Incorporating Parent Perceptions:
A Replication and Extension Study of the Internal-External Frame of Reference Model of Self-Concept Development

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This study replicated findings of research on the internal-external frame of reference model of self-concept with a sample of Chinese adolescents and extended this line of research by incorporating parent perceptions of their children's abilities. The results comparing adolescent self-concepts and parent perceptions show that parents did not use processes similar to the internal-external frame of reference when assessing their children's academic abilities. Parent perceptions seemed to have the same gender biases as adolescents do when math and verbal abilities are concerned. Adolescent self-concept and parent perceptions also had significant effects on subsequent achievement in matching subjects beyond what was explained by prior achievement. The results are discussed in light of self-appraisal of performance, social comparison, and evaluative feedback from significant others as three main processes contributing to adolescents' academic self-concepts.

Historically, investigation of the origins of achievement-related self-perceptions has focused on three main processes: self-appraisal of performance, social comparison, and evaluative feedback from significant others (Bandura, 1986; Bannister & Agnew, 1977; Harter, 1983; Marsh, 1986). Some researchers have mainly focused on the impact of prior achievement and frames of reference children use to infer ability (e.g., Marsh, 1986, 1990a). Others have emphasized the persuasive influence of significant others such as parents and teachers (e.g., Eccles, Adler, & Kaczala, 1982; Frome & Eccles, 1998). Still others looked at more proximal processes such as self-efficacy appraisals as mediators between performance and/or achievement and self-concept (e.g., Pajares & Miller, 1994). As an attempt to achieve a more integrated understanding of the ontogeny of adolescents' academic self-concepts, in this study of Chinese adolescents, I replicated

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Marsh's **(1986, 1990a?)** internal-external frame of reference (I/E) model and compared structural features of adolescent self-concepts with those of parent perceptions. I further integrated gender along with prior academic achievement as potential sources of adolescents' academic self-concepts and related parent perceptions. I also attempted to extend research on the I/E model by incorporating a mediational model to elucidate the possible effects of self-concepts and parent perceptions on subsequent achievement.

I/E Model

Marsh (1986, 1990a) proposed an I/E frame of reference model in explaining how individuals develop academic self-concepts, particularly in math and English (or verbal ability). The external frame of reference refers to the fact that a peer group provides a frame of reference or standard of comparison by which individuals form self-perceptions of competence. This social comparison hypothesis is typically tested by correlating prior performance (e.g., grades or exam scores) and measures of self-concepts in matching subjects. Moderate to high correlations have been found in numerous studies with diverse cultures (e.g., Kong, Hau, & Cheng, 1998; Marsh, **1990a, 1990b?**; Marsh & Gouvernet, 1989; Marsh & Yeung, **1997a, 1997b?**; Skaalvik **OR SKAAVILK?** & Rankin, 1995; Tay, Licht, & Tate, 1995; Yeung & Lee, 1999).

In studying social comparison effects, research consistently reveals a puzzling phenomenon: Whereas math and English achievement indices are significantly correlated, math and English or verbal self-concepts are not. To explain this anomaly, Marsh and his colleagues (Marsh, 1986; Marsh, Smith, & Barnes, 1985) postulated an internal frame of reference by which students' achievement in one domain may negatively or positively influence their judgment of self-competence in another. Particularly in the case of math and English or verbal self-concepts, high achievement in one subject will influence individuals' judgments unfavorably in the other and vice versa. This internal reference process manifests itself in negative correlations between math achievement and English self-concept and between English achievement and math self-concept. According to Marsh (1990a), the joint operation of both internal and external reference processes, depending on the relative strength of each, will lead to a near-zero correlation between math and English self-concepts. This internal reference effect has been documented by many studies with culturally diverse populations (e.g., Marsh, 1986, 1990a; Skaalvik **OR SKAAVILK?** & Rankin, 1995; Tay et al., 1995), including Chinese adolescents (Kong et al., 1998; Lee, Yeung, Low, & Jin, 2000; Yeung & Lee,

1999). However, see Bong (1998) for a different approach and interpretation.[1]

Antecedents and Consequences of Parent Perceptions

According to the symbolic interactionist perspective (Cooley, 1902; Mead, 1934), children's self-perceptions reflect the perceptions of them by significant others. This early view of the role of significant others is revived by modern developmental researchers (e.g., Eccles et al., 1982) who are concerned with socialization effects of parents' and teachers' achievement-related expectancy beliefs and values on children's self-perceptions. Although early research findings cast doubts about such effects (e.g., Shrauger & Schoeneman, 1979), developments in theories and measurement techniques have established the legitimacy of the claims on the effects of reflected appraisals and expectancy socialization (Baker & Entwisle, 1987; Cole, Maxwell, & Martin, 1997; Eccles et al., 1982; Frome & Eccles, 1998; Phillip, 1987). Longitudinal studies consistently found that parents' perceptions have a stronger effect on children's perceptions than on children's actual academic grades (Eccles et al., 1982; Frome & Eccles, 1998). These findings suggest that far from an accurate self-assessment, adolescents' self-perceptions of ability are subjective and thus susceptible to the influence of evaluation by others, particularly parents and teachers (Eccles, 1993).

Although significant others are an important force in adolescents' lives, the process of socialization is far more complex than that of unidirectional influences from parents or teachers to adolescents. Whether the children's characteristics such as gender and school performance influence parent perceptions the same way they influence children's self-concepts is not well understood. Specifically, whether parents also invoke processes similar to the I/E reference process used by adolescents is not as systematically investigated. Early research by Marsh (personal communication, **DATE?**) and his colleagues indicated the absence of the internal reference process in parents' perceptions of their children's math and verbal abilities. Different perceptions by parents would further justify them as a unique source of influence in the development of adolescent self-concepts.

Gender Effects on Adolescent and Parent Achievement-Related Perceptions

Central to the socialization effects are emergent gender differences in the development of self-concept (Baker & Entwisle, 1987; Eccles, 1993).

Research consistently found that adolescent girls have higher self-perceptions of ability in English (or verbal ability) than do boys and that adolescent boys have higher self-perceptions of ability in math, although performance history does not warrant such differential perceptions (e.g., Eccles, 1984; Eccles, Adler, & Meece, 1984; Eccles et al., 1989; Frome & Eccles, 1998; Li & Adamson, 1995; Terwilliger & Titus, 1995; also see Dai, Moon, & Feldhusen, 1998; Meece, Parsons, Kaczala, Goff, & Futterman, 1982, for reviews). Eccles and her colleagues (1982) found that parents of adolescent daughters believed their children had to work harder to do well in math than did parents of sons. Yee and Eccles (1988) found that mothers of adolescent daughters attributed their daughters' success in math more to effort than to ability more so than did mothers of sons; they also perceived math as more difficult for girls than for boys. Jussim and Eccles (1992) found that teachers' perceptions of adolescents' math ability were biased in favor of boys regardless of actual performance in math. Taken together, these findings suggest that adolescents' self-perceptions in math and English or verbal ability are influenced by gender-stereotypical expectations in society, which are potentially transmitted by parents. Thus, one would predict that parent perceptions of their children's abilities would carry gender biases in favor of boys when math is concerned and in favor of girls when verbal ability is concerned.

Potential Impact of Academic Self-Concept and Parent Perceptions on Achievement

A main impetus of self-concept research is that a positive self-concept not only promotes the well-being of a person but also motivates one in terms of course selection (Marsh & Yeung, 1997b), effort expenditure (Helmke, 1987), persistence (Dai, in press), intrinsic motivation (Harackiewicz, Manderlink, & Sansone, 1992), and subsequent achievement (Marsh & Yeung, 1997a). Although the impact of achievement on self-concept is well documented, the effect of self-concept on achievement is yet to be established. Yoon, Eccles, and Wigfield (1996), in a longitudinal study, found some evidence, although inconclusive, for the effects of self-concept on subsequent grades and reciprocal relationships between achievement and self-concept, although prior achievement seemed to enjoy the causal predominance. In a structural modeling of longitudinal data with a sample of Australian high school students, Marsh and Yeung (1997a) found that math self-concept consistently accounted for a significant portion of the variation in subsequent math achievement beyond what was explained by prior math achievement. However, the results were less consistent for science and in par-

ticular, English self-concepts. In a study of Norwegian elementary school students, Skaalvik **OR SKAAVILK?** and Rankin (1998) found no evidence supporting the reciprocal relationship between achievement and self-concept. Thus, the issue of positive effects of self-concept on achievement remains unresolved. From a different perspective, parent perceptions can also be a potential contributor to adolescent achievement, either through encouragement and high expectations or through active involvement in their children's education.

Relevance and Significance of Self-Concept to Chinese Adolescence

With regard to the development of self-concept in the context of Chinese culture, Stigler, Smith, and Mao (1985) used a Chinese version of Harter's (1982) Perceived Competence **SCALE?** for Children to study a sample of Chinese older children and early adolescents. It almost perfectly replicated the factorial validity of the four subscales of self-concept. Other research using Marsh's (1990b) Self-Description Questionnaire (SDQ) also found the psychometric soundness (reliability and internal validity) of the Chinese versions of the SDQ (Cheng, Zhu, Ye, & Tang, 1997; Watkins, Dong, & Xia, 1995). Most recent studies of Chinese students conducted by Yeung and his colleagues (Lee et al., 2000; Yeung & Lau, 1998; Yeung & Lee, 1999) also demonstrated the cross-cultural validity of the SDQ measures and the I/E model. Together, they suggest that the structural properties of self-concept development are quite comparable between Western countries and China. Cross-cultural similarities and differences could shed new light on the nature and of self-concept.

PURPOSE OF THE STUDY

The purpose of this study was to address three related questions regarding the antecedents and consequences of academic self-concept and related parent perceptions. First, did Chinese adolescents use the I/E frame of reference in forming academic self-concept, and did their parents also use similar inference processes? Second, did Chinese adolescents and their parents have similar gender biases in their perceptions regarding math and verbal abilities? Last, did adolescents' academic (especially subject-specific) self-concepts and their parents' perceptions mediate subsequent achievement?

METHOD

Participants

Informed consents were obtained from both parents and adolescents. From six classes of two regular high schools in Shanghai, China, 270 10th-grade students volunteered to participate in this study. The participation rate was 97%. Of the students, 266, 125 male and 141 female, responded to the self-concept instrument. Achievement data (exam scores) were available for 253 students. The average age of participants when the data were collected was 16 years and 2 months, with a standard deviation of 5 months. Of the total sample, 88% are only children and 12% have one or two siblings. A vast majority (94%) of these adolescents lived in intact two-parent families.

The two schools were comparable in terms of the makeup of the student body and educational practices. Both schools complied with the municipal guidelines for curriculum and citywide exam schedules. Both schools made exam scores public (e.g., posted on the bulletin board in the classroom). The only major difference of import to this study is that School A grouped the top 50 students in one advanced class (which was included in this study) based on high school entrance exam scores and treated the rest of 10th-grade students as regular class students. School B did not practice any ability grouping when students entered high school (the 10th grade is the first year of high school based on a 6-3-3 system in China).

A brief parent questionnaire was sent to each participating student's parents, and 255 were returned. The return rate was .94. As the questionnaire requested that one parent or guardian who took primary care of the child's education fill out the questionnaire, 106 respondents (42%) were mothers, 138 respondents (54%) were fathers, and 11 respondents (4%) were grandparents. Of these 255 respondents, 26% received less than a high school education, 22% completed high school, 35% completed a 2-year college, 14% completed a 4-year college, and 4% received graduate education. This information about parent education levels indicates diverse socioeconomic backgrounds in this sample of Chinese adolescents. The two schools were comparable in this regard.

Measures

Adolescent data. Adolescent data consisted of achievement (final exam score) data and three self-concept measures. Exam scores were preferred to

grades because they retain more proximal performance information than do grades. The administrations of the two schools (with the consent of parents and students) supplied scores on the final exams in math and Chinese taken by participants 4 months before they responded to a self-concept questionnaire for this study (Time 1 data, Math1, and Chin1) and 8 months after (Time 2 data, Math2, and Chin2). For School A, additional exam scores were made available, which were final exams in English (as a foreign language; Eng1 and Eng2), physics (Phy1 and Phy2), and chemistry (Chem1 and Chem2). All self-concept items were drawn from the Self-Description Questionnaire II (Marsh, 1990b). The measures were translated into Chinese by the author and back translated into English by a doctoral student in the Department of English at Purdue University. The back translation generally confirmed the semantic and conceptual equivalency of the Chinese version (see Dai, 1998, for details). Three measures of self-concept were included in this study: math self-concept (Math_SC), verbal self-concept [2] (Verbal_SC), and general academic self-concept (Acad_SC), each containing three items. All these self-concept measures used a 5-point Likert-type scale, 5 = *true*, 4 = *somewhat true*, 3 = *undecided*, 2 = *somewhat untrue*, and 1 = *not true*. See Table 1 for specific items.

Parent data. Parents were asked, "Within the same age group, how would you rate your child's academic abilities in the following areas?" Three rating scales were used; parents rated their adolescent children's math ability (Math-P), verbal ability (Verbal-P), and general academic ability (Acad-P). They used a 4-point scale, with 4 = *among the best*, 3 = *above average, 2 = average, and 1 = below average.*

Data Analysis

Confirmatory factor analysis (CFA) was used to assess the discriminant validity of the three self-concept measures. Then, structural equation modeling was used to test the I/E model of self-concept and its extension to parents' ability perceptions. Gender, self-concept, and parent perceptions were then integrated in the structural equation models. A set of mediational analyses (Baron & Kenny, 1986) was conducted to examine the unique effects of self-concept and parent perceptions on Time 2 achievement. Finally, the I/E model and the mediational model were combined in a structural equation model. The EQS **PLS. DEFINE** program (Bentler, 1995) was used for all analyses involving CFA and structural equation modeling.

TABLE 1: Means (and standard deviations) of Exam Scores, Self-Concept, and Perceptions by Parents (School A only, *N* = 144)

	*Class 1 (*n = *49)*		*Class 2 (*n = *47)*		*Class 3 (*n = *49)*	
Math1	81. 33	(7.34)	65.96	(9.10)***	66.51	(10.55)***
Math2	89.27	(6.40)	74.38	(12.35)***	80.38	(9.82)***
Verbal1	76.88	(5.33)	71.51	(4.24)***	68.76	(5.27)***
Verbal2	79.27	(4.41)	72.87	(4.83)***	73.77	(4.16)***
Phys1	81.41	(7.72)	65.74	(8.84)***	71.94	(8.46)***
Phys2	89.22	(5.94)	72.77	(10.23)***	77.00	(11.10)***
Chem1	86.92	(5.75)	73.19	(8.06)***	73.80	(8.40)***
Chem2	75.29	(7.68)	61.06	(9.60)***	65.06	(9.99)***
Eng1	84.96	(5.15)	74.00	(8.17)***	74.00	(7.96)***
Eng2	80.98	(5.27)	69.36	(7.03)***	68.73	(6.98)***
Math_SC	3.42	(1.03)	3.27	(.84)	3.50	(.99)
Verbal_SC	3.39	(1.12)	3.60	(.84)	3.50	(1.05)
Acad_SC	3.37	(.70)	2.96	(.59)*	2.85	(.84)***
Math_P	2.82	(.70)	2.67	(.67)	2.49	(.68)*
Verbal_P	2.49	(.68)	2.36	(.57)	2.30	(.71)
Acad_P	2.93	(.53)	2.60	(.65)*	2.63	(.57)*

NOTE: All exams used a 100-point system, and scores were based on points achieved; statistical significant differences between Class 1 and the other two classes. Acad_P and Math_P were used as a proxy measure of self-concept for physics and chemistry, and Acad_P and Verbal_P were used for English.
*$p < .05$ ***$p < .001$.

RESULTS

Preliminary Analyses

Because exams in most academic subjects in China used a percentage scoring system, the scale for which can be meaningfully interpreted in terms of levels of achievement (e.g., 90 to 100 = excellence, 80 to 89 = good, 70 to 79 = fair, 60 to 69 = pass, 0 to 59 = fail), the scores obtained for this study might have unique distributions. Therefore, raw score means and standard deviations were calculated. The two Chinese exam scores had an average mean of 74.15 and a standard deviation of 6.56. The two math exam scores had an average mean of 76.53 and a standard deviation of 11.71. This indicates that whereas average achievement levels on these two subjects are comparable, math achievement had greater variability, which can potentially influence the effect sizes. All score distributions were normal except for Math1, which was slightly negatively skewed (skewness = –1.08).

One critical factor in the proper use of achievement data in the self-concept research is to determine how students perceive and interpret exam scores as a form of performance feedback. They could focus on absolute (i.e., criterion-based) levels of performance, because in these schools, letter grades were assigned based on percentage of points achieved rather than on deviation scores from the mean. Thus, performance feedback such as percentage scores or corresponding letter grades conveys information against an absolute standard (e.g., a B means a fairly good performance regardless of how many student received Bs). Alternatively, they could focus their attention on their relative performance within the class, regardless of their absolute levels of performance (e.g., who is on the top and who hits the bottom). Although absolute levels of performance are an important basis for performance self-appraisal, the likelihood of using social comparison information was also high in these schools. For one thing, each class in Chinese school systems, even at the high school level, is a highly stable social unit, with class members staying together for most of the school day and being taught different subjects (except lab classes) in the same classroom. For another, social comparison information such as within-class rankings on major exams was made public and was too salient to be ignored.

To explore whether students mainly used final exam scores in the context of within-class social comparison or absolute performance levels across classes, exam scores were standardized within each class and served as proxy measures of social comparison information. The within-class standardization amplified within-class differences while blurring absolute levels of performance across classes. Using z scores increases the correlations between exam scores and within-class academic rankings (from an average of .34 to that of .40 for the four math and Chinese exams) but decreases the correlations between exam scores and the grade-level rankings that were based on total points achieved on the five final exams (from an average of .63 to that of .27). Partial correlation analyses indicated that z scores of the four math and verbal exams accounted for additional variance in the measures of self-concept in matching subjects when the raw scores were partialled out (the average effect size was .14). In contrast, using standardized scores did not change the sizes of correlations between exam scores and parent perceptions.

Another way to determine whether students derived self-concept using within-class peers as a reference group or evaluated self-competence against an absolute performance standard or mastery criterion is to compare between-class differences on self-concept relative to differences in corresponding academic performance in matching school subjects. The case in point is the advanced class in School A, which consisted of the top 50 students in the 10th grade (the number of the total 10th graders in the school was

295). This class outperformed the other two classes that participated in this study on all of the five Time 1 as well as all five Time 2 measures of achievement, as indicated by post hoc tests (see Table 1). Records of their academic rankings showed that of these 50 top-ranked students, 40 remained among the top 50 on their first semester final exams (i.e., Time 1 exams in this study) and 36 still remained among the top 50 on their third semester final exams (i.e., Time 2 exams). However, their self-concept did not show an advantage commensurate with their absolute levels of performance. They scored higher on the measure of general academic self-concept than did the other two classes, 3.37 versus 2.96 and 2.85, $F(2, 142) = 7.18$, $p < .001$, but did not differ with the other two in their math scores, 3.42 versus 3.27 and 3.50, $F(2, 142) = .70$, **not significant?**, and their verbal self-concepts, 3.39 versus 3.60 and 3.50, $F(2, 142) = .56$, **not significant?**. The comparable math and verbal self-concepts among the three classes implicate what Marsh (Marsh, Chessor, Craven, & Roche, 1995; Marsh, Kong, & Hau, in press) called the "big-fish-little-pond effect"; that is, students tend to use peers within the class as a reference group in forming self-concepts rather than relying on the absolute levels of performance across classes, particularly when subject-specific self-concepts are concerned.[3] Based on the results of these probes, in the following analyses, standardized scores were used to amplify within-class social comparison information when math and verbal self-concept data were involved, but raw scores were used whenever parent data were involved.

Because parent ratings were done by either mothers or fathers, *t* tests were conducted to see whether there were statistically significant differences between fathers and mothers in the ratings of their adolescents' math, verbal, and general academic abilities. No significant difference was found. Therefore, no further distinction was made in this regard in the ensuing analyses.

To examine the discriminant validity of the three self-concept measures, a CFA was conducted and the results (factor loadings, intercorelations, and the variance-covariance matrix) are presented in Table 2. Although the chi-square value was statistically significant, $\chi^2(24, N = 266) = 56.54$, $p < .01$, the chi-square–degree of freedom ratio, which reduces the sensitivity of the chi-square statistics to the sample size, was less than 3 ($\chi^2 / df = 2.36$), Bentler-Bonett Nonnormed Fit Index (NNFI; i.e., Tucker-Lewis Index) = .94, Comparative Fit Index (CFI) = .96, the root mean square error of approximation (RMSEA) = .08. All these values of fit indices are considered adequate (Kline, 1998). The most noticeable result was the negative correlation between math and verbal self-concept ($r = –.43$). Inspection of the variance-covariance matrix (see Table 2) indicates that the negative correlation was mainly due to negative correlations between Item 4 ("Mathematics is one of

TABLE 2: Results of Confirmatory Factor Analysis of the Self-Concept Measures Used in the Study

Items Adapted From the Self-Description Questionnaire (Marsh, 1990b)	*Academic*	*Math*	*Verbal*	*Variance-Covariance Matrix*								
				1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1. I do well in tests in most school subjects	.54			.936								
2. I get poor marks in most school subjects[a]	.69			.390	1.418							
3. I get good marks in most school subjects	.75			.376	.594	.906						
4. Mathematics is one of my best subjects		.89		.220	–.118	–.064	1.382					
5. I often need help in mathematics[a]		.67		.187	.164	.040	.582	1.260				
6. I learn things quickly in mathematics		.77		.161	–.036	–.063	.901	.593	1.129			
7. Work in Chinese classes is easy for me			.84	.247	.489	.399	–.605	–.262	–.482	1.833		
8. I do badly on tests that need reading ability[a]			.55	.191	.425	.324	–.298	–.019	–.204	.951	1.414	
9. I learn things quickly in Chinese classes			.86	.221	.326	.237	–.434	–.062	–.313	1.012	.688	1.191
Intercorrelations												
Math self-concept	.47											
Verbal self-concept	.00	–.43										
Alpha reliability	.69	.82	.79									

NOTE: χ^2 / *df* ratio = 2.36; Nonnormed Fit Index (NNFI) = .94, Comparative Fit Index = .96, root mean square error of approximation = .08.
a. Reversal item.

my best subjects") and Item 6 ("I learn things quickly in mathematics") with the three verbal self-concept items.

Means, standard deviations, and zero-order correlations of relevant variables are presented in Table 3. The Time 1 and Time 2 math exam scores with an interval of 1 year were correlated ($r = .61$, $p < .001$), as were the two Chinese exam scores ($r = .25$, $p < .01$). It is worth noting that the two math exams were more highly correlated than were the two Chinese exams. The Time 1 and Time 2 exam scores for the other three school subjects were also correlated. The correlation was .64 (p <@060 .001) for physics, .60 ($p < .001$) for chemistry, and .80 ($p < .001$) for English.

Testing the I/E Model With Adolescent and Parent Data

The I/E model was first tested using structural equation modeling, with two achievement (final exam) z scores (Math1 and Chin1) as exogenous variables and two matching self-concepts as endogenous variables. Results are presented in Figure 1.

All indices indicate a good data-model fit. The chi-square statistic was not statistically significant, $\chi^2(14, N = 252) = 19.07$, $p = .16$; χ^2 / *df* ratio = 1.36, NNFI = .98, CFI = .99, and RMSEA = .04.[4] All path coefficients were in accordance with the I/E model (see Figure 1). Prior math achievement had a positive effect on math self-concept (.45) and a negative effect on verbal self-concept (–.31). Likewise, prior achievement in Chinese had a positive effect on Chinese self-concept (.26) and a negative effect on math self-concept (–.23). These results replicated findings of many studies with European and American adolescents. What was different from previous research was the negative residual correlation between adolescents' math and verbal self-concepts ($r =$ ".32), which is also shown in the CFA results presented earlier.

To explore whether gender moderated the relationship between achievement and verbal and math self-concepts, a multigroup structural equation modeling was performed with boys ($n = 120$) and girls ($n = 132$). Four equality constraints were imposed on the model (i.e., four path coefficients set to be equal across the groups). The chi-square value was statistically significant, $\chi^2(30, N = 252) = 40.09$, $p < .05$; χ^2 / *df* ratio = 1.34, NNFI = .95, CFI = .97, and RMSEA = .05. The Lagrange multiplier (LM) test indicated that releasing the constraint on the path from Chinese exam to verbal self-concept would significantly improve the data-model fit. Therefore, the model was rerun with the constraint released (i.e., the parameter freed for estimation). The chi-square value for the final model was not statistically significant, $\chi^2(29, N = 252) = 39.02$, $p > .10$; χ^2 / *df* ratio = 1.34, NNFI = 97, CFI = 98,

TABLE 3: Means, Standard Deviations, and Zero-Order Intercorrelations of Investigated Variables (*N* = 253)

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
1. Math1																
2. Math2	.61															
3. Chin1	.21	.20														
4. Chin2	.29	.21	.25													
5. Phy1	.61	.48	.28	.37												
6. Phy2	.62	.63	.35	.35	.64											
7. Chem1	.64	.53	.37	.48	.65	.66										
8. Chem2	.66	.62	.26	.40	.56	.67	.60									
9. Eng1	.58	.35	.45	.50	.46	.45	.57	.43								
10. Eng2	.64	.42	.40	.44	.48	.56	.63	.49	.80							
11. Math_SC	.38	.32	–.12	–.04	.26	.19	.18	.21	–.06	.00						
12. Verbal_SC	–.24	–.18	.14	.15	–.23	–.22	–.11	–.15	.08	–.07	–.33					
13. Acad_SC	.39	.29	.07	.32	.31	.37	.48	.38	.38	.38	.37	.07				
14. Math_P	.46	.32	.01	.11	.32	.33	.33	.39	.22	.28	.53	–.21	.45			
15. Verbal_P	.04	.05	.32	.20	.10	.16	.19	.13	.30	.22	–.11	.41	.28	.27		
16. Acad_P	.32	.21	.12	.25	.37	.37	.42	.35	.44	.46	.17	.06	.43	.55	.55	
Mean	71.12	81.75	75.85	72.46	73.13	79.78	78.03	67.24	77.70	73.10	3.34	3.52	2.76	2.62	2.44	2.66
SD	13.15	10.98	6.82	6.31	10.50	11.10	9.79	10.89	8.85	8.57	1.04	.94	.73	.73	.66	.62

NOTE: All numbers are rounded up to the second decimal place. For physics, chemistry, and English, *N* = 144. Parent data used a 4-point scale. Acad_P and Math_P were used as a proxy measure of self-concept for physics and chemistry, and Acad_P and Verbal_P were used for English.

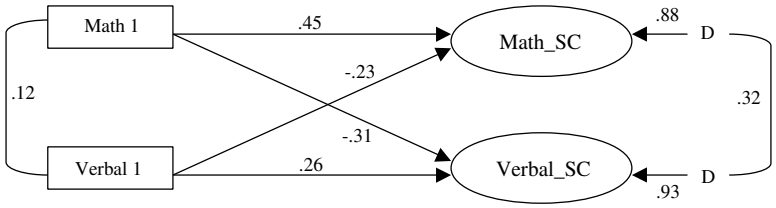

Figure 1. Structural equation modeling of the I/E effects on adolescent self-concept.

NOTE: The measurement component of the model is omitted for presentation clarity, $\chi^2(14) = 19.07$, χ^2 / *df* ratio = 1.36; Normed Fit Index = .97, Nonnormed Fit Index (NFI) = .98, Comparative Fit Index (CFI) = .99, root mean square error of approximation (RMSEA) = .04; D = disturbance; I/E = internal-external frame of reference. The EQS notation system was used.

RMSEA = .04. The square difference between the initial and final models (*df* = 1) was statistically significant ($\chi^2_{\text{difference}} = 6.07$, $p = .02$). Path coefficients showed the Chinese exam had no effect on boys' verbal self-concept (.09) but had a salient effect on girls' verbal self-concept (.40).

To address the issue of whether parents rely on processes similar to an I/E in forming perceptions of their children's academic abilities, a similar I/E model was run with parent data (see Figure 2). The initial model fixed the correlation between the two achievement scores to zero to allow for one degree of freedom for the model estimation. The Wald test was used to determine whether any parameter can be dropped without worsening the data-model fit, and the LM test was used to determine whether adding any parameter would significantly improve the data-model fit (Bentler, 1995). The chi-square value for the initial model (*df* = 1) was statistically significant, $\chi^2(1, N = 252) = 12.39$, $p < .001$, and NNFI, which corrects for model complexity, was extremely low (NNFI = .50), suggesting that a more parsimonious model would better fit the data. The Wald test suggested dropping the two diagonal paths (internal reference effects), and the LM test suggested adding the omitted correlation between the two achievement scores. The final model added the correlation between the two achievement scores (freed for estimation) but dropped the two diagonal paths, which improved the data-model fit, $\chi^2(2, N = 253) = 3.19$, $p = .20$; χ^2 / *df* ratio = 1.60, NNFI = .97, CFI = .99, and RMSEA = .05. The chi-square difference between the initial and final models (*df* = 1) was statistically significant ($\chi^2_{\text{indifference}} = 9.2$, $p < .01$). The results indicated the absence of internal reference effects in parent perceptions. In contrast to

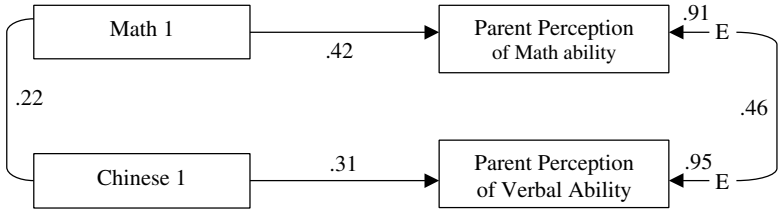

Figure 2. Structural equation modeling of I/E effects on parent perceptions.
NOTE: Final model is presented. $\chi^2(2) = 3.19$, $p = .20$; (χ^2 / *df* ratio = 1.60; Normed Fit Index = .98, NFI = .97, CFI = .99, RMSEA = .05.

the negative correlation between adolescent math and verbal self-concepts, the two error terms of parent verbal and math perceptions were positively correlated ($r = .46$).

Integrating Gender Effects on Both Adolescent Self-Concept and Parent Perceptions

To address the second research question, structural equation modeling was performed with one achievement score (Math1 or Chin1), gender as two exogenous variables (with male coded as 1 and female coded as 2), and adolescent self-concept and parent ability perceptions in the matching subject as two endogenous variables. According to the hypothesis, there would be positive effects of gender (i.e., in favor of girls) on adolescent and parent perceptions of verbal ability and negative effects of gender (i.e., in favor of boys) on adolescent and parent perceptions of math ability. The results are presented in Figures 3 and 4.

For the math model (see Figure 3), all fit indices were satisfactory, $\chi^2(5, N = 248) = 6.46$, $p = .26$; χ^2 / *df* ratio = 1.29, NNFI = .99, CFI = .99, and RMSEA = .04. The same is true for the verbal model (see Figure 4), $\chi^2(5, N = 248) = 7.03$, $p = .22$; χ^2 / *df* ratio = 1.41, NNFI = .98, CFI = .99, and RMSEA = .04. As predicted, gender had a negative effect on math self-concept (–.38 in favor of boys) and a positive effect on verbal self-concept (.25 in favor of girls). The same pattern holds for parent data. Thus, the results support the postulation of gender stereotypical biases on adolescent and parent perceptions regarding math and verbal abilities, although the effect size of gender seemed to be larger on adolescent self-concepts than on parent perceptions. The residual correlations between self-concept and parent perceptions in math ($r = .49$) and verbal ability ($r = .38$) were also high.

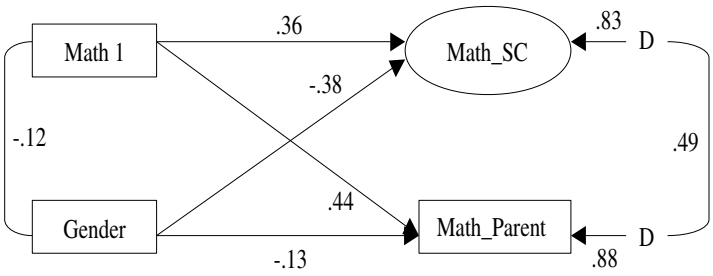

Figure 3. Structural equation model of math and gender effects on adolescent math self-concept and parent perceptions of their children's math ability.

NOTE: The measurement component of the model is omitted for presentation clarity. $\chi^2(5, N = 248) = 6.46$, $p = .26$; χ^2 / *df* ratio = 1.29; Normed Fit Index = .99, NFI = .99, CFI = .99, RMSEA= .04; E = error.

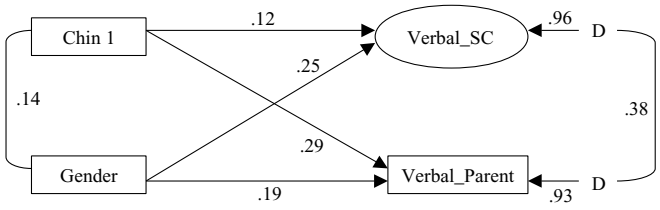

Figure 4. Structural equation model of effects of the Chinese exam score and gender on adolescent verbal self-concept and parent perceptions of their children's verbal ability.

NOTE: The measurement component of the model is omitted for presentation clarity. $\chi^2(5, N = 248) = 7.03$, $p = .22$; χ^2 / *df* ratio = 1.41; Normed Fit Index = .98, NFI = .98, CFI = .99, RMSEA= .04.

Testing the Effects of Self-Concept and Parent Perceptions on Achievement

To test whether self-concept measures had a significant effect on subsequent achievement in corresponding subjects beyond what was explained by the prior achievement (the last research question), a series of mediational models were tested using self-concept as a mediational variable between the two waves of achievement data. The mediational model resembles the causal modeling of the reciprocal relationship between achievement and self-concept (Marsh & Yeung, 1997a) in that that self-concepts were mea-

sured between the two waves of achievement data and presumed to partly mediate the effects of Time 1 achievement on Time 2 achievement (Baron & Kenny, 1986). In addition to verbal and math achievement, general academic self-concept was used as proxy measures of self-concept for physics, chemistry, and English (data available only in School A; $N = 144$). The mediational model specifies three main variables, the independent variable, the mediator variable, and the dependent variable, and three paths, a path from the independent variable to the dependent variable (Path 1), a path from the independent variable to the mediator variable (Path 2), and a path from the mediator variable to the dependent variable (Path 3). The Wald tests were used to test the mediational effects, that is, to determine whether Path 3 can be dropped without worsening the data-model fit (see Baron & Kenny, 1986, for alternative ways to test mediation hypotheses). The results are presented in Table 4.

As is shown in Table 4, most mediational effects (Path 3) were statistically significant, with an average effect size of .25 for self-concept and .21 for parent perceptions. The Wald tests show that for all the models tested, no Path 3 can be dropped from the model without worsening the data-model fit. The results also show a consistent pattern of larger effect sizes of path coefficients for Time 1 exams on Time 2 exams (Path 1), with an average of .36 for the adolescent model and an average of .41 for the parent model.

As a final step, the I/E model tested earlier was expanded to include the Time 2 achievement variables so that the I/E effects and mediational effects of math and verbal self-concepts can be tested simultaneously within one model.

The initial model specification combined the I/E model and the mediational model (the two paths from math and verbal self-concepts and the two Time 2 exams in matching subjects were added). The chi-square statistics ($df = 26$) was 44.65, $p = .01$; χ^2 / df ratio = 1.71. The NNFI was .96, the CFI was .98, and the RMSEA was .05. The LM test suggests adding two paths, one from the Time 1 math exam to the Time 2 Chinese exam and the other from the Time 1 Chinese exam to the Time 2 math exam. The Wald test suggests dropping the path from verbal self-concept to the Time 2 Chinese exam (path coefficient = .04 in the initial model). So, the model was rerun with the two parameters added into the model and the one parameter dropped. The results of the final model are presented in Figure 5.

As a result of model respecification, the data-model fit was improved. The chi-square value for the final model was not statistically significant, $\chi^2(25, N = 252) = 28.37$, $p = .29$; χ^2 / df ratio = 1.13. The NNFI was .99, the CFI was .99, and the RMSEA was .02. The chi-square difference ($df = 1$) between the initial and final models was statistically significant ($\chi^2_{\text{difference}} = 16.28$, $p < .001$).

TABLE 4: Mediational Effects of Self-Concept or Parent Perceptions on Subsequent Achievement

	NNFI	*CFI*	*Path 1 (from Time 1 to Time 2 exams)*	*Path 2 (from Time 1 exam to SC)*	*Path 3 (from SC to Time 2 exam)*
Math (SC)	.99	.99	.43	.43	.17
Math (P)	(path analysis, no fit index)		.44	.48	.14
Verbal (SC)	.99	.99	.20	.26	.21
Verbal (P)	(path analysis, no fit index)		.30	.41	.15
Physics (SC)	.81	.94	.32	.50	.34
Physics (P)	.99	.99	.36	.46	.29
Chemistry (SC)	.97	.99	.36	.63	.27
Chemistry (P)	.94	.99	.38	.49	.30
English (SC)	96	.99	.51	.51	.25
English (P)	.98	.99	.57	.45	.17

NOTE: NNFI = Nonnormed Fit Index The mediational model assumes that the effect of the Time 1 achievement on Time 2 achievement is partly mediated by self-concept or parent perceptions. In multiple regression terms, Path 1 was estimated with Path 3 statistically controlled and vice versa. For physics, chemistry, and English exams ($N = 144$), Acad_P and Math_P were used as a proxy measure of self-concept for physics and chemistry and Acad_P and Verbal_P was used for English. For math and Chinese exams, $N = 253$. SC = adolescent data; P = parent data.

DISCUSSION

In this study, I aimed at integrating two traditions of the self-concept research, one of which focused on prior achievement and frames of reference adolescents use to form self-perceptions of competence and the other focused on the role of significant others' perceptions and expectancy beliefs. Although it relies heavily on Marsh and his colleagues' **(Marsh, 1986; Marsh et al., 1985?)** work, this study provides a unique perspective by comparing adolescent self-concept with parent perceptions in their relations to prior achievement, possible gender biases, and subsequent achievement.

Consistent with findings of previous research, Chinese adolescents also seemed to rely on I/E. The sizes of path coefficients are also comparable to other studies of Chinese students (from –.19 to –.29; see Lee et al., 2000; Yeung & Lau, 1998). Moreover, the internal frame of reference seemed to be used in science classes as well, as correlations between verbal self-concept and exam scores in chemistry and physics also tended to be negative (ranging from –.11 to –.23). In addition, this study found a striking negative correlation between math and verbal self-concepts, which was not predicted by the I/

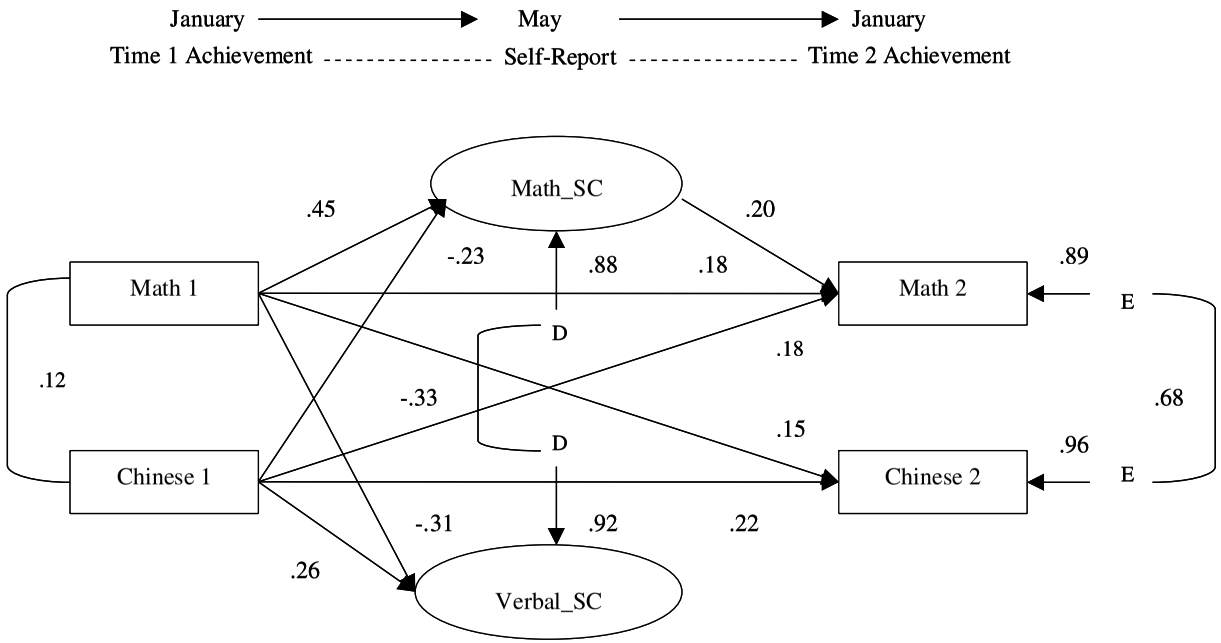

Figure 5 .The I/E model combined with the mediational model.

The measurement component of the model is omitted for presentation clarity. $\chi^2(25, N = 252) = 28.37$, $p = .29$; χ^2 / *df* ratio = 1.13; NNFI = .99, CFI = .99, and RMSEA = .02.

E model. Yeung and Lau (1998) and Lee et al. (2000), in their studies of Chinese students, also found small but statistically significant negative correlations (ranging from .12 to .19) between verbal and math self-concepts. As Marsh (personal communication, **DATE?**) pointed out, some items in the SDQ, such as "Math is one of my best subjects," almost forced students to use an ipsative frame of reference. Thus, the negative correlation may be a measurement artifact rather than something of theoretical or practical significance. To be sure, such a negative correlation is likely to be a result of a heightened internal contrast between math and verbal self-concepts. For example, when Bong (1998) phrased self-concept items explicitly in terms of an internal frame of reference ("Compared with my ability to learn other subjects, my ability to learn . . . is . . . ," p. 103), a negative correlation ($r = -.18$) was found between verbal and math self-concepts. However, an examination of the variance-covariance matrix (see Table 2) shows a consistent pattern of negative correlations across several items. The item "I learn things quickly in math," which was negatively correlated with all three verbal self-concept items, can be based on social comparison (e.g., "I learn quickly compared to others") as well as on internal reference process (e.g., "I learn quickly in this school subject compared to other school subjects"). Because participants were not directed to use I/E in this study, as was the case in Bong's study, their use of an internal frame of reference (i.e., the use of an ipsative frame) can be seen as spontaneous rather than primed by the wording of items. Taken into account the moderate to low effect sizes of the internal reference effects (i.e., diagonal paths) and positive correlations of the two exam scores, such a negative correlation between math and verbal self-concepts becomes even more compelling. One would speculate that given the existence of a tracking system in China that gears all college-bound high school students toward either a science or engineering track or a liberal arts track, Chinese high school students may be prompted by this specific educational context to polarize their own self-concept in one direction or the other. Because math ability is quintessential to science and engineering majors and verbal ability and achievement are the most heavily weighted factors in admission to liberal arts majors in China (Dai & Davis, 1998), the prospective choice could heighten an internal contrast in math and verbal abilities among Chinese adolescents, which presumably would lead to the observed negative correlation between verbal and math self-concepts. Such an interpretation, of course, is highly tentative. Although more research is needed to render conclusive evidence, it does not seem that the anomaly of the negative correlation between math and verbal self-concepts can be easily explained away as a methodological artifact.

Probably the most revealing finding of this study is that parents did not seem to use the I/E the way their adolescent children did in assessing their

academic abilities. The internal reference effects were absent. Furthermore, parent perceptions of their children's math and verbal abilities were positively correlated, in contrast with the negative correlation between math and verbal self-concepts. Together, these results suggest that although adolescents tend to use relative (both internal and external) performance standards in self-assessment of ability in specific subjects, parents seem to use more absolute criteria in assessing their children's performance and ability. Thus, parent perceptions and judgments may be a less biased source of feedback and evaluation compared with adolescents' self-concepts. Moreover, the uniqueness of parents' perspectives also suggests that parent perceptions are less likely to be shaped by their children's self-perceptions. Otherwise, the structure of the I/E model would be reflected in parent perceptions as well. Thus, treating parent perceptions and judgments as independent sources of social persuasive influence (Eccles et al, 1982; Frome & Eccles, 1998) gains indirect support from this study, although the design of this study prevents any causal interpretations regarding parent perceptions and adolescent self-concepts.

This study also found similarities between parent perceptions and adolescent self-concepts, particularly with respect to the effects of gender. Several possibilities exist that might explain the observed gender effects. Adolescent self-concepts and parent perceptions may reflect actual gender differences in math and Chinese abilities, but any single exam score will not provide a perfect performance index. Thus, with more adequate multiple indicators of math or Chinese performance, the gender effects found in this study might disappear. Alternatively, gender-stereotypical expectations regarding math and verbal ability (e.g., girls had to work harder to earn good grades in math; math is more difficult for girls; Eccles et al., 1982; Yee & Eccles, 1988) may be a powerful cultural myths that influence both adolescents and their parents, which leads in turn to the observed gender effects on adolescent self-concepts and parent perceptions. There still exists the third possibility that adolescent girls may convince themselves over time that they are weak in math and strong in verbal ability and that adolescent boys think the opposite. The third possibility is supported, albeit weakly, by the fact that gender effects seemed to be stronger on adolescent self-concepts than on parent perceptions and by the finding that girls seemed more likely than boys to infer verbal ability from their performance in Chinese. Based on the I/E, one would expect gender differences in math and verbal self-concepts to be accentuated. In other words, part of gender differences in math and verbal self-concepts can be explained by the use of the I/E by adolescents.

Using achievement data as possible consequences as well as antecedents of adolescent self-concepts and parent perceptions is another way to demon-

strate the potential important role of parent perceptions in their children's school achievement. Given the moot status of the postulated reciprocal relationship between achievement and self-concept (Marsh & Yeung, 1997a), the results of this study appear quite encouraging (see Table 4). Although caution needs to be exercised in inferring causality from correlation data, they nevertheless demonstrate distinct predictive power of adolescent self-concepts and parent perceptions on subsequent achievement beyond what is explained by prior achievement. Although strong empirical evidence for the contribution of self-perceptions to achievement can only be obtained from controlled experiments and more micro-level analyses of the processes, the results can be interpreted in light of our understanding of the processes that have been well documented in the motivation research. For example, positive self-concept in a school subject can lead to increased interest in that subject (Deci & Ryan, 1985; Koller, Schnabel, & Baumert, 1998), more effort expenditure (Helmke, 1988), challenge seeking (Harter, 1992), and intrinsic task motivation (Deci & Ryan, 1985; Harackiewicz et al., 1992). As for parent perceptions, confidence in children's ability can be a great source of social-emotional support. Parents who have confidence in their children's ability are more likely to encourage their children to try hard and persist when schoolwork becomes increasingly challenging in high school. Parent perceptions and expectancy beliefs not only are shown to have a potential impact on their children's self-concept (e.g., Frome & Eccles, 1998) but also are likely to increase their involvement in their children's education when they perceive the need to do so, which can also be important for their children's school success (Gronick **OR GROLNICK?** & Slowiaczek, 1994). Thus, it is not surprising that parent perceptions were found in this study to account for additional variance in the measures of subsequent achievement beyond what is explained by prior achievement, as did adolescent self-concept.

The added paths in the combined model of I/E and mediational effects, from the Time 1 math exam to the Time 2 Chinese exam and from the Time 1 Chinese exam to Time 2 math exam, were unexpected but potentially important. The cross-over effects suggest generalization effects of prior achievement, with achievement in one subject carried over to other subjects. Such positive cross-over effects on achievement are in sharp contrast with negative cross-over effects on self-concept. The exact mechanisms, however, remain to be understood. It is possible, however, that more general processes other than subject-specific self-concept, such as changes in school attitude, school affect, and cognitive engagement, may mediate such cross-over effects. It should be noted that such effects could be either positive or negative. For example, good performance in one subject motivates one to do better in other

subjects; likewise, poor performance in one subject can lead to deteriorating performance in others.

Ideally, one would wish to test reciprocal effects by including achievement, gender, adolescent self-concept, and parent perceptions in one structural equation model, However, stringent requirements and assumptions of structural equation modeling prevent such an endeavor. Because the mediational model in its simplest form is already potentially vulnerable to multicolinearity problems (David Kenny, personal communication, **DATE?**), to avoid further complications, no effort was made in this study to determine the unique contributions of adolescent self-concepts and parent perceptions to subsequent achievement. Such an effort, however, may not be very fruitful because the reciprocal interactions of these factors not only make it impossible to tease apart effects of any single variable but also make such an attempt spurious in terms of ecological validity. Ultimately, we may have to sacrifice some precision in terms of the effects of any single variable but gain insights into a more dynamic, integrative process of how adolescents and their parents perceive, interpret, and construe a reality of importance to both of them and how these processes maintain or change adolescent achievement behaviors.

With respect to effect sizes of achievement on self-concept, the effects of math exam on math self-concept and parent perceptions were consistently higher than were the effects of Chinese exams on verbal self-concept and parent perceptions. Likewise, in the final mediational model, the effect of verbal self-concept on Time 2 Chinese achievement was negligible. Several factors may explain why it was so. Technically, the more variability of the two math exams tended to produce larger effect sizes, with everything else being equal. However, there seems to be more to these larger effect sizes than merely the variability of the measures involved. The correlation between the two Chinese exams with a 1-year interval was much lower ($r = .25$) than that for the two math exams ($r = .61$) as well as those for the two physics, chemistry, and English exams, suggesting less stability in performance over time. As Byrne and Gavin (1996) pointed out, language courses such as English (or Chinese) cover a wide range of elements such as literature, reading, writing, grammar, or various combinations of these elements. Thus, lack of performance consistency and stability may be due to the multidimensional nature of the subject. The relationship between achievement in English or Chinese and verbal self-concept becomes precarious because performance consistency and stability is an important basis for inferring subject-specific competence and ability. In contrast, math curriculum is typically more structured and progressive in its difficulty levels. Besides, as Eccles et al. (1989) pointed out, performance

feedback in math is more concrete and more clearly linked to specific performance criteria than is performance feedback in English, which can be highly subjective and impressionistic. Thus, lack of a clear set of criteria can also make ability inference less reliable and stable. Eccles et al. provided longitudinal evidence for higher stability in math self-concept and lower stability in English self-concept among a group of early adolescents.

Another factor is the cultural beliefs about what it takes to do well in math and English (or Chinese). If parents, teachers, and students believe that natural ability or talent is more important for success in math than in English (Eccles et al., 1982), then adolescents will more readily infer math ability when they do well in math (hence the higher correlation) but are less likely to infer verbal ability when they are equally successful (hence the lower correlation). No research evidence to date, however, has substantiated this conjecture. The positive correlation between general academic self-concept and math self-concept but not verbal self-concept found in this study seems to implicate differential inference processes whereby math self-concept but not verbal self-concept substantially contributes to a sense of general academic ability in a hierarchical self-concept structure (Shavelson & Bolus, 1982). However, the postulated role of cultural belief systems in self-concept formation remains speculative. Whatever the case, differences in the stability of math and verbal performance and their impact on self-concept formation warrant more research attention.

Finally, an important methodological issue is whether raw scores or some forms of standardized exam scores should be used as achievement information. The way exam scores (or grades, for that matter) are used can potentially influence the results and the way these results should be interpreted. Preliminary analyses in this study clearly supported the use of class-level (i.e., within-class) standardized scores. Thus, each class was assumed to be a basic unit or an external frame of reference and different classes were assumed to be more or less equivalent in the way social comparison is carried out. Comparisons of the results of structural equation modeling with standardized scores versus raw scores, however, show little difference in outcomes. There seems to a trade-off between using exam scores mainly as an index of social comparison information and using exam scores as an indicator of an absolute level of performance or performance feedback. As discussed in the beginning, both self-appraisal of performance (performance feedback based on absolute standards or mastery criteria) and social comparison (comparing self performance with a reference group) shape individuals' self-concepts and exam scores carry both types of information. Thus, when scores were standardized for each class separately, social comparison information was amplified at the expense of information about absolute levels of performance.

One weakness of this study and probably of many other studies on the I/E model is that it is impossible to determine whether the effects of achievement on self-concept in a matching subject were due to social comparison process or simply to criterion-based performance feedback. The overlap between raw scores and standardized scores (correlations ranging from .70 and 74 for the two Chinese exams and from .87 and .88 for the two math exams) seems too large to render a meaningful distinction. Future research needs to develop proper indices of achievement that are capable of teasing apart these two components of performance information because it directly influences how effects of achievement on self-concept should be properly interpreted.

In conclusion, this study successfully replicated earlier findings of Marsh's **(WHICH?)** I/E model of self-concept with a group of Chinese adolescents and extended this line of research to parents. It revealed important similarities and differences between adolescent academic self-concepts and parent perceptions in relation to prior achievement, gender, and subsequent achievement. Incorporating parent perspectives and perceptions will further enrich and deepen our understanding of how performance self-appraisal, social comparison, and persuasive influence of significant others interact in the development of children's and adolescents' self-concepts.

NOTES

1. Bong (1998) questioned the viability of the internal-external frame of reference model by showing that math and verbal self-concepts were positively correlated. However, Bong has yet to provide adequate explanations as to why in the study, the paths from verbal achievement to math self-concept and from math achievement to verbal self-concept were all negative (exactly predicted by the I/E model). Also, an inspection of zero-order correlations in that study indicates a negative correlation, although it is a small one ($r = -.18$), between math and verbal self-concept when the internal frame of reference was used (Bong, 1998). All these beg the question of what exactly the data are showing. One reviewer likewise pointed out the existence of a positive correlation between math and English self-concepts in Eccles's and her colleagues' **(WHICH?)** research. However, in a study of a nationally representative sample of 14,825 high school students (HSB **PLS. DEFINE** data), Marsh (1990a) found that whereas achievement indices in English and math were highly correlated ($r = .88$), the correlation between math and English self-concepts was close to zero. Although the I/E model seems well established in literature with diverse cultural populations, different operational definitions and different instruments used in research may contribute to the presence or absence of internal reference effects. For example, Skaavilk **OR SKAALVIK?** and Rankin (1995) demonstrated that the I/E model was supported when self-concept measures were used but not when measures assessing success expectations on specific math or verbal tasks (or self-efficacy measures) were used.

2. The academic subject of *yuwen* (translated as "Chinese") in China encompasses reading, writing, language (e.g., grammar), and literature. There is no separate reading class in China. Therefore, one item assessing reading self-concept was included to reflect the scope of the sub-

ject. A more generic term, *verbal self-concept*, was used because it parallels math self-concept as *yuwen* does in China.

3. The higher general academic self-concept may reflect what is called a reflected glory effect (Marsh, Kong, & Hau, in press) because this class was the most distinguished among the six 10th-grade classes in School A. For example, when general academic self-concept is concerned, the reference groups used to infer ability may be shifted from class level to grade level, and they may then identify themselves as the elite group. An alternative explanation would be that higher general academic self-concept was based on their higher absolute level of overall academic performance.

4. When the same I/E model was rerun with the raw scores of the Time 1 math and Chinese exams, all fit indices and path coefficients were almost identical to those when *z* scores were used. This suggests that overlapping may be too large between raw scores and standardized scores to render any meaningful differences.

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