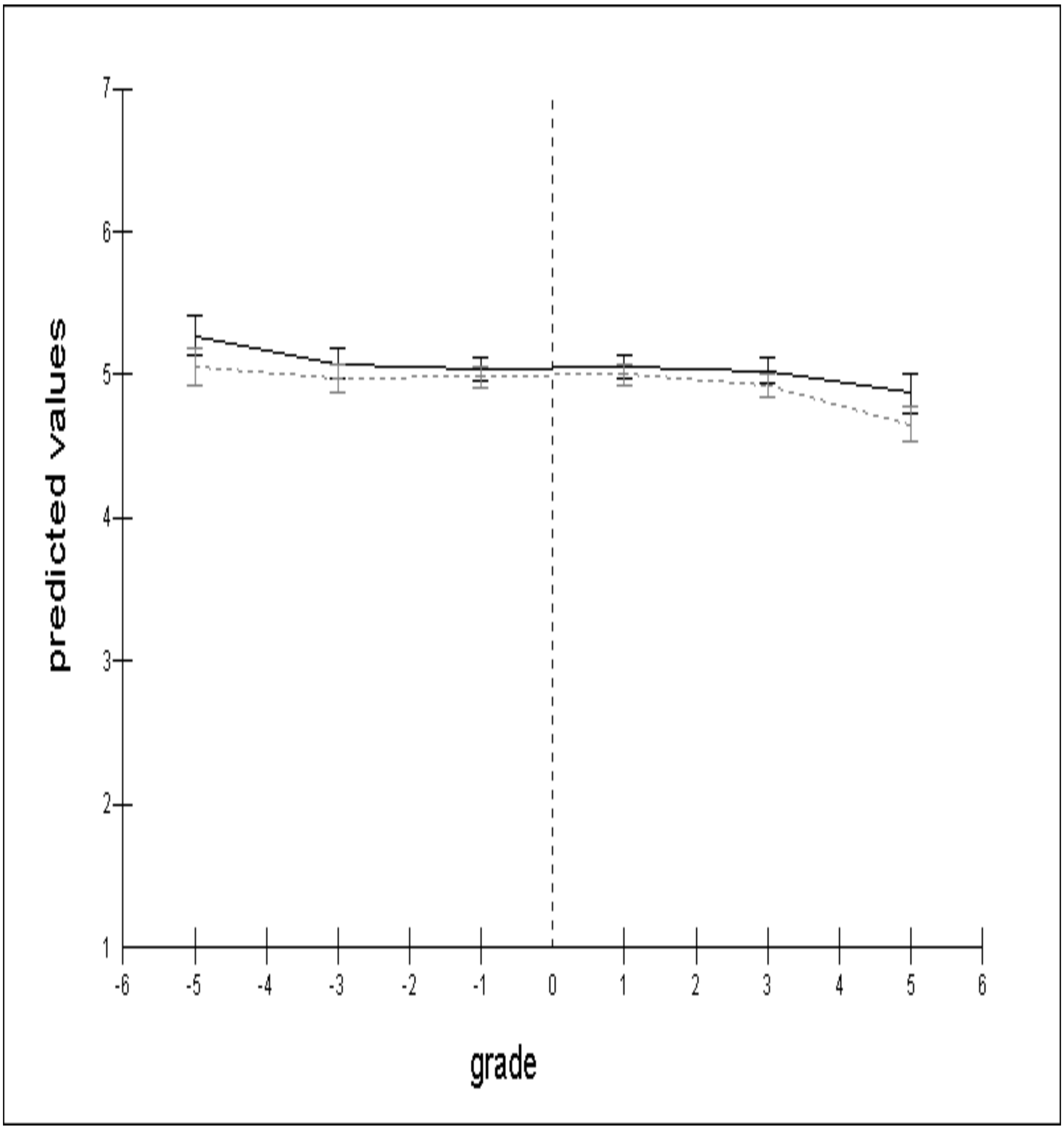
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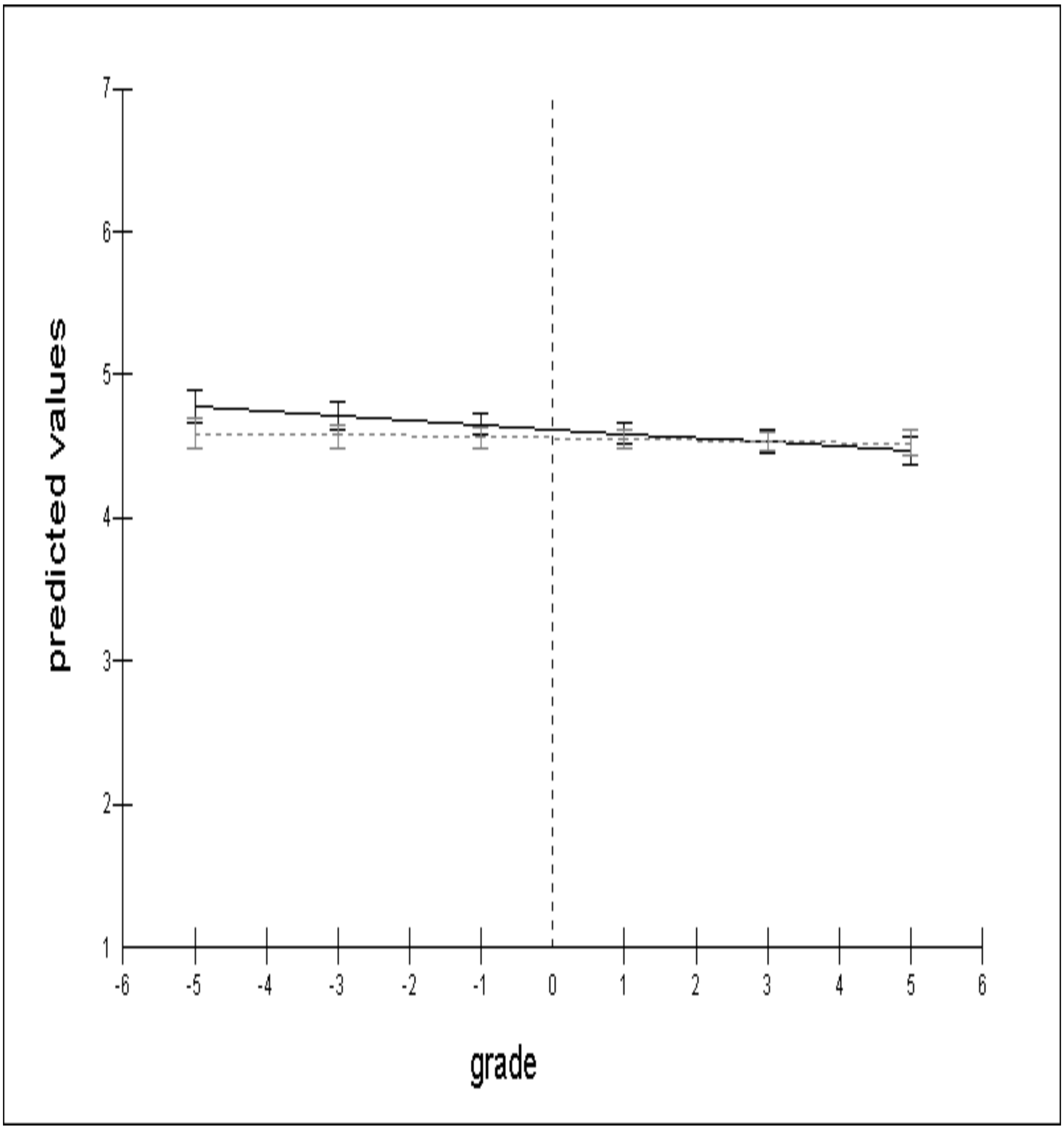
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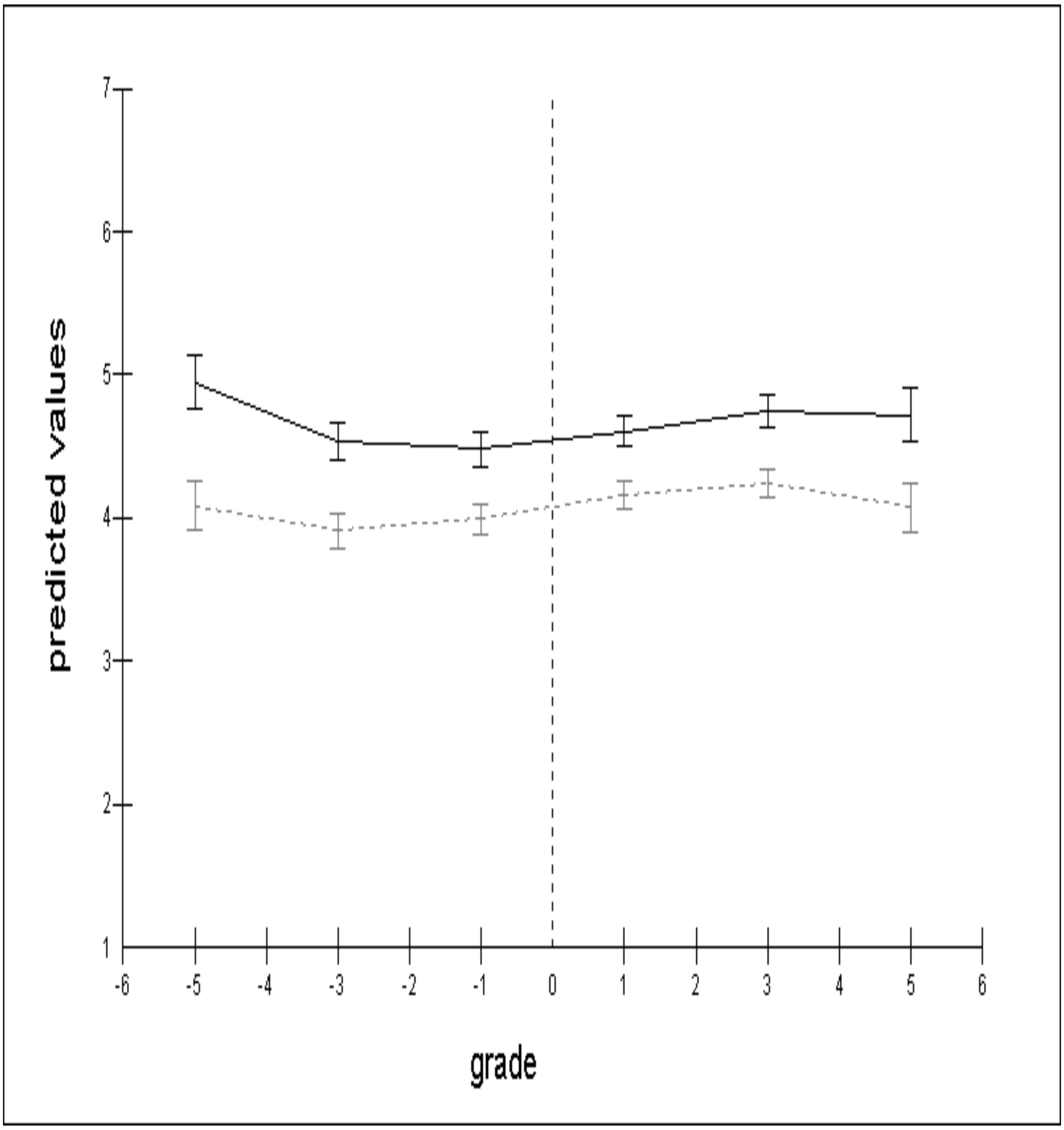
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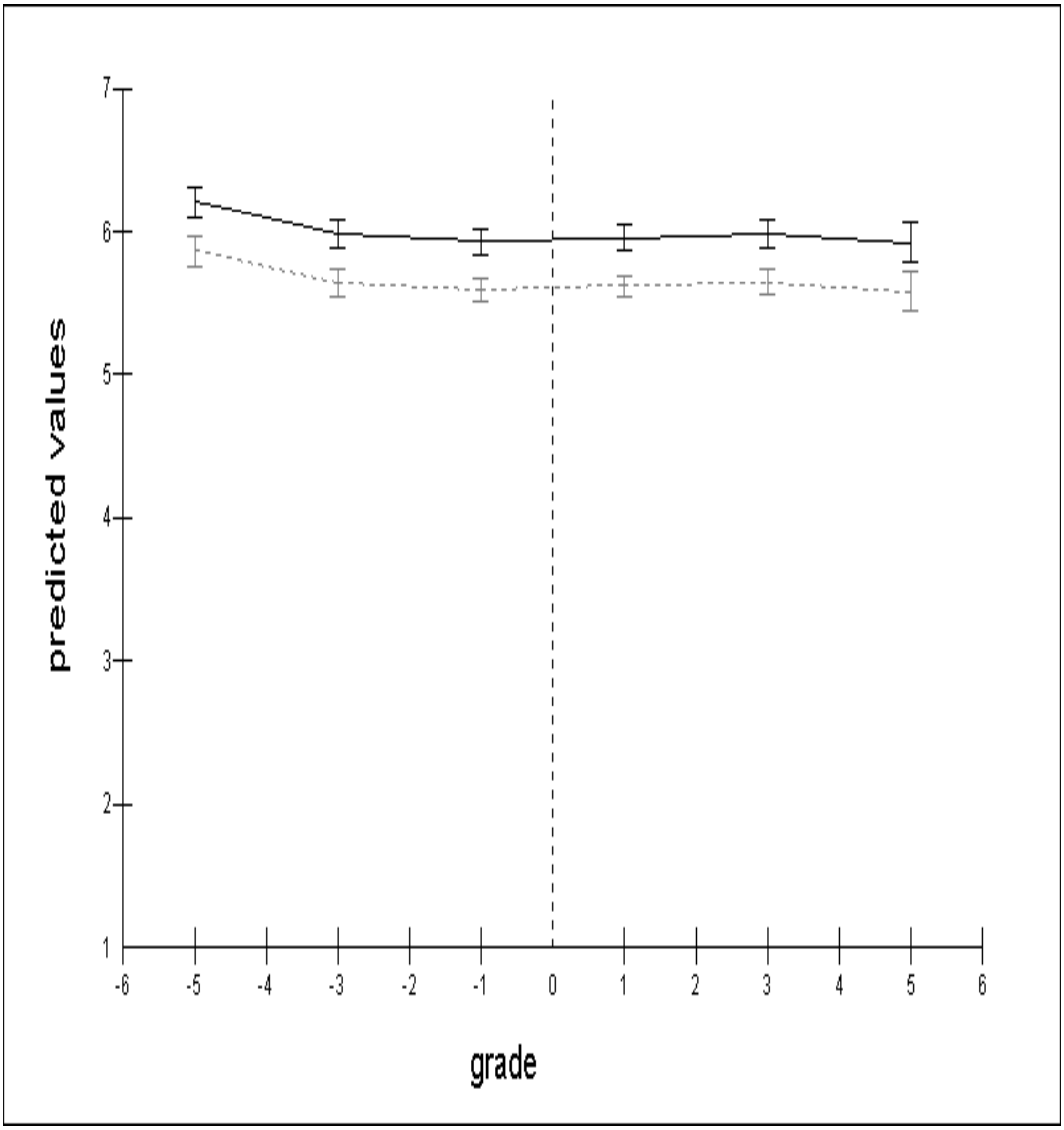
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