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Direct and Indirect Effects of IQ, Parental Help, Effort, and Mathematics Self-Concept on Mathematics Achievement

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Abstract

This study examined the structural relationships among cognitive constructs (intelligence and achievement) and affective constructs (perceived parental help, effort and self-concept). It was proposed that the relationships are not invariant across gender. The sample consisted of 219 boys and 133 girls from elementary and preparatory public schools in Al Ain in the United Arab Emirates. Intelligence (IQ) was measured by the Test of Non-verbal Intelligence (TONI) and parental help was measured by 4-Likert-type items. Effort was measured by 4-Likert-type items. Self-concept (SC) was measured by 8-Likert-type items taken from the SDQ I (Abu-Hilal, 2000). Mathematic Achievement was the scores of students in mathematics from school records. The structural model assumed that IQ would have an effect on parental help, effort, SC and achievement. Parental help would have an effect on effort, SC and achievement. Also, effort would have an effect on SC and achievement. Finally, SC would have an effect on achievement. The structural model was tested for invariance across gender. The measurement model proved to be invariant across gender and so was the structural model. The non-constrained model indicated that the structural relationships among the variables do vary according to gender. For example, boys benefited from parental help by exerting more effort while girls did not. Boys with high IQ exerted more effort than boys with low IQ; but girls with high IQ exerted the same amount of effort as girls with low IQ. The model explained 45% and 39% of the variance in math scores for boys and girls, respectively.

Keywords: IQ, parents’ help, effort, self-concept, math achievement, UAE

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Introduction

There has been a proliferation of research and models that have attempted to understand achievement behavior. The focus of researchers on the correlates of achievement has varied from social and demographic factors to personal and psychological factors. Previous research has drawn on various psychological and educational hypotheses and theories (e.g., self-worth theory, social cognitive theory, expectancy-value theory, and attitude behavior relations, etc.). Among the personal and psychological variables used to predict academic achievement is ability (intelligence). It has been well documented that intelligence and academic achievement are positively correlated (Jensen, 1980; Kraft, 1991; Lavin, 1965).

Parental involvement and effort are two other factors used to explain variances in achievement. Fantuzzo, Tighe, and Childs (2000) indicated that family has the most important influence on children's development. Keith, Reimers, Fehrmann, Pottebaum, and Aubey (1986) and Astone and McLanahan (1991) found that increased parental involvement led to children spending more time doing homework. Whether parental involvement -perceived or actual- has an effect on children's achievements is debatable. Abdel-Rahim and Al-Khelaifi (1992) found a significant effect for parental involvement on academic performance with Qatari students, while Abdel-Rahim (1991) found no significant effect for parental involvement on achievement among Egyptian students. Furthermore, Abu-Hilal (2001) found a negative effect for parental help on mathematics achievement.

Researchers also found that the more time spent on homework the better achievement would be (e.g., Abu-Hilal, 2000; Cooper, Valentine, Nye, & Lindsay, 1999). In fact, effort has been hypothesized to compensate for ability (Cooper et al., 1999). Cooper et al. found that homework improved achievement significantly especially for children in high school. However, using multiple regression, Abu-Hilal (2001) found no significant partial effect for effort (time spent on studying and doing homework) on mathematics achievement.

Self-Perceptions and Achievement

Previous research has documented that self-concept and self-efficacy in a specific domain influence one's effort expenditure, activity choice and persistence (e.g., Bandura, 1997; Pajares, 1996). Effort is important for success. However, high effort may mean low ability to some students (Dweck, 2000). Students vary on their perception of effort and ability. To some students ability is fixed while to others it is malleable. Also, effort to some is valued while it is not to others. Dweck (2000) argued that students who believe in malleable ability tend to believe that success requires effort, while those who believe that ability is fixed have little faith in the effectiveness of effort.

Social cognitive researchers (e.g., Cleary, 2009; Eccles & Wigfield, 2002; Schunk, 1981; Schunk, Pintrich, & Meece, 2008; Wigfield, 1994) argue that students' achievement behaviors are influenced by both environmental factors (e.g. school environment, parental involvement, teachers feedback, etc.) and personal processes such as self-concept, self-efficacy, task value, goal orientation and attribution; and they assert that self-motivation beliefs including task interest and perception of ability must be closely evaluated (Ames, 1992; Zimmerman, 2000). Reciprocal-effects modeling with longitudinal data indicate that math-ability beliefs predict later standardized-test performance much more strongly than test scores predict competence beliefs (Marsh, Craven, & Debus, 1999; Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005).

Individuals' perceptions of ability (competence) and their willingness to engage in academic activities or tasks are two crucial and complementary aspects of academic motivation. The two aspects are related to various academic outcomes such as persistence, dropout, engagement and achievement (Bandura, 1997; Nicholls, 1990; Skaalvik & Rankin, 1995; Wigfield, 1994). Different researchers have given different labels to this kind of perception, but "all are concerned primarily with students' perceptions of how well they do in academic subjects and of their likelihood for future success in those subjects." (Randel, Stevenson, & Witruk, 2000, p. 190). For example, self-efficacy was used by Bandura (1997), perception of competence by Harter (1981), and perceptions for success by Eccles and her associates (e.g., Eccles & Wigfield, 2002; Wigfield & Eccles, 2000).

Both perceived ability and self-efficacy target perceived capabilities, hence, are considered to be similar (Cleary, 2009). However, they differ in that students use normative and self-evaluative criteria in the former, while they use only self-evaluative criteria in the latter. Within the context of an expectancy-value framework, Eklöf (2006) indicates that "the expectancy component in the model can be operationalized in terms of the individual's general ability beliefs as well as his or her self-efficacy beliefs" (p. 644). Cleary (2009) indicates that perceived ability is isomorphic to self-concept beliefs. The results of Eklöf support the argument of Wigfield and Eccles (2000) that self-efficacy and ability beliefs are theoretically distinguishable but are hard to empirically distinguish. It seems that the relationships between self-perceived ability and achievement and between self-efficacy and achievement depend on how each of the constructs is operationalized and measured and probably on other factors such as culture, gender, grade level, etc. Therefore, we don't make the distinction here between the two constructs but only treat perceived ability within the self-concept theory. Also, although important, we don't distinguish between competency and affect components but deal with academic self-concept as a global construct despite the fact that the self-concept construct contains competency and affect items.

Gender and Achievement

For researchers in the West, ethnicity and gender have been assumed to be among the most influential factors that explain individual differences in achievement (Cooper, Valentine, Nye, & Lindsay, 1999). Western researchers in the sixties and seventies looked for explanations to gender differences in mathematics (Maccoby & Jacklin, 1974). At that time boys outperformed girls in these subjects. Of all of the gender differences in cognitive abilities, differences in quantitative abilities have received the most attention in research (Abu-Hilal, 2000; Dhindsa & Chung, 2003; Hyde, Fennema, Ryan, et al., 1990; Randhawa & Gupta, 2000) and media (Halpern et al., 2007). Some attributed the differences to genetic factors while others pointed to social factors such as the fear of success hypothesis (Fennema & Sherman, 1978). Others (e.g., Halpern et al., 2007 for review) employed spatial ability to explain gender differences in quantitative abilities. Halpern et al. indicated that male advantage occurs when mathematical concepts require more reasoning and are more spatial in nature which happens frequently in secondary school. Also, they explained that males' performance is more variable than that of females in quantitative and visual and spatial abilities. As such, the average difference in performance between females and males for most assessments is smaller in the middle than it is at the high- and low-ability tails of the distribution. Fennema and Peterson (1985) attributed the gender differences in mathematics performance to independent learning experiences. They believe that self-beliefs about oneself and mathematics as well as feedback from significant other (e.g., teacher, parents and peers) determine the learning experiences a student has in school. It should be noted, however, that selection of learning experiences is not available to students in the preparatory school.

Recently, a new variable has been introduced to the issue of gender differences in achievement. The new variable is the type of schooling: single-sex vs. coeducation (Dhindsa & Chung, 2003; Halpern et al., 2007). Marsh et al. (in press) found that gender is significantly related to cognitive (achievement) and affect variables (self-concept and subject value) differently between Arab (single sex setting) and Anglo-Saxon (coeducational setting). Despite the attention this issue has received among researchers, the gap between boys' and girls' performances in mathematics has narrowed significantly. From the last decade of the 20th century onwards researchers have reported small or no gender differences in mathematics performance (Hyde, Fennema, & Lamons, 1990). Hedges and Nowell (1995) meta-analyzed studies and concluded that "average sex differences in most measured abilities are small, with the possible exception of science, writing, and stereotypical vocational aptitudes" (p. 45).

Researched gender differences have not been confined to cognitive abilities, but included other variables like attitudes, self-concept, task value and motivation (Abu-Hilal & Aal-Hussain, 1997; Dhindsa & Chung, 2003; Frenzel, Pekrun, & Goetz, 2007; Hyde, Fennema, & Lamons, 1990; Lee & Bryk, 1986). In their meta-analyses, Hyde, Fennema, and Lamons (1990) indicated that gender differences in mathematics attitudes are small, but cautioned that this should not be taken to mean that attitudes have no influence on gender differences in mathematics performance.

As the educational system in the United Arab Emirates is single-sex, it is interesting to explore: how boys and girls fare in mathematics achievements, self-concepts, perceived effort and perceived parental help; and if the relationships among these variables are affected by gender.

The Present Study

The purpose of this study was to test the predictive power of IQ, parental help, perceived effort and self-concept in mathematics achievement. Particularly, we wanted to know if IQ had an effect on perceived parental help, perceived effort, self-concept and achievement. Also, we wanted to examine if IQ had any direct or indirect influence on achievement via parental help, perceived effort and self-concept. Furthermore, we wanted to investigate the predictive power of perceived parental help, perceived effort and math self-concept in explaining variance in mathematics achievement.

According to some researchers, these variables reflect a pattern of cognition and affect which is more favorable for boys in terms of learning and practicing mathematics (Frenzel, Pekrun, & Goetz, 2007; Hyde, Fennema, Ryan, Frost, & Hopp, 1990; Randhawa & Gupta, 2000). Hence the relationships among the aforementioned variables will be tested across gender. Thus, we proposed a model (see Figure 1) that discerns these relationships.

Method

Sample

The sample for this study consisted of N = 352 [boys N = 219 (62.2%) and girls N = 133 (37.8%)] preparatory school students from Al-Ain school district in the United Arab Emirates. The average age of the students was 14.08 and the standard deviations was .81. They represent classes 6 (N = 37), 7 (N = 92, 8 (N = 86), 9 (N = 77), 10 (N = 60). The data is part of a larger study. However, the variables included in this study were measured among 574 of which 222 cases had incomplete data. Many of those missing cases did not take the IQ test. Hence, the analyses in this study were performed on cases with complete data.

Data and Variables

Intelligence (IQ). Intelligence was measured by the Test of Non Verbal Intelligence (TONI). The test is made of 50 pictures with one missing part in each picture. The TONI scores range between 0 and 50. Each student was individually asked to choose one of six alternatives located below the picture. The test administrator directly registered the student responses on the answer sheet. The test measures students' abilities to identify similarities, contrasts, relations, omissions, classifications, and fine observations. Reliability as estimated by Cronbach's alpha was 0.90 (Abu-Hilal, 2001). Factor analysis of the responses produced one factor which justified the derivation of a single score for IQ. The loadings on the factor ranged between .31 and .70.

Parental Help (PH). Four items – as part of a questionnaire designed to collect data about various variables related students' academic life such as parents' help, effort, subject importance, etc. – were used to measure perceived parental involvement. The verbatim items were "To what extent does your father/mother follow up you progress in school?" and "To what extent does your father/mother discuss with you or help you in your homework?" Coefficient alpha was computed for the present sample (α = .75). Responses were rated on a 5-point scale ranging from not at all (1) to always (5).

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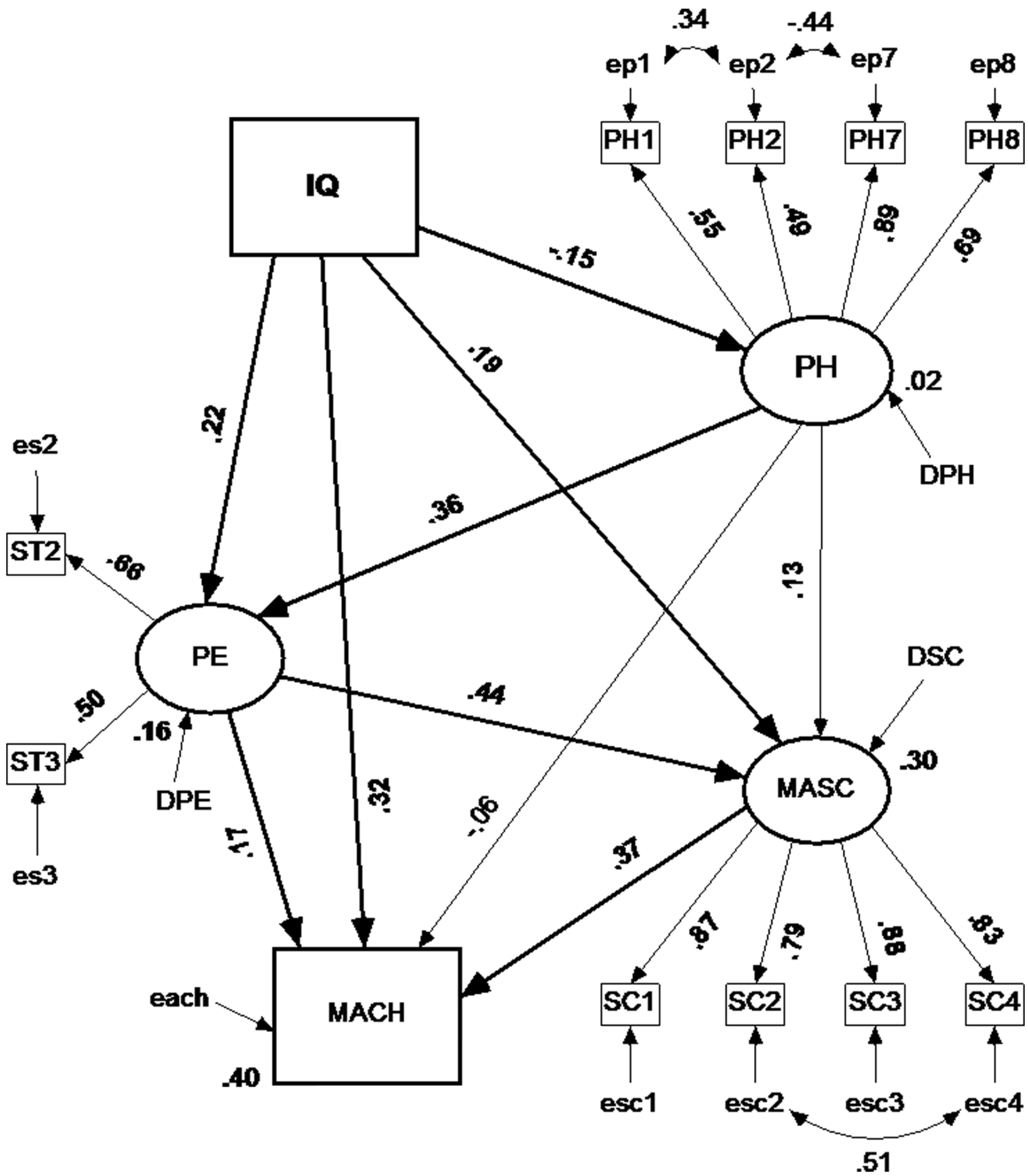

Figure 1. Structural model of simultaneous gender analysis.

Note. Rectangles are observed variables, ovals are latent. IQ: intelligence; PH: perceived parental help; PE: perceived effort; MASC: math self-concept; MACH: math achievement; e: error; D: disturbance. $p < .05$ for thick arrows, thin is not significant. All factor loadings are significant, $p < .001$.

Perceived Effort (PE). Effort was defined as the amount of time spent on studying. The construct was part of the abovementioned questionnaire and measured by two items which evaluated students' perceived effort in usual times and during examinations. Responses to these questions were rated on a 6-point scale ranging from no time at all (1) to more than three hours a day (6) (α = .47).

Self-Concept in Mathematics (MASC). Mathematics self-concept was defined as general feelings of doing well or poorly in mathematics. This construct was measured by 8-item scale (α = .94 adapted from the Self-Description

Questionnaire-I (Marsh, 1988). Factor analysis produced one factor for the eight items. Four indicators (parcels) were computed by summing two items for an indicator.

Mathematics Achievement (MACH). For the purpose of the present study, mathematics grades were obtained from the official school records. Those grades are aggregate scores of assignments, quizzes, and exams at the end of the academic year. The maximum score is 100 and the lowest is zero.

Structural Model and Data Analysis

With the use of structural equation modeling (SEM), several models were developed: the measurement models and the structural models. The structural models are very effective in data analysis since they are capable of analyzing regression equations concurrently. As such many variables can be used as independent variables and dependent variables at the same time. The model in this study encompasses three parts. The first part is made of one exogenous observed variable (IQ). The second part is made of three endogenous latent constructs that were assumed to be influenced by IQ. Perceived parental help was assumed to be influenced by IQ and at the same time to influence perceived effort, math self-concept and math achievement. Perceived effort was assumed to have influence on math self-concept and achievement. Math self-concept was assumed to influence math achievement. Each of the three latent constructs was hypothesized to have effects on the observed variables that measure the construct. This model was tested by the SEM with AMOS 16. The specifications just outlined are depicted in Figure 1.

Results

Descriptive Statistics

Table 1 presents the zero correlations, means and standard deviations of the study variables. Indicators of the mathematics SC were all significantly positively correlated. Also, the parental help indicators were significantly positively correlated. Intelligence was moderately correlated with mathematics achievement (r = .34 for girls and .49 for boys) but weakly correlated with all other variables. Mathematics achievement correlated with most of the variables positively and significantly except with two of the parental help indicators (parhelp7 and parhelp8).

Factorial Structure of the Scales

Before testing the invariance of the hypothesized model across gender, we examined the pattern of relations among constructs separately for each gender. The maximum likelihood method was used to analyze the data. Because the χ^2 statistic is widely known to be sensitive to sample size, we also evaluated model fit using the comparative fit index (CFI) and the root mean square error of approximation (RMSEA) that have been recognized to be least affected by sample size (Dimitrov, 2010). According to Hu and Bentler (1999), a good model fit is indicated by CFI values close to or above .95, and when the RMSEA value is ideally below .10.

We tested the full model with observed and latent constructs all in one model (as explained earlier and as shown in Figure 1) for boys and girls separately. Examination of the hypothesized model showed a poor fit: χ^2 (46) = 146.82, p < .001; CFI = .905; RMSEA = .100, for boys; and χ^2 (46) = 119.90, p. < .001; CFI = .898; RMSEA = .110, for girls. Inspection of the modification indices suggested that allowing the residual terms of some observed variables to correlate would improve the fit of model significantly for both boys and girls. The fit indices are as shown in Table 2. The fit indices improved significantly whereas the χ^2 statistics dropped from 146.82 to 82.36 ($\Delta\chi^2$ (3) = 64.46, p < .01). Also, the CFI indices jumped from .905 to .963 for boys, and from .898 to .965 for girls.

Table 1

Zero Correlations, Means, and Standard Deviation of the Observed Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	*M*	*SD*
1. IQ	----	.09	.17	.49	.22	.13	.31	.16	-.05	.01	-.24	-.16	26.87	6.95
2. PE1	.07	----	.37	.21	.33	.31	.29	.41	.21	.09	.21	.21	5.04	1.25
3. PE2	-.03	.22	----	.26	.20	.20	.19	.18	.24	.16	.21	.16	5.66	.84
4. MACH	.34	.30	.15	----	.51	.37	.47	.37	.09	.18	-.07	.01	69.48	22.15
5. MSC1	.17	.30	.16	.48	----	.74	.83	.73	.22	.21	.18	.19	7.31	1.67
6. MSC2	.05	.27	.19	.34	.69	----	.75	.83	.30	.25	.20	.14	7.54	1.47
7. MSC3	.25	.26	.21	.51	.72	.64	----	.78	.22	.18	.11	.14	7.48	1.56
8. MSC4	.11	.33	.19	.36	.37	.76	.73	----	.28	.26	.18	.12	7.37	1.37
9. PH1	.11	.21	.13	.17	.17	.26	.26	.16	----	.56	.56	.41	3.95	1.13
10. PH2	.18	.04	.03	.20	.16	.20	.28	.14	.55	----	.33	.42	3.61	1.50
11. PH7	-.06	.13	.04	.08	.08	.19	.13	.18	.46	.26	----	.62	3.17	1.42
12. PH8	.00	.13	.07	.07	.15	.24	.21	.30	.30	.29	.61	----	3.07	1.46
M	26.05	4.62	5.52	72.62	7.13	7.59	7.45	7.43	3.75	3.79	3.21	3.20		
SD	9.29	1.38	1.02	18.77	2.23	2.30	2.25	2.47	1.40	1.31	1.53	1.49		

Note. Boys' Statistics above Diagonal, Girls' Statistics below Diagonal. PE: perceived effort; MACH: math achievement; MSC: math self-concept; PH: perceived parents' help.

r > .14 (for boys) and > .17 (for girls) is significant at p < .05.

Table 2

Fit Indices of The Basic Model for Each Gender

Model/Gender	χ^2	DF	P	CFI	RMSEA
Basic Model/Boys	146.82	46	.000	.905	.100
Basic Model/Girls	119.90	46	.000	.898	.110
Basic + 3 error correlations were allowed/ Boys	82.36	43	.000	.963	.065
Basic + 3 error correlations allowed/ Girls	68.46	43	.000	.965	.067

The Hypothesized Model With Gender Invariance

The next part of the analysis was to discern the extent to which the hypothesized revised model was invariant across gender. A series of progressive steps outlined by Bentler (1995) were followed. Table 3 presents the fit indices for the nested models. As can be seen in Table 3 the goodness-of-fit indices of the model constraining loadings to be equal across gender (model 2: χ^2 (94) = 145.73, p < .001; CFI = .971; RMSEA = .040) are close to those of the unconstrained (model 1: χ^2 (140) = 134.45, p < .000; CFI = .972; RMSEA = .041). Even the most restricted model (model 8) revealed an acceptable fit with CFI = .946 and RMSEA = .046. Therefore, the hypothesis that factor loadings, covariances, structural weights and disturbances, measurement residuals are invariant across gender is tenable.

Figure 1 shows the path coefficients, loadings and correlations among residuals. The correlation between the residuals (est2) and (esc4) is not shown in the model in order to keep model simple and readable. The correlations among residuals ranged from -.44 to .51. Significant correlations between residuals indicate that the variables or constructs have common variance that is unaccounted for in the model.

Direct Effects. As can be seen in Figure 1 and Table 4, intelligence (IQ) had direct positive effects on all endogenous constructs except for perceived parental help. The path coefficient linking intelligence to perceived

Table 3

Fit Indices of Invariance Across Gender

Model	χ^2	DF	P	χ^2/DF	CFI	RMSEA
1. Unconstrained	150.858	86	.000	1.754	.964	.046
2. Measurement weights	161.299	96	.000	1.680	.963	.044
3. Measurement intercepts	178.897	107	.000	1.672	.960	.044
4. Structural weights	194.533	114	.000	1.706	.955	.045
5. Structural means	195.415	115	.000	1.699	.955	.045
6. Structural covariances	208.491	116	.000	1.797	.948	.048
7. Structural residuals	210.674	119	.000	1.770	.949	.047
8. Measurement residuals	239.871	130	.000	1.845	.938	.049
Independence model	1913.520	132	.000	14.496	.000	

Note. CFI: Comparative fit index; RMSEA: Root mean square error of approximation.

parents' help is barely significant (β = -.15, $p < .05$). Consistent with previous research (Jensen, 1980) the largest coefficient was the one connecting intelligence and mathematics scores (β = .32, $p < .01$). Intelligence had a significant positive effect on perceived effort (β = .22, $p < .01$). Also, more intelligent students had more positive self-concepts (β = .188, $p < .01$). As for perceived parental help, students who thought they received more parental help, expressed more perceived effort (β = .362, $p < .01$) and had more positive – though not significant– self-concepts (β = .129, $p > .05$). However, there was no effect for perceived parental help on math achievement. Perceived parental help did not seem to help achievement directly but its effect on math achievement was rather indirect (mediated). Perceived effort had a significant direct effect on both math self-concept (β = .44, $p < .01$) and math achievement (β = .17, $p < .05$). That is, the more the exerted effort the more positive is the self-concept and the higher the achievement in mathematics. Finally, math self-concept had a positive direct effect on math achievement (β = .369, $p < .01$).

Indirect Effects. Intelligence had positive indirect effect on math achievement (β = .127) but small indirect effect on math self-concept (β = .055). Parental help had substantial indirect effect on both math self-concept (β = .159) and math achievement (β = .168). Finally, perceived effort had a significant indirect effect on math achievement (β = .162).

The explained variance in perceived parents' help was very small (2%) indicating that most of the variance is error variance. The model explained about 16% of the variance in perceived effort, 30% of the variance in math self-concept and 40% of the variance in math achievement.

Discussion

The present study produced interesting results that have theoretical and practical implications. The overall results of this study show that the measurement part as well as the structural part of the structural equation model was created successfully and they were invariant across gender. With invariance in the intercepts, one can make a comparison of construct means across populations (e.g., sex, nationality). Also, as the measurement residuals are invariant, it is possible to compare manifest variables across groups such as gender.

As for the relation between intelligence and perceived parents' help, students who had high IQ scores indicated that they didn't have much parental help, while those with low IQ scores indicated more parental help. This is

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Table 4

Direct, Indirect and Total Effects of Variables on Math Achievement

	IQ	Parents' help	Perceived effort	Math self-concept
Direct effect				
Parents' help	-.149			
Perceived effort	.222	.362		
Math self-concept	.188	.129	.440	
Math achievement	.324	-.058	.170	.369
Indirect effect				
Parents' help				
Perceived effort	-.054			
Math self-concept	.055	.159		
Math achievement	.127	.168	.162	
Total Effect				
Parents' help	-.149			
Perceived effort	.168	.362		
Math self-concept	.243	.288	.440	
Math achievement	.451	.110	.333	.369

probably because intelligent students were more confident of their intellectual abilities, and believed they didn't need the help in the first place. However, students with high IQ scores indicated more exerted efforts both regularly and during exams. Also, students with high IQ scores had high math scores and more positive math self-concept. More positive math self-concept was associated with high math scores. This result is consistent with previous research that self-concept has a positive effect on achievement in the same subject (e.g., Abu-Hilal, 2005; Abu-Hilal, Abdelfattah, Shumrani, Abduljabbar, & Marsh, in review; Papanastasiou & Zembylas, 2004; Randel et al., 2000; Randhawa & Gupta, 2000). Using logistic regression, for example, Ismail (2009) found significant effects for self-efficacy and mathematics value on mathematics achievement among Malysian students. Randel et al. (2000) reported a significant effect for self-rating of ability on mathematics achievement for German and Japanese students. Similarly, Randhawa and Gupta (2000) reported a significant and positive effect for mathematics self-efficacy on mathematics achievement for Canadian and Indian students. Our results and those of previous research imply that, in order for teachers to improve achievement in mathematics, they should work on students' self-perception of ability both cognitively and affectively. Also, the more the students expended effort, the more positive their self-concept and consequently the better their achievement was.

Although perceived parents' help did not have an impact on achievement, it seemed to have improved students perception of effort and self-concept that both mediated the effect of parents' help and math achievement. The implications of these results are that apart from intelligence, parental help did contribute significantly to improving other motivational constructs such as effort and self-concept. Although it did not directly and positively influence achievement, perceived parental help was crucial in encouraging students to perceive themselves as exerting more effort and boosting their self-concepts that in turn positively influenced achievement. Therefore, any intervention programs should include parental involvement as a basic component in bolstering academic achievement, especially for difficult subjects like mathematics. Citing Henderson and Berla (1994), Gonzalez-DeHass, Willems, and Holbein (2005) stated that "efforts to improve student outcomes are more effective when the family is actively involved." (p. 100). In support of our results, Gonzalez-DeHass et al. reported that several studies assert that parental involvement was positively related to time spent on homework.

Self-enhancement is another important component in any achievement behavior model. Self-enhancement can be achieved by encouraging students to exert more effort and spend more time on schoolwork. Exerted effort proved to be instrumental to both self-enhancement and achievement. After controlling for parental help and intelligence, perceived effort had substantial effect on achievement both directly and indirectly.

Gender differences are a particularly interesting aspect of the present investigation especially considering that, in most Arab countries, schools are gender-segregated. As presented in Table 1, girls outscored boys in mathematics but both genders expressed an equally positive self-concept. The relationship between math achievement and the other variables is further complicated in the Arab countries, due to educational settings being single-sex (see also Lee & Bryk, 1986), so that the frames of reference are specific to each gender (i.e., boys have little opportunity to compare their performances with girls, or vice versa). Abu-Hilal's (2001) and Abu-Hilal and Bahri's (2000) research suggests that the socialization process in the school and family leads Arab students—particularly boys—to be less critical of themselves, so that they have higher self-concepts than might be expected from their objective achievements. Also, the Arab society has changed – somewhat– its attitude towards females taking on jobs that have been considered 'male jobs', therefore gender-role socialization can be used to explain gender differences in math achievement that favor girls. Girls no longer have low expectations for success in mathematics. Arab parents still favor boys over girls; however, success rates and high achievement among girls have changed parents' attitudes towards girls' education. This in turn bolsters girls' self-concept, though more realistically than boys (Abu-Hilal, 2001).

The present study is not without limitations, however. Future research should include more sources of information about parental help such as reports from parents. Also, parents may provide more reliable data about their children's school efforts. Future research may include other subjects like language, science and social studies to test hypotheses about the effects of parental help, effort and self-concept on academic achievement. Experimental designs may be utilized by future researchers to establish actual cause and effect relations between achievement and other constructs such as parental help, effort and self-concept.

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