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James R. Campbell, Kirsi Tirri, & Seokhee Cho

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Guest Editorial

James R. Campbell[1], Kirsi Tirri[2] and Seokhee Cho[1]

Academic competitions in STEM (Science, Technology, Engineering, and Math) fields have been used in the United States and across the world as a tool to identify the most creative and talented students. This process takes place outside the curriculum that is mandated by the schools. Many teachers recognize the extraordinary talents of their gifted students and use competitions to foster their development. This theme issue presents information about a set of prestigious high school competitions – the international academic Olympiads. The articles included provide a cross-cultural lens in examining the long-term outcomes of being identified as a national academic Olympian.

Did these highly talented individuals live up to their potential? How did the Olympiad programs influence the career trajectory of their participants? What factors helped or hindered the development of the extraordinary talent of the Olympians? The International Academic Olympiad study teams have accumulated empirical evidence to answer these questions within cross-cultural contexts.

The Olympiad research teams started collecting data in 1994 and presented their first set of findings in 1995 at AERA. These Olympic competitions started in the former Soviet Union in 1934 as a way to find the technical talent that was needed. In the intervening years these competitions have spread around the world in much the same way that the sports Olympics have expanded over the years.

These competitions use a series of demanding tests to identify the most advanced high school students in the STEM fields. The United States was late in sponsoring its first Olympiad competition (Math) in 1972 and did not start the Chemistry Olympiad until 1984, and the Physics Olympiad in 1987.

The Olympiad investigations are retrospective studies that track down former national winners over decades to find how these individuals turned out. We have research teams in Scandinavia, Europe, Asia and the United States. These research teams have constructed their own instruments and conduct parallel studies that use the same methods and procedures.

We have collected data in three waves (1995, 1998, 2006) and have been able to get responses from 725 academic Olympians and their families. We have data from 229 American, 235 German, 165 Finnish, 71 Chinese, and 25 Korean Olympians.

This theme issue will include two articles from the American team, one article from the Finnish team, and two articles from the Korean team. In the articles that follow some of the authors have supplemented their Olympiad data with data from related samples within their country.

The first cross-cultural article examined the family life of 576 parents of the academic Olympians from the United States, Germany, and Finland. We examined the factors that contribute to the adult productivity of these gifted individuals. We found that socio-economic status is a substantial predictor of many of the parental variables we studied. The family dynamics that consist of positive and negative sets of parental factors unearthed a number of significant combinations. One set deals with the press for literacy and its correlations with parental support and expectations. The other set centers around pressure, help, and supervision. Overall, we uncovered distinctive roles for these Olympian mothers and fathers.

[1] *St. John's University, New York, USA*
[2] *University of Helsinki, Finland*

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The second cross-cultural article summarizes the perceptions of 2,908 parents from the United States, Taiwan, Germany, and Cyprus. We examine the family dynamics within these families, and we investigate the roles mothers and fathers play. Our findings show that for the international samples, pressure was a negative predictor for math achievement; whereas, for the American samples pressure was a positive predictor on achievement. The extent of help provided to children is not related to their ability. Only the right kind of help was found to be a predictor for achievement. We also find that fathers have distinctive roles to play.

The third article investigates ethical thinking skills of mathematically highly gifted Finnish young adults ($n = 13$) and their relation to general intelligence and moral reasoning. Results showed that mathematically gifted young adults who had highest scores in general intelligence reported higher ability to tolerate different ethical views, take other persons' position when facing a conflict situation and recognise new, right at the moment important ethical problems than their lower achieving peers. Further, individual differences in general intelligence did not differentiate one's ability to express different feelings to other people, take care of the other peoples' well being, control own prejudices when making ethical evaluations and create alternative ways to act when facing ethical problems in everyday life. Results further showed that mathematically gifted young adults who scored highest and lowest in moral reasoning were more neglective about their interpersonal relationships than those with mid scale scores. Further, highest order ethical sensitivity was positively related to moral reasoning.

The fourth article examines predictive relationships of the personal characteristics (intrinsic and extrinsic motivation, confidence in intelligence, incremental belief about intelligence, giftedness) and environmental characteristics (family involvement) with the development of leadership with 25 Olympians, 633 scientifically talented future Olympians and 628 general education students in grades 4 to 12 in Korea. It was found that Olympians showed the highest leadership competencies among all the scientifically talented individuals implying that it is a developmental trait acquired through experiences. Best predictors were confidence in intelligence for Olympians, family process for future Olympians and general education students. Significant predictors changed as students get older from family processes, intrinsic motivation to self-confidence in intelligence.

James R. Campbell

Kirsi Tirri

Seokhee Cho

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Comparing Parental Involvement for International Academic Olympians from Europe, Scandinavia, and America

James R. Campbell[1*], Mary E. Freeley[1] and Sharon A. O'Connor-Petruso[2]

Abstract: This cross-cultural article examines the family life of 576 parents of the academic Olympians from the United States, Germany, and Finland. We examined the factors that contribute to the adult productivity of these gifted individuals. We found that socio-economic status is a substantial predictor of many of the parental variables we studied. The family dynamics that consist of positive and negative sets of parental factors unearthed a number of significant combinations. One set deals with the press for literacy and its correlations with parental support and expectations. The other set centers around pressure, help, and supervision. Overall, we uncovered distinctive roles for these Olympian mothers and fathers that have directly or indirectly affected their children's scholarly productivity.

Keywords:
cross-cultural, gifted, competitions, international studies, adult productivity

This article compares perceptions of 576 parents of the academic Olympians from America, Germany and Finland with regard to their influence on their children's intellectual and academic development and scholarly productivity down the road. It is a cross-cultural study where the focus is on families with exceptionally gifted children (academic Olympians) and the factors that influence the development of their talents. In a previous publication Campbell and Verna (2004) compared the national samples of Olympian parents in terms of a number of constructs, but instead of doing similar comparisons in this article, we decided to keep the cross-cultural sample together so that readers across a number of cultures could search for possible connections to the factors that are instrumental to developing talent.

The samples include 280 American parents (107 fathers, 173 mothers), 150 German parents (53 fathers, 97 mothers), and 146 Finnish parents (65 fathers, 81 mothers). The academic Olympians are a select group of high school students who participate in a demanding series of subject matter tests to emerge as the top 20 students in their country in that domain. Once identified, the Olympians attend a national training camp where the top five or six students are selected to compete in the international Olympiad competition that is held in different countries, much like the sports Olympics. Winners win gold, silver, and bronze medals by competing against other students from around the word.

The academic Olympiads have been annual competitions in the United States for math since 1972 and for chemistry and physics since the 1980s. The German and Finland Olympiad programs were in operation for decades before the Americans joined. Campbell and his international colleagues have undertaken the Olympiad studies to isolate the factors that helped or hindered the development of the talents of these Olympians. In order to accomplish this goal, the research staffs in each country had to locate the national and international participants, many who competed decades ago. This process was especially difficult because of the mobility of these talented individuals. Some attended colleges/universities in different countries, and their career paths varied

[1] *St. John's University, Jamaica, USA*
[*] *Corresponding author: St. John's University, 517 Sullivan Hall, Jamaica, NY 11439 USA. Email: Campbelj@stjohns.edu*
[2] *Brooklyn College of the City of New York, USA*

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greatly. Over the years, the international research teams isolated 345 American Olympians, 235 German Olympians, and 157 Finnish Olympians. The Olympians and their parents completed the same set of surveys and instruments, and subsequent analyses and methods were consistent across countries (Campbell, 1996).

As of 2006 the American Olympians produced 8,629 publications and can be expected to continue publishing as their careers mature (Campbell & Walberg, 2011). The Olympiad studies collected many measures of productivity however, we followed Terman's (1954) lead by selecting the total publications the Olympians produced over their lifetime. Publishing is in essence a measure of leadership. This article examines the factors that contributed to the adult productivity of the Olympians, namely, the number of publications produced.

Theoretical Framework

This study examines the viability of using the Munich Dynamic Ability-Achievement Model (MDM) as an organizing schema and as a source for generating research questions. This model was initially developed to explain the developmental trajectory of the gifted and talented individuals. The first iterations of the MDM reached the research community in publications and papers from 1985–1994. The model lays out a child's initial signs of talents, predispositions, and abilities on the left side of the model, and the endpoints where contributions are made to society (exceptional achievements) are positioned on the far right side (see figure 1).

The middle section contains one set of moderator variables *(personality characteristics)* that interact with the emerging talents, and another set of environmental variables that nurture its development. The triangle in between these moderators represents the active learning process. At the beginning (apex of the triangle) the individual starts to work at developing his talent. As time accumulates more and more of the triangle is occupied as expertise is gained. Ericsson (2010) refers to this as *deliberate practice.* At some point the whole triangle is filled in, and the talent reaches the point when contributions are possible.

The current version of the MDM adds more developmental triangles. As with the earlier version the abilities at the far left side are the starting point. The talent development process occurs in the middle sections where a series of triangles interact. One set concerns the *building of a knowledge base;* another one *builds competencies:* and a larger triangle concerns the *deliberate practice* needed to become an expert. Below these developmental triangles are more specialized triangles including one labeled *professions*.

Campbell and Kyriakides (2011) suggest that the academic Olympians while still in high school engage the *early career triangle*. Their early acquisition of specialized subject matter knowledge and skills in a technical domain occurs for most students while attending colleges/universities as they major in the domain subject or in graduate school as they pursue a technical career. However, our follow-up studies with the Olympians indicate that when they get to college their advanced knowledge enables them to join ongoing research projects. Consequently, the academic Olympians have a head start over their peers as they enter college and graduate school. Does this head start pay off in greater productivity as these individuals pursue their technical careers?

This study uses different sections of the model to investigate the factors that contribute to talent development and career productivity. We include variables that represent different moderator variables beginning with the environments that were provided as the Olympians developed their talents. The Model's *Environmental Characteristics* contain a number of examples of environmental variables that influence development. The first one listed is *Company Climate,* and we believe that it can be subdivided into age-specific climates such as the *Academic Home Climate,* the *Classroom/School Climate,* and the *Workplace Climate.* Our studies have data on the family atmosphere, especially on the

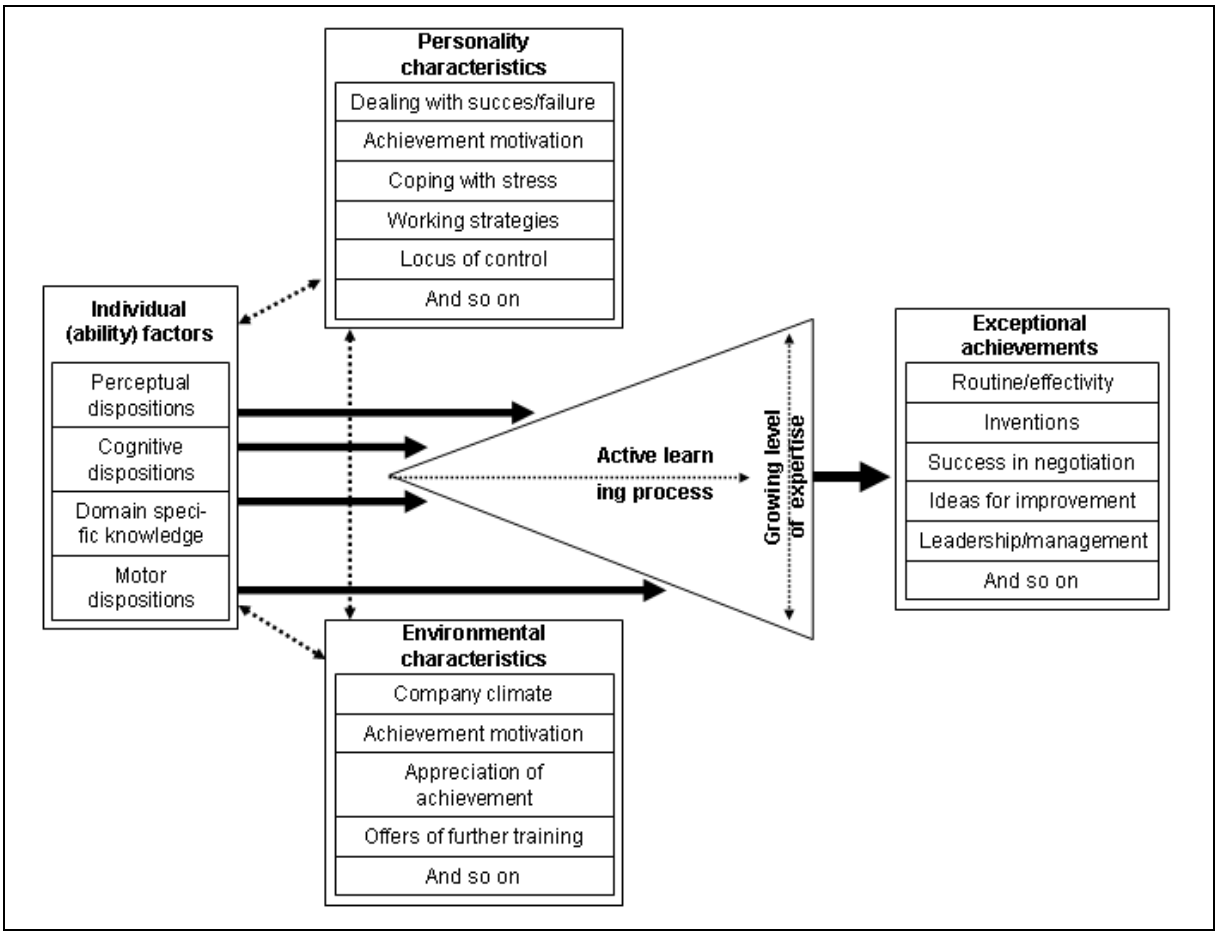

Figure 1. The munich process model of giftedness by Heller and Perleth (2004).

family climate, during the years before school and then during the school years that extend to high school. We administered a survey to both the Olympians and their parents that contains a section about academic climate in the Olympians' home and another section about difficulties at school.

Using items from the section of the survey dealing with the home learning climate, we isolated a factor that is labeled *Conducive Home Atmosphere.* Some of the items that make up this factor include parent's recognition of their child's talent and their encouragement to develop it. This factor was validated and utilized together with a number of other variables in two studies of the most and least productive Olympians (one international Olympian study, and one study of the American Olympians). In both studies the most significant variable accounting for the career productivity of Olympians is the *Conducive Home Atmosphere* in the Olympians' homes. This factor was found to contribute, directly or indirectly, to the career productivity of the Olympians even for 40 or 50 year-old adults (Campbell & Feng, 2011; Nokelainen, Tirri, Campbell, & Walberg, 2007).

The qualitative data from our studies show that the home atmosphere also provides *recognition of achievement* (another moderator) and the *opportunity for students to continue* (still another moderator) their preparation and intense study for the Olympiad tests.

Questions

1. Does the *Conducive Home Atmosphere* continue to have any significant relationship with the adult productivity?
2. How do the interconnections of the positive and negative combinations of factors affect the adult Olympian's publications output?
3. What factors make up the academic home climate for the Olympians?

4. How do the family dynamics of parental factors operate within this climate?
5. How do the interconnections of positive and negative combinations of factors affect the adult Olympian's publications output?
6. What school-age parental factors (moderators) account for the adult productivity of the academic Olympians (endpoints)?
7. How do the perceptions of mothers' and fathers' parental factors differ in terms of long-term productivity?

Methods

Data Sources and Samples

In a previous study of the parents of the Olympians, Campbell and Verna (2004) found that merged data from mothers and fathers caused problems. To solve this difficulty they analyzed mothers' and fathers' data separately.

The mother's sample consists of data from 173 American, 97 German, and 81 Finnish mothers. The fathers sample is made up of 107 American, 53 German, and 65 Finnish fathers. In the American and Finnish national studies, requests were made for responses from either one or both parents, whereas in the German study only one parent contributed data; therefore, 79 American Olympians have mothers' and fathers' data, and 29 Finnish Olympians have data from both parents. When we analyzed data from the mothers and fathers of the same Olympian there were important differences. It is for these reasons that the reader should view each sample as having its own distinctive perspective.

Descriptive Statistics

In terms of subject domains, the mothers' sample contains data from 138 math, 91 physics, 111 chemistry Olympians, and 5 Olympians that competed in two of these competitions. The fathers' sample included data from 74 math, 70 physics, and 81 chemistry Olympians.

The descriptive data for the samples are found in table 1. The average age of the Olympians in the mothers sample is 333 months (27.75 years old), with the oldest Olympian being 51 and the youngest being just 16 years of age. In the fathers' sample the average age is 339 months (28.25 years old), with the oldest at 46, and the youngest also at 16. Most of the Olympians in both samples grew up in two-parent families. In the mothers' sample 91% of the Olympians lived in two-parent homes, and in the fathers' sample the figure is 93%. The Organization for Economic Co-operation and Development (OECD) compiles national data on family structure, and their 2007 report had the rate of two-

Table 1. Demographics for Mothers and Fathers of Academic Olympians

Variable/Factor	Mothers (n = 351) *M* (*SD*)	Fathers (n = 225) *M* (*SD*)
Gender (male/female)	321/30	212/13
Family structure	1.91 (.29)	1.95 (.23)
Age	333.83 (79.67)	339.80 (78.71)
SES	75.69 (20.38)	73.02 (20.74)
Ability composite	54.60 (12.43)	53.94 (12.07)
Computer literacy composite	4.61 (1.77)	5.02 (1.77)
Total publications (Pub_Log)	.81 (.80)	.80 (.79)
Pressure	1.63 (.59)	1.47 (.64)
Support	3.87 (.57)	3.01 (.80)
Expectations	4.00 (.53)	4.37 (.64)
Supervision	2.21 (.89)	2.17 (.91)
Press for literacy	3.15 (.98)	3.67 (1.02)
TV	2.34 (1.03)	2.33 (1.14)
Conducive home atmosphere	3.08 (.95)	2.62 (1.03)

parent families in Finland at 95.2%, in Germany at 82%, and in the United States at 70.7% (Database, 2010). Consequently, the Olympian families are more stable than the general population in Germany and in the U.S.

Both samples contain many more males than females with 321 males and only 30 females in the mothers' sample, and 212 males and only 16 females in the fathers' sample. In terms of the families' SES, both samples are comparable in terms of status occupations. Miller (1991, p. 340) provides summary statistics for the occupational status for the Nam-Powers scale. He subdivides status occupations into 10 categories. The highest SES group is the professional class, and the next level lists occupations of managers, officials, and proprietors. These are the occupations of the average Olympian family. The lowest three levels are for laborers, and in each sample there are Olympians with at least one parent who is a laborer.

Instruments

Inventory of Parental Influence (IPI). The IPI is a cross-cultural instrument that has been developed to examine school-related parental activities that are hypothesized to potentially contribute to the child's academic achievement. The IPI has been translated into nine languages and has undergone two US copyrights. For more details consult the following publications (Campbell, 2010; Campbell, 1996). This study used the maternal and paternal versions of this instrument (Form G2). Part 1 contains 28 Likert statements with five response choices (strongly disagree to strongly agree); Part 2 has 26 statements and five response choices (never to always).

In each sample Principal Component Analyses (PCA) and Principal Axis Factoring (PFA) analyses were done to separate the Part 1 items into two factors (pressure, support). Additionally, we followed Chin's (1988) recommendation and took the support items and used them in another PCA where we isolated two factors (expectations, support). We followed the same approach for the pressure items to derive two more factors (pressure, dissatisfied). Accordingly, this process synthesizes additional factors at a higher level of abstraction. Chin calls this process molecular modeling. The Part 2 IPI items produce three factors; namely, a press for literacy factor, a supervision factor, and a TV factor.

Operational Definitions

Pressure. Pressure describes a demanding parent. For both parents the following statements depict such pressure: "I was very upset when my child did not make the top of the class," and "I didn't feel my child did his/her best in school." In order to get a high score the parents agree or strongly agree with these statements; but different items turned up in the mother's factor than in the father's factor. For example, the mother's pressure factor contains two additional items: "My child is afraid to go home with a poor grade." "I am only pleased when my child gets 100% on a test." For the father's pressure factor an additional item refers to the child as "basically lazy."

Psychological Support. For the support factor the Olympian's mother agrees or strongly agrees with these statements: "I have much patience with my child when it comes to his/her education." "I take a big interest in my child's schoolwork." "I am proud of my child." These items suggest a psychologically supportive atmosphere at home. The father's support factor includes different items such as "I was enthusiastic about my child's education." "I felt children need parental guidance..." "My child did well in school mostly because of my help." The reader can see the subtle difference from the mother's perception. Still both parents are supportive.

Expectations. The expectations factor has more agreement between mothers and fathers with both of them agreeing with such statements as: "I expected my child to go to college." "I got along well with my child." "My child missed school only when absolutely

necessary." The mother's factor also included agreement with the statement that, "My child is smarter than he/she thinks." Again, both the mothers' and the fathers' expectations factors are positive.

Press for Literacy. The press for literacy factor asked how often the parent encourages the child to read books, buy books as presents, or stress the value of the local library. Families with high scores on this factor underscore the development of literacy.

Supervision. The supervision factor for both parents contains statements that signify that parents supervise homework, keep track of the amount of time given to it, and expect it to be completed. Families with high scores in this area have distinct rules about homework and studying.

TV Factor. For both parents the TV factor includes statements pertaining to the fact that these parents established definite rules about the kinds of TV programs that their children watched. They restricted their children's TV viewing. The mothers' factor also includes the insistence that children watch "educational TV."

Olympiad Parent Survey. The Olympiad Survey completed by the parents contains 12 items pertaining to the atmosphere in the Olympian's home while the child was growing up.

Conducive Home Atmosphere. We used PCA and PAF analyses to derive this factor. The items contained in this factor have statements that recognize and encourage the development of the child's talents. Additional items include statements that both parents are avid readers and that there is an abundance of books and magazines available in their home.

Olympian Survey. Five additional endogenous variables are used.

1. **Ability Composite**. This variable is made up of a number of achievement measures (high school GPA, SAT scores, class rank, etc.).
2. **Computer Literacy**. This is another composite that is made up of the extent of the Olympians' knowledge and applications of computer hardware and software.
3. Olympians' Current Age (in Months)
4. **Adult Productivity.** The adult productivity of the Olympians is represented by the total number of publications produced. Due to the extreme skewing of publications where some Olympians produced hundreds of publications, while others produced almost nothing, we use a log transformation to normalize the publication data.
5. **Socio-Economic Status (SES*).*** The Nam-Powers scale (1983) was used to measure *Socio-Economic Status* (SES) (Nam & Boyd, 2004; Nam & Powers, 1983). This scale was derived from U.S. Census data. The scale scores range from 0–99. For all the samples included in this study we used the average of the parents' occupational status scores and the converted parents' education scores as a measure of SES.

Data Analysis

Path analysis has been the major analytical technique for deriving the scales and factors of the Olympiad studies. With more than 10 years of data from the Olympians and their families, we have data extending well into the careers of the Olympians. Consequently, we have developed measures of adult productivity that can be used as a dependent variable with the IPI factors, the academic home climate factor, and other variables as predictors. All of the analyses use SmartPLS 2.0, M3 a Partial Least Squares (PLS), and structural equation modeling (SEM) software tool (Ringle, Wende, & Will, 2005). The SmartPLS program assesses the psychometric properties of the *measurement model* by calculating PCAs of the indicators for each latent variable and then determining the reliability and validity of these constructs. The program then goes on to estimate the parameters of the *structural model* and determines path coefficients for each hypothesized connection and R^2 values for the endogenous variables. The general path model used in this study is illustrated in figure 2.

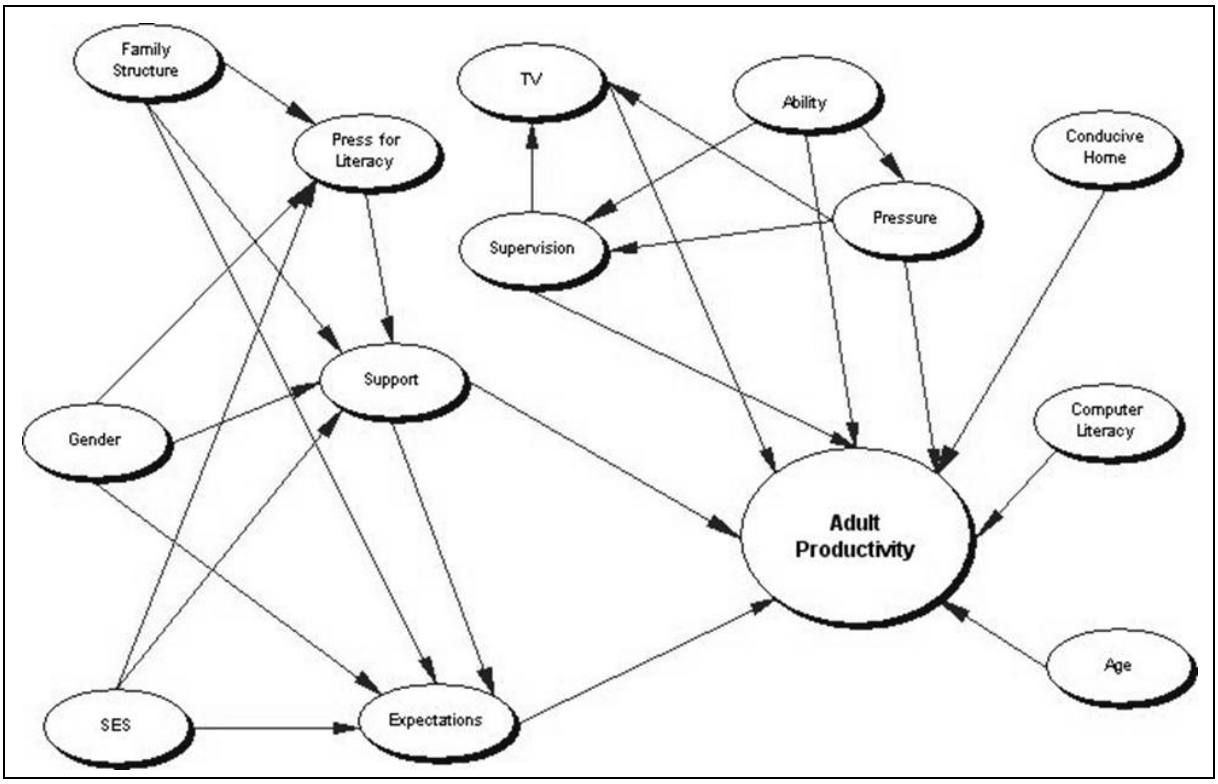

Figure 2. Path model showing the interconnections of the constructs analyzed with the parents of academic Olympians (reflective mode).

Measurement Model

Two measures of reliability are used in this study: Composite reliability, and the Average Variance Explained (AVE). The final factors have Composite reliabilities that range from .87–.95 for the mothers' factors, and for the fathers the range is from .76–.89. The AVE values range from .51–.79 (see table 2).

This study depends upon the validity of the latent variables, and therefore it is essential to demonstrate the viability of the measurement model. To illustrate the strength of the Principal Component Analyses data, the factor loadings and the cross-loadings of the indicators are shown in table 3 for the fathers' sample (the mothers' data are similar and are not included). These seven constructs are sharply focused with high factor loadings in a narrow range. All of the factor loadings are in the range between .6000 to .8000. We eliminated indicators with loadings in the .5000 to .4000 range to obtain better measures of reliability. The fact that the indicators load only on one construct contributes to their convergent validity.

Table 2. Measurement Model Statistics for the Constructs Used with the Parents of Academic Olympians

Factor	AVE		Composite reliability		Final # items	
	Mothers	Fathers	Mothers	Fathers	Mothers	Fathers
Pressure	.51	.53	.88	.76	7	3
Expectations	.79	.66	.95	.88	5	4
Support	.55	.51	.88	.80	6	4
Supervision	.58	.59	.91	.88	8	5
Press for literacy	.62	.68	.90	.89	6	4
TV	.69	.68	.87	.89	4	4
Conducive	.60	.53	.92	.87	7	6

Table 3. Factor Loadings (Bolded) and Cross-Loadings for the Items Making up the Constructs for the Fathers of the Academic Olympians Sample

	Conduc	Exp	Literacy	Pressure	Superv	Support	TV
FA10	0.729522	0.088719	0.097493	-0.047710	-0.005515	-0.022667	0.021253
FA11	0.874881	-0.163816	0.003666	0.107036	0.117973	0.076070	0.068173
FA12	0.896413	-0.112697	0.058801	-0.027548	0.041653	0.074502	0.010277
FA3	0.634070	-0.008825	0.082590	-0.181876	-0.025181	-0.032702	0.054059
FA6	0.640108	0.107834	0.179168	-0.008495	0.129799	0.122400	0.180952
H22	-0.084733	0.929808	0.601376	-0.061085	-0.066349	0.121559	0.069248
H25	-0.047031	0.929767	0.599770	-0.058060	-0.077890	0.083099	0.121545
H5	-0.078502	0.903605	0.501198	-0.158863	-0.182219	0.054109	0.053262
h13	-0.012706	-0.064016	-0.002168	0.740569	0.264606	0.245372	0.228999
h16	-0.043217	0.005421	0.224184	0.283557	0.443691	0.614211	0.264328
h19	-0.063086	-0.133795	0.004028	0.736095	0.248732	0.268574	0.105591
h20	0.090464	0.136786	0.473970	0.122254	0.543097	0.829887	0.426700
h24	0.061212	0.049004	0.348825	0.291835	0.532973	0.767382	0.469885
h26	0.080070	-0.028465	0.013945	0.734602	0.199854	0.212759	0.110681
h30	0.064127	-0.007726	0.469837	0.254239	0.772799	0.625281	0.481727
h33	0.018805	0.319285	0.755117	0.050378	0.397452	0.451434	0.321256
h34	0.102782	-0.305220	0.090240	0.145133	0.720784	0.398545	0.445300
h37	0.035084	-0.054491	0.289394	0.284020	0.823040	0.572550	0.522506
h38	0.069382	0.586412	0.889597	0.074889	0.383428	0.501261	0.403786
h4	0.060205	0.032841	0.255270	0.354330	0.395345	0.627052	0.311675
h40	0.102968	0.082931	0.334324	0.096756	0.477927	0.400347	0.826345
h42	0.036069	0.056655	0.318125	0.248915	0.569183	0.454639	0.842209
h46	0.069175	0.135128	0.430654	0.160123	0.719934	0.537326	0.538548
h49	0.050367	-0.181544	0.140764	0.360614	0.817254	0.455731	0.450384
h50	0.077229	0.517945	0.789260	-0.180786	0.155337	0.274558	0.259863
h52	0.077456	0.138602	0.388927	0.135866	0.522163	0.433492	0.865927
h53	0.032597	0.014134	0.304716	0.189022	0.473132	0.426054	0.756008
h54	0.088630	0.574898	0.855946	0.050207	0.265787	0.344909	0.349713

Table 4 contains the latent variable correlations where the diagonal has been substituted for the square root of the Average Variance Extracted values (AVE). AVE is determined by a formula that uses the factor loadings of the indicators relative to their measurement error (Fornell & Larcker, 1981; Henseler, Ringle & Sinkovics. 2009; Urbach & Ablemann, 2010). All of the AVE values are greater in all cases than the off-diagonal elements in their corresponding column and row. AVE is a measure of discriminant validity and represents the degree to which indicators agree (converge) in their representation of each construct (Chin, 2010).

Table 4. Latent Variables Correlations of Constructs (Bold) for the Fathers of the Academic Olympians (Discriminant Validity)

	Conduc	Exp	Literacy	Pressure	Superv	Support	TV
Conduc	**.761577**						
Exp	-.076069	**.921141**					
Literacy	.079148	.617124	**.916515**				
Pressure	.002977	-.099356	.006574	**.734846**			
Superv	.081429	-.116690	.365948	.324264	**.772010**		
Support	.069525	.094376	.479953	.327889	.672314	**.714143**	
TV	.072623	.088604	.409365	.209415	.623618	.523193	**.823408**

Results

SES Findings

- SES is a significant contributor to many factors that constitute parenting in the families of the Olympians. The spokes-in-the-wheel metaphor where SES predicts a number of parental factors illustrates this conclusion.
- Low SES Olympian families had higher expectations. They saw their Olympian's talent as a ticket to a better life for their child.
- High SES parents provided more supervision, pressure and support.

Family Dynamics Findings

- Olympians' parents that pressure more also supervised more and had more TV restrictions.
- Families that supplied higher levels of literacy had higher expectations and also provided more support. This connection between early literacy development and other factors that will eventually foster adult productivity is an important finding. Educators can use it as a good message to parents that developing early literacy has big benefits for the child not only in school but also later in life.

Mothers' Role

- Mothers are more involved in creating the conducive home atmosphere in the Olympian's home but a certain level of resources is needed (higher SES), as is growing up in a two-parent family household. This connection makes sense because more resources are generally available in such homes. These findings support the importance of social capital (Coleman, 1987, 1990).

Fathers' Roles

- The path model results show that fathers have a different focus in parenting a gifted child – they are more involved in preparing their child for the rigors of the adult world.
- Only in the fathers' model does computer literacy show up as a significant predictor for productivity. Obviously the fathers had a hand in their child's use of computers as they were growing up.
- Fathers withheld support as a way to expect more from their Olympian. When the Olympian scored low in tests or did not do as well as expected the fathers' pressured more. However, the Olympian home is characterized by its low pressure. This low tension atmosphere lets the Olympian acquire confidence in his/her abilities that will continue as they become adults. Our study shows that this low pressure environment can even extend to the Olympian's adult productivity.
- Finally, our study shows that what parents do during the child's early life has consequences that go on to influence the individual well into their careers.

Structural Model Significant Paths (SES Spokes-in-a- Wheel)

In both samples SES has a broad range of associations with the endogenous variables that comprise the positive and negative family dynamics within the families of the Olympians. For the positive dynamics, the press for literacy is hypothesized to predict parental support and parental expectations. In both samples large path coefficients are found justifying these predictions. Families that actively encourage early literacy offer more

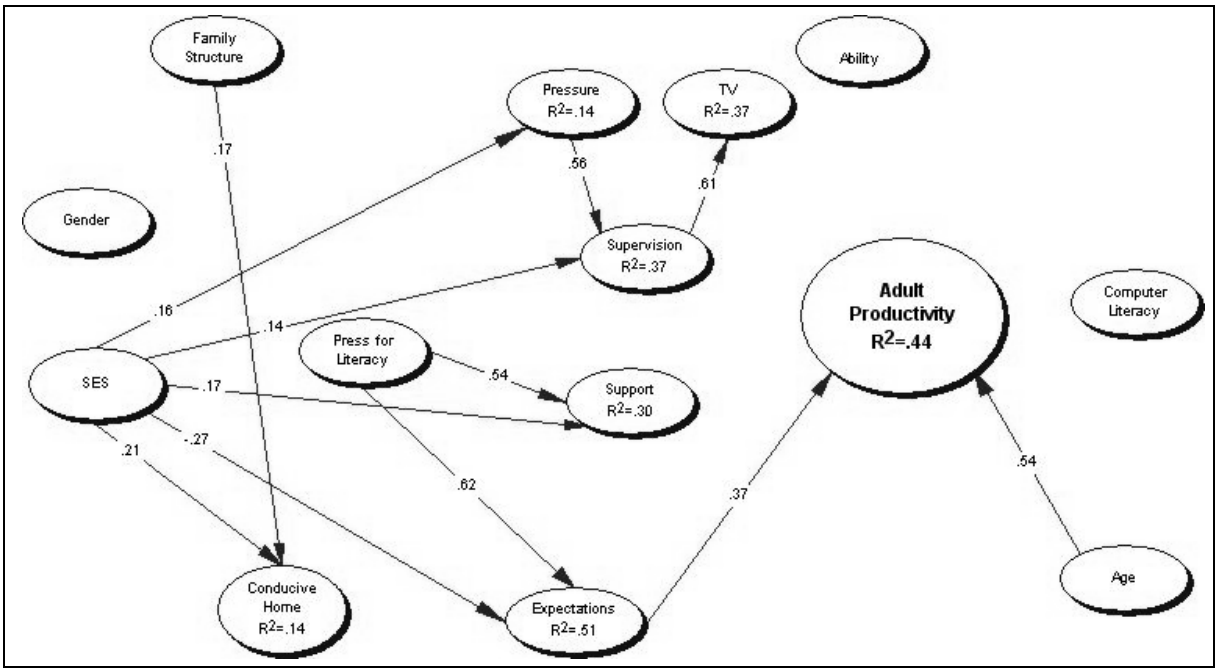

Figure 3. Significant path coefficients for mothers of academic Olympian's adult productivity (total publications).

support and have higher expectations. Furthermore, families with higher expectations also predict greater adult productivity (mother's model, beta = .37; father's model, beta = .16). Our models explain 50% of the expectation factor's variance and more than 27% of the support factor's variance. We found SES connections with the following positive factors: *conducive home atmosphere* (beta = .21); *support* (beta = .17); and *expectations* (beta = -.27). The negative path coefficient between SES and the expectation factor signifies that lower SES families have higher expectations. These low SES parents view their child's giftedness as a way to advance the child's prospects in the future. The significant path coefficients for the expectation factor with adult productivity indicate that their efforts bore fruit.

There are still more SES connections with the negative set of variables. This combination involves predictions that pressure effects supervision, which further effects how parents restrict TV viewing during the school years. SES again has significant connections to two of these factors in the mothers' model and all three in the fathers' model. In both models the path coefficient going from supervision to TV is substantial (beta = .61). Looking at both models where only significant paths are presented the SES connections are like "*Spokes-in-a-Wheel*" (see figures 2, 3). These families are energized to help their child pursue challenging technical careers.

In both samples the *conducive home atmosphere* is not a significant predictor of adult productivity. This finding is in contrast to two studies from the Olympians where we analyzed age cohorts and found *conducive home atmosphere* to be the most consistent predictor of adult achievement (Nokelainen, Tirri, Campbell, & Walberg, 2007; Campbell & Feng, 2011). A number of researchers (Campbell, 2011; Desimone, 1999; Keith, 1992; Schwarz, Barton-Henry, & Pruzinsky, 1985; Schwarz & Mearns, 1986) have postulated that student data is more valid than parent data because parents have a tendency to portray themselves in a more favorable light, while students tend to be more honest.

The fathers' path model has one important finding that does not appear for the mothers. This finding concerns the parental pressure exerted on the Olympian. Both samples posted very low mean levels of parental pressure, but for the fathers' low levels of

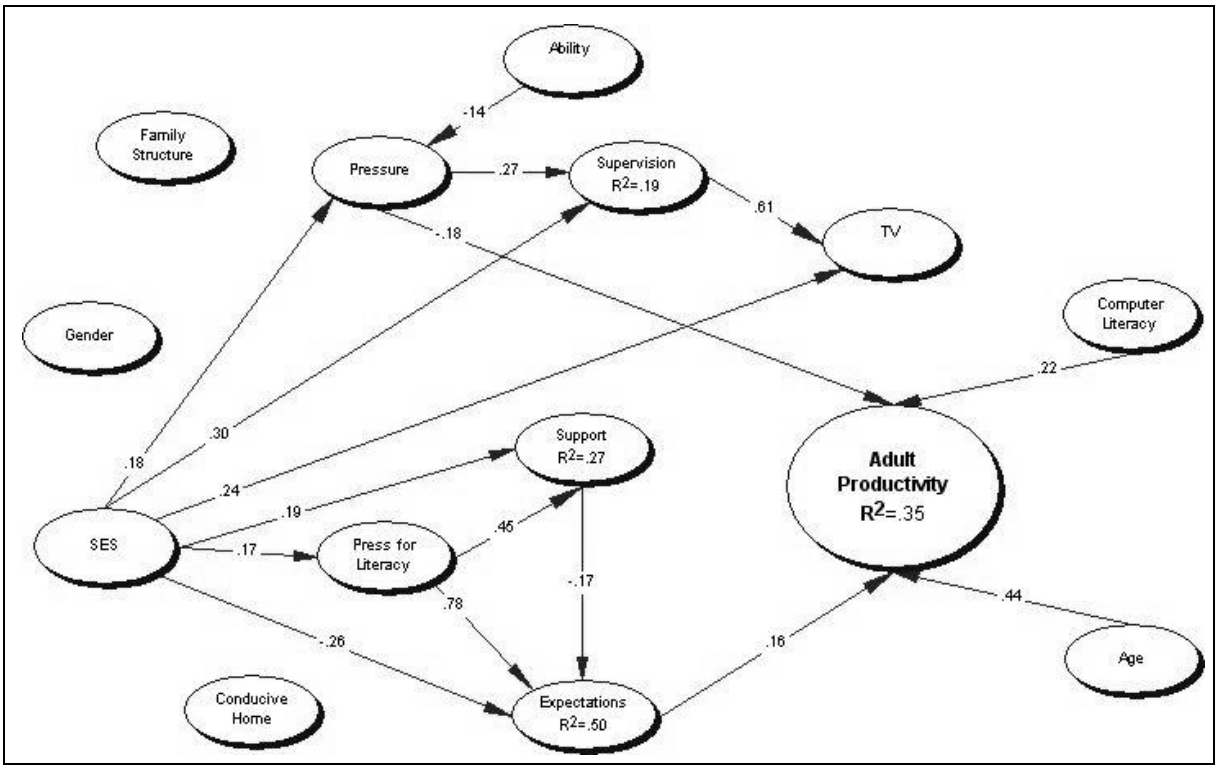

Figure 4. Significant path coefficients for fathers of academic Olympian's adult productivity (total publications).

pressure predicted higher adult productivity. This finding has been found in a number of our studies with school-aged children (Burke, 2003; Campbell, 1994; Campbell & Uto, 1994; Campbell & Wu, 1994; Candia, 2004; Flouris, Calogiannakis Hourdakis, Spiridakis, & Campbell, 1994; Koutsoulis & Campbell, 2001; Lenz, 1999; O'Connor, 1997; Pitiyanuwat & Campbell, 1994; Verna, 1996). A related finding is that Olympians with lesser ability are pressured more, supervised more, and restricted more in their TV viewing.

The one variable with the largest path coefficient in both samples for adult productivity is age. Older Olympians published more because they had more time to do so.

Discussion

All of the parent variables in this study are retrospective in nature; that is, we asked the participants and their parents to reflect on their days in school and their life at home when they were growing up. It is surprising to us to find that these home variables emerge significant for adult Olympians.

How useful is the MDM model for researchers? We found that it helped us organize the variables we used in this study, and more importantly, it gave us a larger context to analyze our findings. Essentially, our study concerns very gifted individuals as they developed their talents 3–5 years ahead of their high school peers. The Olympians at ages 16–18 are reading the research literature in their discipline and are equivalent to advanced undergraduate majors or even graduate students in that technical domain who are at the same level. By age 28 (mean for both samples) most of the Olympians are busy gaining the knowledge and expertise needed in their professional careers. Once at this level, they began to publish. As the years pass by they reach the point when they become *producers of knowledge.* The oldest Olympians (age 51 for the mothers' sample; age 46 for the fathers' sample) are well along in their careers. These individuals are mature professionals that should be producing many publications. However, our previous studies of the most productive and nonproductive Olympians (As vs. Cs) either within international age cohorts (Nokelainen, Tirri, Campbell, & Walberg, 2004; Nokelainen, Tirri,

Campbell, & Walberg, 2007) or within matched American pairs of Olympians (Campbell & Feng, 2011) show that age alone does not account for productivity. It is other factors such as drive, and commitment that count more. Being passionate about research goes a long way in actualizing one's talents. Consequently, at each stage of development, some Olympians will outperform their peers, but the older group will publish more than the younger.

Aside from age, what moderator variables contribute to the Olympians productivity? Surprisingly, the ability composite which represents high scoring students who make very high SAT scores or high class ranks because of their very high GPA is not a significant predictor of adult productivity. Renzulli and Reis (2000) characterize such high scoring students "schoolhouse gifted." In fact, for both samples the path coefficients are negative, meaning that the Olympians who were not the academic stars in high school published the most. Gladwell (2008) comes to the same conclusion for the individuals that make important contributions to society.

The next research question asks about the network of parental factors that interact with each other to ultimately influence the Olympians' adult productivity. The negative parental variables strongly interact with each other but did not influence the Olympians future publishing. The reader gets a sense of how these variables interact for the school-age Olympian. The low levels of parental pressure are significantly connected to supervision, explaining 37% of the variance, and this supervision is associated with the restriction of TV during the school years. In the fathers' sample the Olympians with lower levels of ability are supervised more and have more restrictions to TV viewing.

It is interesting to note that pressure shows up as a significant predictor only for the fathers. Another finding only with fathers is a significant negative path coefficient between support and expectations, meaning fathers with higher expectations offer less support to their Olympian. One explanation for this finding is that fathers do not readily accept shortfalls in productivity – they are less susceptible to excuses for poor performance. Traditionally, mothers are expected to offer more nurturance and fathers more discipline. This contrast shows the different perspectives of each parent. A mother's role in child-rearing is better understood by the public and by researchers. However, the roles that fathers play is less understood. Although fathers do not spend as much time with their child, they are present for the most important nurturing decisions that affect the child (such as motivation, developing the child's interests, encouraging career tracks, etc.), and they seem to be more interested in toughening up their child for the rigors of adult life. They also have less time to communicate with their child, and therefore when they do have something to say, the child might take it more seriously.

The interactions of positive parental factors also provide useful information. This set of factors starts with the families' press for early literacy. What was found from the qualitative data is that Olympian families value reading and have a profusion of books and magazines to fuel the young Olympian's interest. Visits to libraries, museums, and other cultural centers are part of the factor. This factor is then hypothesized to be connected to parental support (both samples have large path coefficients) and to expectations. Our models explain over 50% of the expectations variance and 27–30% of the support variance. Finally, expectations in both models are significantly related to adult productivity. The families with higher expectations are associated with Olympians that publish more as adults. According to Scott-Jones (1995) parental expectations are like an iceberg of potentials in shaping the child's motivation to succeed. That is why parents' expectations have been found to be an important predictor of children's achievement (Kyriakides, 2009; Lee & Bowen, 2006; Okagaki & Frensch, 1998; Scott-Jones, 1995), especially in the national studies done with U.S. databases (Fan, 2001; Fan & Chen, 2001; Hong & Ho, 2005; Keith et al., 1993; Muller, 1998).

These negative and positive family dynamics show that patterns in the gifted child's early development continue to "play out" later in their life.

The last research question concerns how mothers' and fathers' perceptions differ within the family. Campbell and Verna (2004) reported that mothers' and fathers' data could not be combined without having problems with the factor analyses. When we used the PCAs within the SmartPLS program, we uncovered another reason for the differences between mothers and fathers. Each mother's factor contained more items than the corresponding father's factor. In some cases there are almost twice as many items used in the mothers' factors. Why does this happen? Our explanation is that mothers are able to recognize and exert more of the parenting practices that are reflected in IPI statements. This is self-explanatory because mothers are usually more involved in everyday parenting.

Therefore, the different results in the path models between mothers and fathers, together with the item differences, suggest that there are different parenting roles for the mothers and fathers of the Olympians. The fact that our data consists of parents from three countries makes these patterns all the more interesting.

Conclusions and Implications

The development of every child's talents is crucial to society. Gagné (2010) believes that talent must be developed in a timely fashion or it vanishes. No country can afford to waste talent. The implication of this study is that we must take a lesson from the low SES parents in this study who recognize that their child has exceptional talents and put together the home atmosphere to develop those talents. We conclude that these parents gain the satisfaction of seeing their child progress in society and do much better than themselves. But every story of low SES parents producing an Olympian adds up to a plus for society. This study found the ingredients of this accomplishment to be the nurturing actions of a mother who figured out how to develop the child's talents, with limited resources, and the actions of the father who provided incentives in the form of expectations that propelled the child forward. What the Olympiad mothers did was what many mothers of average ability students do to promote achievement. They provide the resources to encourage the development of literacy, they offer the needed support, and both of these factors feed into higher expectations. With the fathers, they provide the technical help their child needs; they restrict the child when he/she goes astray; and they provide a measure of pressure when the child needs it. The child with limited talents has little chance of becoming an academic Olympian, but if he/she has an optimal academic home atmosphere, he can make a successful career out of his talents. We need to multiply this scenario over and over again for society to benefit.

The real tragedy is that minority children with exceptional talents do not have the academic home atmosphere that could develop their talents to benefit not only their family but society as well. No talent can lie fallow if society is to prosper. Minority families with children of limited ability must create the academic home atmosphere that can help their child succeed in life.

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The Authors

Dr. James Reed Campbell is an established researcher on the national and international scene. He has authored six books, and more than 250 articles and research reports. He is best known for his books for parents. He is currently a professor at St. John's University in New York and was formerly a faculty member at the University of Pennsylvania in Philadelphia. Dr. Campbell has 43 years experience as an educator. Among the gifted research community he is recognized as the originator of the International Academic Olympiad studies. In 2012 he received an AERA Lifetime Achievement Award for scholarship and service.

Dr. Mary Ellen Freeley is an Associate Professor in the Department of Administration and Instructional Leadership at St. John's University where she teaches graduate and doctoral level classes. She has served as a New York City teacher and as an elementary principal and assistant superintendent in Nassau County. Subsequently, Dr. Freeley worked as a Superintendent of Schools for 12 years in Nassau County. She is the past president of International ASCD and currently faculty advisor to the St. John's Chapter of PDK and an executive board member of the Metropolitan Council of Educational Administration Professors (MCEAP).

Sharon A. O'Connor-Petruso is known for her work in both instructional technology and secondary analysis of large national and international databases. Her research interests include exploring predictor variables that lead to high achievement in the hard sciences, the dearth of female mathematicians and scientists worldwide, and integrating Web 2.0 tools and source ware into teacher education training. Her publications focus upon pedagogical and parental involvement, gender paradigms, and preparing teachers with global age skills. As the 2007–09 Childhood Education MSED & BA Program Head, she created the data aggregation assessment system and achieved National Council of Accreditation of Teacher Education.

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Fathers Say Less and Are Listened To More: Results from a Cross-Cultural Study of Family Dynamics with German, Cypriot, Chinese and American Parents

James R. Campbell[1*], Mary E. Freeley[1] and Sharon O'Connor[2]

Abstract: This cross-cultural article summarizes the perceptions of 2,908 parents from the United States, Taiwan, Germany, and Cyprus. We examine the family dynamics within these families, and we investigate the roles mothers and fathers play. Our findings show that for the international samples, pressure was a negative predictor for math achievement (low pressure was associated with high achievement); whereas, for the American samples pressure was a positive influence on achievement (higher pressure was associated with high achievement). The extent of help provided to children is not related to their ability. Only the right kind of help was found to be a predictor for achievement. We also find that fathers have distinctive roles to play in all of these cultures: *Fathers say less and are listened to more*.

Keywords:
parent involvement, achievement, cross-cultural, parent's role

Theoretical Framework

Our intent in this study concentrates on how parent involvement influences academic achievement. Most parental involvement studies in the United States can be classified as being centered within school-based frameworks. Epstein's typology of six types of involvement is the most widely cited school-based framework in these studies (Type 1. offering parenting courses; Type 2. communication between the home and school; Type 3. volunteering; Type 4. learning at home; Type 5. involving the parents in decision making; Type 6. collaborating with the community).

Little research has been reported in the literature about home-based studies where researchers examine how family dynamics within the home influence achievement. Keeves (1972) was one of the first to label certain French families of high achieving children as "*la famille educogene*" (families that provide educative environments that reinforce schooling). Bloom (1981, p. 12) synthesized the contribution made by the parents in studies he directed (Dave, 1963; Wolf, 1964) as the "curriculum of the home." Campbell and his colleagues have used this paradigm as an organizing schema for their cross-cultural studies (Campbell, 1995, 1994a, 1994b, 2010; Campbell, Flouris, & Spiridakis, 1989; Campbell & Uto, 1994; Campbell & Verna, 2004, 2007; Campbell, Verna, & Kalaboukas, 2006; Flouris, Calogiannakis Hourdakis, Spiridakis, & Campbell, 1994; Koutsoulis & Campbell, 2001; Koutsoulis, 1995; O'Connor & Miranda, 2001; O'Connor, 1997; Pitiyanuwat & Campbell, 1993; Pitiyanuwat & Campbell, 1994).

The family processes involved in this study include parental pressure, dissatisfaction, support, expectation, help, supervision, and the press for literacy in the family. Previous studies (Campbell, 2008) consisted of data from the children's perspectives of these factors. The results of these studies showed that low levels of pressure are the only significant connection to higher math and reading achievement. In these studies, support and the press for literacy are generally associated with positive correlations with

[1] *St. John's University, Jamaica, USA*
[*] *Corresponding author: St. John's University, 517 Sullivan Hall, Jamaica, NY 11439 USA. Email: Campbelj@stjohns.edu*
[2] *Brooklyn College of the City of New York, USA*

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achievement, while help is negatively associated. In this study we examine these factors from the parents' perspectives. Do children and their parents have the same perspectives about such school-related factors?

More recently, Campbell has synthesized another schema within the curriculum of the home, namely, the academic home climate. When parents create an academic home climate that meshes with the academic climate in their child's classrooms, achievement is enhanced. Their children feel comfortable in such a familiar setting and use this advantage to do better in school (Coleman, 1987; Comer, 1991; Marchant, Paulson, & Rothlisberg, 1995). In one of our cross-cultural studies (Campbell & Mandel, 1990) we proposed that the home-based parental factors (parental pressure, dissatisfaction, support, expectation, help, supervision, and the press for literacy in the family) can be conceptualized as beta values in a regression equation. These combinations represent how the academic climate works in the home. Each factor's specific beta value varies for different productive families. No family has the same set of beta values, but productive families have different combinations of positive and negative betas that have significant effects on achievement. Families with low achieving children have dysfunctional combinations.

In Campbell's (2011) review of three decades of parental involvement research that included 10 national US studies and six review studies, he concluded that the school-based paradigm has not produced consistent significant findings, whereas the smaller number of home-based studies has more consistent findings related to academic achievement. In this review Campbell found that the most important home-based variables are the family's expectations and the intercommunication within the family.

Family Dynamics

One practical way to examine the academic home climate is through combinations of the parent variables. Campbell has derived 24 of these variables (Campbell & Verna, 2004, 2007; Campbell, 2010), and the focus of this study is on seven of them. They are organized in two sets.

The first contains the positive variables, press for literacy, support, expectations, and their 12 connections (see figure 1).

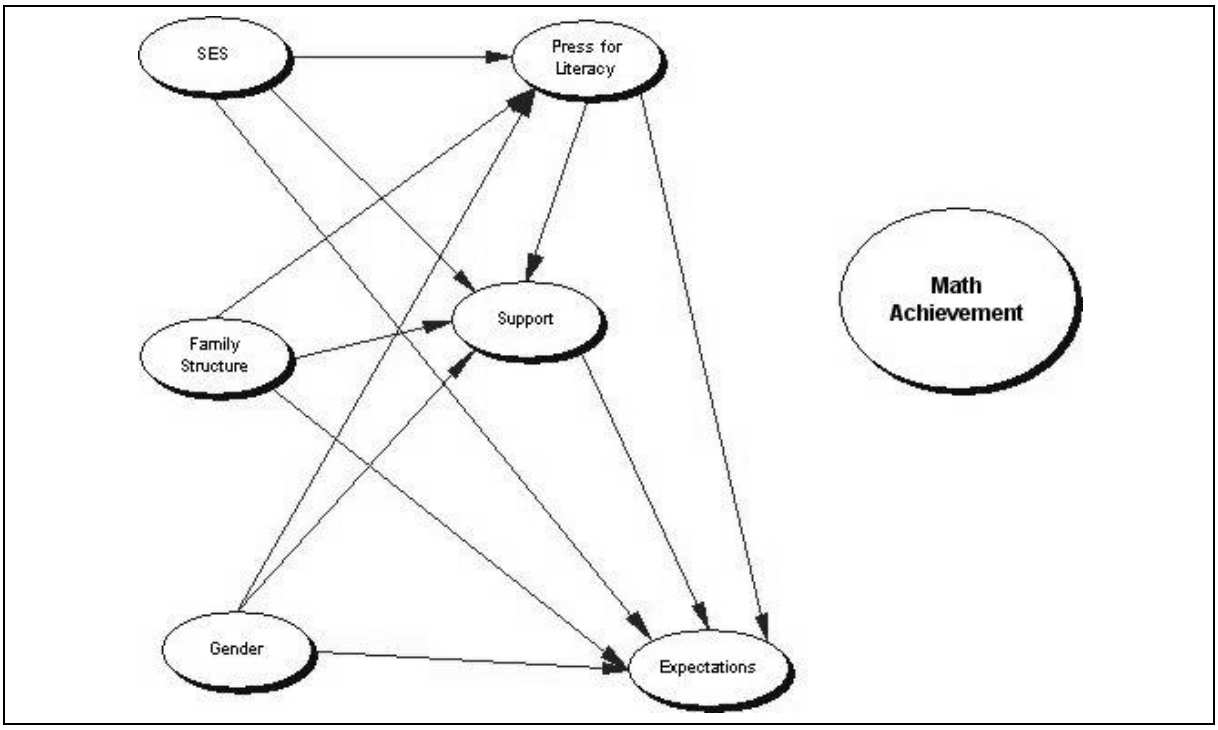

Figure 1. Positive family dynamics variables and their connections.

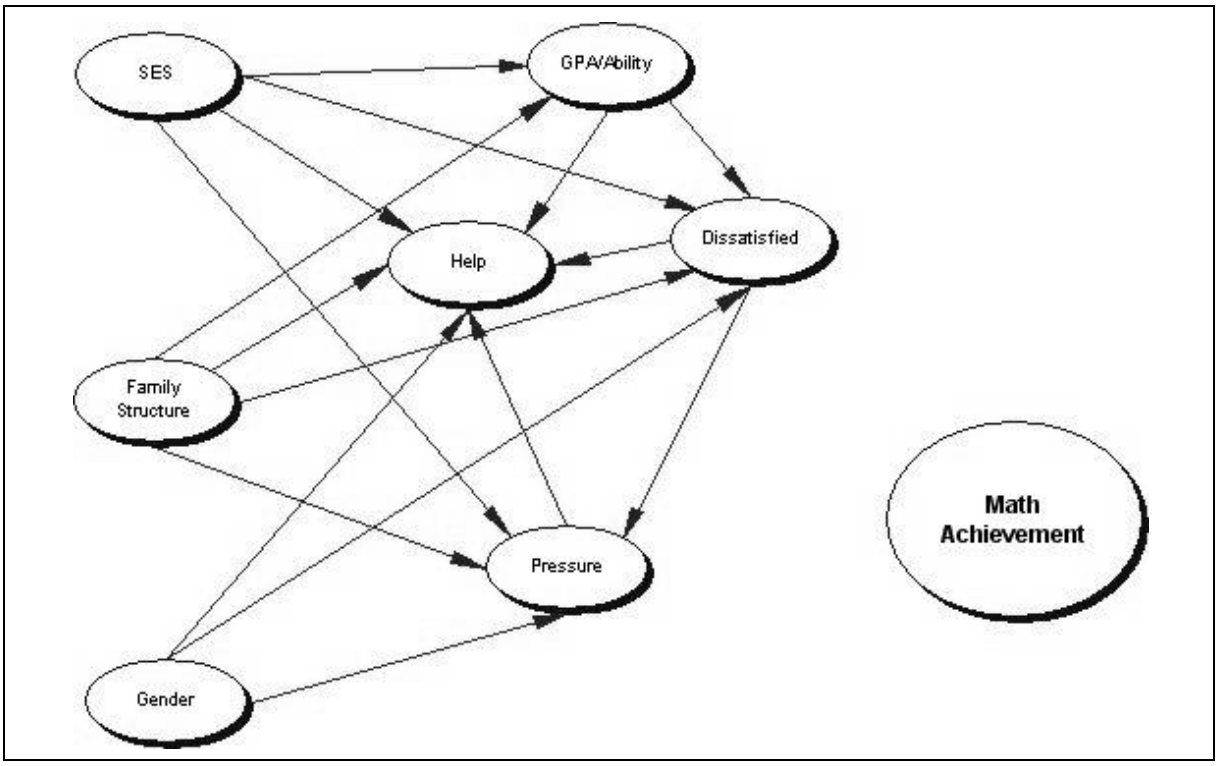

Figure 2. Negative family dynamics variables and their connections.

The second set of variables centers on the degree of parental pressure exerted by the parents (see figure 2) and the dissatisfaction, supervision and help factors. Sixteen pathways are analyzed.

How important are these family dynamics? Do the negative combinations undermine the child's motivation? Are the positive combinations helpful in providing the child with a positive home atmosphere for learning? How do both sets contribute to the child's achievement?

Parental Help and Achievement

In previous research, parental help produced a series of findings where different explanations had been proposed. There is the assumption among educators, especially teachers, that when parents help with their child's homework, the child's achievement will improve. But does it? What does the literature say? There is a growing body of studies that find such help to be associated with lower achievement. One of the first studies to uncover such a finding was Epstein in 1983. In this study Epstein added up the minutes that parents helped with homework and reported negative correlations for reading achievement (r = -.180) and math achievement (r = -.195). In a national study with National Science Foundation data (LSAY), Madigan (1994) reports negative correlations of parents' help and achievement.

Chen and Stevenson (1989) reported that the correlations between homework help and achievement were mostly negative (24/27 and 10 were significant; the remaining were small). Their explanation for these results was that in the three cultures from which they had data (Japan, Taiwan, and the United States), children not doing well received greater amounts of help for completing their homework assignments.

Jeynes (2005), in his analysis of 41 studies, found that parents who help with homework had a small but negative effect size (-.08). Cooper (1989) found that parental involvement with homework was negatively related to achievement (r = -.22 to -.40). Other researchers also reported negative associations between parental help and achievement (Domina, 2005; Lee & Bowen, 2006; Redding, 1992).

Our own cross-cultural studies in a number of countries (Campbell, 1994; Campbell & Uto, 1994; Campbell & Wu, 1994; Flouris, Calogiannakis, Hourdakis, Spiridakis, & Campbell, 1994; Pitiyanuwat & Campbell, 1994) consistently show negative correlations between a help factor and reading and math achievement. It is safe to conclude that children in families helping more have lower achievement.

The big question is "why." What explanations do researchers provide to answer this question? The most accepted explanation for these findings is that children who are doing poorly require more help, and therefore the correlation really represents either lower ability or lower prior achievement (Lee & Bowen, 2006).

Our study will test this explanation by seeing if the ability is actually significantly connected to the help factor. If the Lee and Bowen explanation is true, then low levels of ability will be associated with high levels of help (negative correlations or betas). Such an association would also be expected to be significant.

Campbell (2011) has a different explanation. Consider the fact that math homework and the methods that are now used to teach math have changed over the years. This fact means that the methods taught to the parents, even if he/she could remember how the subject was taught, do not coincide with today's methods. Parents trying to use yesterday's outmoded approaches are more likely to confuse their child rather than help the child.

Campbell's qualitative data present a different explanation. The effective parent spends time either teaching the child how to solve his homework problems, or encouraging the child to figure out how to solve the problem by himself – to take responsibility for his/her own learning. This is a different kind of help. We wonder how many busy elementary school parents take the easy way out and simply give the answers to their child. In this case the negative correlations reflect the fact that the child learned nothing except being able to manipulate his parent to do the homework for him/her. Scott-Jones (1995) has a separate variable (doing) in her framework that demands that the parent not do the child's schoolwork. Teachers often complain that a parent is the real author of some students' reports or projects, and this makes grading very delicate.

Methods and Procedures

Data Source

This article uses data from 2,908 parents (1,640 mothers and 1,208 fathers). It uses samples of mothers and fathers from the United States and from three other countries (Taiwan, Germany, and Cyprus, see table 1).

International Samples

The international sample consists of parents of elementary school children (5th grade) from 10 schools in Taipei, Taiwan; the parents of 7th and 10th grade students from Germany, and the parents of high school students (grades 10–12) from Cyprus. The China study

Table 1. Parent Samples

Parents	Mothers	Fathers
Americans		
Elementary Sample	253	81
High School Sample	199	163
Totals	452	244
International		
Taiwan/China	369	365
Germany	243	183
Cyprus	533	495
Totals	1,145	1,043

was designed to include the one gifted class in each school at the 5th grade, and was matched by randomly selecting one non-gifted class from the same school. In the German study, three types of schools were used, including the 10th grade Gymnasium students who are the college bound students. The Cyprus study used a stratified random sample to select students and their families.

There are more males in the China samples (56%), in contrast to the other samples where females predominate (Germany 57%; Cyprus 64%). In terms of giftedness there were no gifted classes in the Cyprus schools. The German Gymnasium students are classified as gifted, and 45% of the Chinese students are enrolled in gifted classes. For all three countries the score data consisted of report card grades for the children's achievement. In this study we used overall GPA as a measure of ability and final grades for math as the dependent variable. All of these scores were converted into T scores.

American High School Samples

The American high school samples consisted of 199 mothers, and 163 fathers whose children attended 42 high schools located in the Metropolitan New York City region. Seventy percent of the children in this sample were enrolled in gifted classes, and the other 30% of students were enrolled in high achieving classes. Seventeen percent of the participating families are single-parent households.

In terms of ethnicity, the same percentages are either Caucasian (47%) or Asian Americans (47%). The schools supplied Scholastic Aptitude Test scores (SATV, SATM). The regression and path analyses combined the SAT scores as a measure of ability.

American Elementary Samples

We derived these samples from parents whose children attended three New York City public schools. Two of these schools were low performing schools serving minority families. For these samples there are 253 mothers and 81 fathers. In all of these schools, every elementary school pupil in each grade and their parents were tested. In terms of giftedness, 37% of the students were enrolled in gifted classes. The samples contain slightly more males (53%) than females (47%), and 22.6% of these children are being raised in single parent households.

The ethnicity of these samples reflects the diversity that exists in today's New York City's public schools. Sixty-four percent of this sample is from minority groups (15% African American and 49% Latino). In terms of immigration, 12.5% are first-generation immigrants (born in a foreign country), and 74.9% are second-generation Americans because one or both of their parents were born overseas. The achievement data supplied by the schools were report card math grades that were converted to T scores (Anastasi, 1982; McCall, 1922).

Socio-Economic Status (SES)

The Nam-Powers scale was used to measure *Socio-Economic Status* (SES) (Nam & Boyd, 2004; Nam & Powers, 1983). The scale scores range from 0–99. For all the samples included in this study, we used the average of the parents' occupational status scores and the converted parents' education scores as a measure of SES (see table 2). We did not use income because of currency discrepancies among the countries. The German participants have the lowest SES level, and the American high school samples have the highest level.

Miller (1991, p. 340) compares the four most widely used SES scales (including the Nam-Powers scale) and assigns summary values for different occupational groups. Using these values the German SES level for these samples indicates that these parents are employed mostly as "operatives" (factory workers). In the American high school samples, the parents' occupations include managers, officials, and proprietors. The Chinese parents' SES levels point to sales or clerical occupations. The elementary U.S. sample SES levels have some clerical jobs, but parents also serve as bus drivers, postal workers, and

Table 2. Socio-Economic Status (Nam-Powers-Boyd)

Parents	Mothers *M* (*SD*)	Fathers *M* (*SD*)
Americans		
Elementary Sample	59.01 (22.98)	51.55 (26.11)
High School Sample	71.29 (24.39)	71.81 (23.92)
International		
Taiwan/China	62.12 (29.29)	63.19 (28.72)
Germany	35.39 (24.24)	36.96 (25.06)
Cyprus	43.05 (21.17)	42.64 (20.79)

policemen. The Cyprus SES level indicates that the parents have occupations that range from craft jobs but even include farming and fishing occupations.

Instrumentation

Seven of the latent variables used in this study originate from the Inventory of Parental Influence (IPI; Campbell, 2007). This instrument contains 27 items in Part 1 and 27 items in Part 2. In previous studies our normal procedures for synthesizing components/factors was to do Principal Component Analyses (PCAs) or Principal Axis Factoring (PAFs) until stable latent variables were produced. However, when analyzing data from parents, Campbell and Verna (2004) found combining the data from mothers and fathers produced very confusing results that were difficult to interpret. After much experimentation they separated the mothers and fathers data and did factor analyzes for each set of parents. This is the main reason for assembling separate samples of mothers and fathers.

In preparing the IPI data for the path analyses, PCAs were done on the six samples. For each analysis, four criteria were used to isolate factors: the factor must have an Eigen value exceeding 1; factor loadings for each item must exceed .4000; the factor loadings must only load on one factor; and the factor must fit some existing theory.

Before creating the international samples, separate PCAs were performed for the data from China, Germany, and Cyprus. Once the same stable factors were evident in each country, the mothers of each country were combined into an international sample. The same approach was done with the international fathers. PCAs were then calculated for the following samples: the international sample of mothers and fathers; the American high school mothers and fathers; the American elementary school mothers and fathers.

In each sample PCAs were done on the Part 1 items to produce two factors, pressure, and support. Chin (1988) recommends using the items isolated in a preliminary factor analysis (either PCA or PFA) and then to do further factor analyses to isolate different factors at a higher level of abstraction. Chin calls this process second-order molecular modeling. We used this procedure to derive a dissatisfaction factor from items in the original pressure factor and to derive the expectations factor from the support items. The Part 2 IPI items produced a parental help factor, a press for literacy factor, and a supervision factor.

Operational Definitions

The reader can get a better understanding of these family process factors by analyzing some of the items. For the pressure factor, a high score is achieved if the parent would agree or strongly agree with such statements as: "My child is afraid to go home with a poor grade." "I am only pleased when my child gets 100% on a test. "I will be very upset if my child doesn't make the top of the class." All of these items suggest a demanding parent who exerts pressure in the hope of spurring the child to put in more effort.

The dissatisfied parent factor describes a parent who feels that the child is not doing his/her best in school. Such parents believe their child could do better, and have doubts

when the child has no homework. Parents with high scores on this factor may never be satisfied with their child's grades, and may view their child as lazy.

For the support factor, the parent would agree or strongly agree with these statements: "I have much patience with my child when it comes to his/her education." "I take a big interest in my child's schoolwork." "I am proud of my child." These items suggest a psychologically supportive atmosphere at home. Parents who create such an atmosphere are trying to develop a more confident child.

The expectations factor indicates the parents' commitment that the child goes on to college. Such parents believe that children need parental guidance when it comes to schoolwork.

The helping factor asks how often the parent would go over mistakes from a test, help with schoolwork, and help the student before a test. The emphasis here is upon the parents' giving the time that is needed to actually help the child complete the schoolwork. High scores for this factor might also suggest fostering less independence for the child.

The press for literacy factor asks how often the parent encourages the child to read books, buy books as presents, or stress the value of the local library. Families with high scores on this factor underscore the development of literacy.

The supervision factor asks how often the parent sets rules on the kind of TV watched, requires the child to do his /her homework at the same time each night and expects it to be completed. Families with high scores in this area have distinct rules about homework, studying, and TV.

Path Analysis Program

The research models illustrated in figures 1 and 2 contain 28 path connections. However, the full models we analyzed contain 10 additional connections from each variable to the main dependent variable, math achievement. The USA elementary mothers' and fathers' samples did not have any measure of ability and therefore did not use the connections originating or terminating with this variable.

All of the analyses used SmartPLS 2.0, M3 a Partial Least Squares (PLS), and structural equation modeling (SEM) software tool (Ringle, Wende, & Will, 2005). The SmartPLS program assesses the psychometric properties of the *measurement model* by calculating PCAs of the indicators for each latent variable and then determining the reliability and validity of these constructs. The program then goes on to estimate the parameters of the *structural model* and determines path coefficients for each hypothesized connection and R^2 values for the endogenous variables. The path coefficients are measures of the strength of the relationships (Gotz, Liehr & Krafft, 2010). The means and standard deviations of the latent variables used in the different samples are listed in table 3 for the mothers' and table 4 for the fathers' samples.

Table 3. Mothers' Latent Variable Means (Standardized Deviations)

Variables	International	U.S. H.S.	U.S. Elementary
Math achievement	50.52 (9.9)	93.91 (4.09)	50.43 (9.02)
GPA	50.58 (9.7)		
Ability		43.64 (19.37)	
Family structure	1.91 (.31)	1.78 (.41)	1.72 (.49)
Gender	1.55 (.50)	1.52 (.50)	1.47 (.50)
Pressure	2.42 (.72)	2.20 (.77)	2.60 (.79)
Dissatisfied	2.84 (.79)	2.18 (.91)	2.95 (.88)
Support	4.08 (.56)	4.28 (.53)	4.41 (.53)
Expectations	3.66 (.91)	4.11 (.73)	4.40 (.66)
Help	2.98 (.93)	2.79 (1.05)	3.79 (.84)
Press for literacy	3.04 (.87)	3.53 (.92)	3.86 (.73)
N	1,145	198	251

Table 4. Fathers' Latent Variable Means (Standardized Deviations)

Variables	International	U.S. H.S.	U.S. Elementary
Math achievement	50.91 (9.5)	94.11 (4.04)	47.19 (17.94)
GPA	50.86 (9.5)		
Ability		44.64 (18.81)	
Family structure	1.96 (.20)	1.88 (.33)	1.92 (.27)
Gender	1.57 (.50)	1.46 (.50)	1.49 (.50)
Pressure	2.44 (.72)	2.24 (.76)	2.78 (.81)
Dissatisfied	2.82 (.75)	2.20 (.89)	2.99 (.83)
Support	4.01 (.64)	4.16 (.64)	4.38 (.47)
Expectations	3.66 (.95)	4.00 (.92)	4.39 (.67)
Help	2.95 (.96)	2.81 (1.06)	3.74 (.84)
Press for literacy	2.91 (.91)	3.34 (.93)	3.64 (.78)
N	1,043	165	79

Results

Measurement Models

SmartPLS utilizes bootstrap analyses to estimate standard errors. For the international samples with more than one thousand parents, we calculated 500 resamples (with replacement) and determined t-tests for the factor loadings and for all of the paths being tested. Since the other samples were smaller, the bootstrap process consisted of 100 resamples (with replacement) for each of the samples.

In view of the fact that this study revolves around the validity of the latent variables, it is essential to analyze the viability of the measurement model. The first step in this process involves analyzing the factor loadings used to synthesize the latent variables. The cross-loadings of all the indicators from the international mothers' sample are shown in table 5. Similar cross-loadings were analyzed for the other five samples. The factor loadings of items used to synthesize each construct are presented in bold fonts to emphasize their magnitude in contrast to the other constructs. This table contains the factor loadings that make up the seven latent IPI variables. The t-tests for all of these factor loadings are significant at the .01 level. The fact that the indicators load only on one construct contributes toward their convergent validity.

Table 5. Factor Loadings (Bolded) and Cross-Loadings for the Items Making Up the Constructs for the International Mothers Sample

	Dissatisfaction	Expectation	Help	Press for literacy	Pressure	Support
g11	0.767492	0.109685	0.099051	-0.013980	0.361560	-0.098860
g12	-0.141539	0.094109	0.202743	0.121236	-0.065450	0.703190
g13	0.198332	0.250662	0.188730	0.071210	0.706760	-0.006620
g20	0.012324	0.134301	0.244990	0.191765	-0.015180	0.788190
g22	-0.125214	0.160533	0.201812	0.078733	-0.061320	0.667110
g24	0.117625	0.615421	0.366132	0.161047	0.155780	0.218754
g25	0.033930	0.919718	0.302104	0.314123	0.218818	0.110014
g26	0.718915	0.065353	0.091980	0.140123	0.233632	-0.074780
g29	0.037239	0.252398	0.696460	0.345068	0.055702	0.295218
g32	0.070167	0.342375	0.827560	0.352490	0.158441	0.160826
g33	0.054928	0.238411	0.322627	0.780880	0.119607	0.131348
g35	-0.025989	0.172531	0.580850	0.090060	-0.028530	0.239368
g39	0.075468	0.329470	0.782660	0.308118	0.131159	0.262487
g44	0.055196	0.292396	0.763360	0.263880	0.106349	0.237925
g48	0.088362	0.267683	0.294372	0.821450	0.140665	0.126171
g50	-0.002639	0.267742	0.337041	0.811320	0.063750	0.193097
g6	0.738016	-0.018455	-0.035380	0.013724	0.206724	-0.047210
g7	0.304579	0.019692	0.001800	0.010816	0.623120	-0.080050

Table 6 contains the latent variable correlations from the international mothers' sample where the diagonal has been substituted for the square root of the Average Variance Extracted values (AVE). The same procedure was followed for the other five samples. AVE is a measure of discriminant validity (Chin, 2010). AVE is determined by a formula that uses the factor loadings of the indicators relative to their measurement error (Fornell & Larcker, 1981; Henseler, Ringle & Sinkovics, 2009; Urbach and Ablemann, 2010).

The AVE and composite reliabilities for the following latent variables are: dissatisfaction factor (AVE = .53; Composite = .80); expectation factor (AVE = .61; Composite = .74); help factor (AVE = .59; Composite = .87); press for literacy factor (AVE = .57; Composite = .85); pressure factor (AVE = .49; Composite = .74); support factor (AVE = .55; Composite = .78).

Gotz et al. recommend a threshold value of .50 for AVE, and this threshold was met for all but one of these constructs (pressure). The threshold for Composite reliability is .60 (Gotz, Liehr, & Krafft, 2010), and all of these constructs exceed this threshold.

Reliability and Validity

The more recent literature touts composite reliability as the better measure of internal consistency. Composite reliability is better at determining how well a construct is measured by its indicators (Gotz, Liehr, & Krafft, 2010), and it takes into account that indicators differ; whereas, Cronbach's alpha assumes homogeneous indicators (Gotz, Liehr & Krafft, 2010).

Table 6 presents discriminant validity information by listing the intercorrelations of the latent variables after substituting the diagonal with the square roots of the AVE values. The AVE values (in bold) are greater in all cases than the off-diagonal correlations. The data in this table shows that the latent constructs discriminate from each other and therefore contribute toward the discriminate validity of the constructs used in this study.

Structural Models

Once the measurement model was judged acceptable, the structural measures were then examined. The bootstrap results were employed to ascertain the path coefficients (standardized beta values) and appear in figures 3–8. To simplify these figures, we do not include the indicator loadings, t-test results, or nonsignificant path coefficients.

Path Analysis Results

Contrasting these samples, the international sample is the largest and represents parents of elementary and middle and high school students from Asia, the Middle East and Europe. The American high school sample is made up of the parents of gifted students (½ Asian Americans; ½ Caucasian), and the American elementary school is a sample of the parents of minority students enrolled in low performing schools. In all these samples the results show important differences between mothers and fathers. The contribution of the fathers is especially important for the international and American parents of gifted high school students. The family dynamics show how mothers and fathers view their child's school-related behavior in different ways.

Table 6. Latent Variables Correlations of Variables Constructs (Discriminant Validity)

	Dissatisfied	Expectations	Help	Press for literacy	Pressure	Support
Dissatisfied	0.741743					
Expectations	0.075447	0.78587				
Help	0.073631	0.39508	0.735196			
Press for literacy	0.055495	0.321581	0.395293	0.804675		
Pressure	0.368959	0.241721	0.144682	0.131407	0.67668	
Support	-0.101380	0.178569	0.302099	0.189355	-0.06	0.721828

International Samples

In both models (see figures 3 and 4) substantial amounts of math achievement variance is explained (mothers' R^2 = .54; fathers' R^2 = .55). The fathers' path model has five significant paths connected to math achievement, while the mothers have four. With both parents, the child's prior ability (GPA), the level of parental help, and low levels of pressure are connected to higher achievement (although the path coefficient in the father's model barely misses significance). However, fathers' expectations have a positive association with math achievement.

When analyzing the negative set of family dynamics, both parents were dissatisfied with low GPAs and then increased pressure and gave more help as an antidote. But high pressure is dysfunctional in terms of achievement. The availability of more resources (higher SES) played an interesting role for the fathers while greater social capital (family structure) played a different role for the mothers. In the fathers model there are seven significant SES paths with these factors. Higher SES fathers exerted more pressure, and are less dissatisfied with their children's performance in school. Furthermore, SES has a significant direct path coefficient to math achievement. In the mother's model two-parent families gave more help and exerted more pressure even though both are associated with lower math achievement. Therefore these mothers did what they believed would benefit their child.

The positive network of family dynamics likewise has important differences between mother and fathers. For mothers, two-parent families have higher levels of the press for literacy, and also have higher expectations, but there is no significant connection with achievement. In the fathers' path model there are no significant connections with family structure, but again there are more SES connections. The path coefficients between support and expectations is larger in the fathers' model than in the mothers'; however, in the fathers' model higher expectations predict higher achievement.

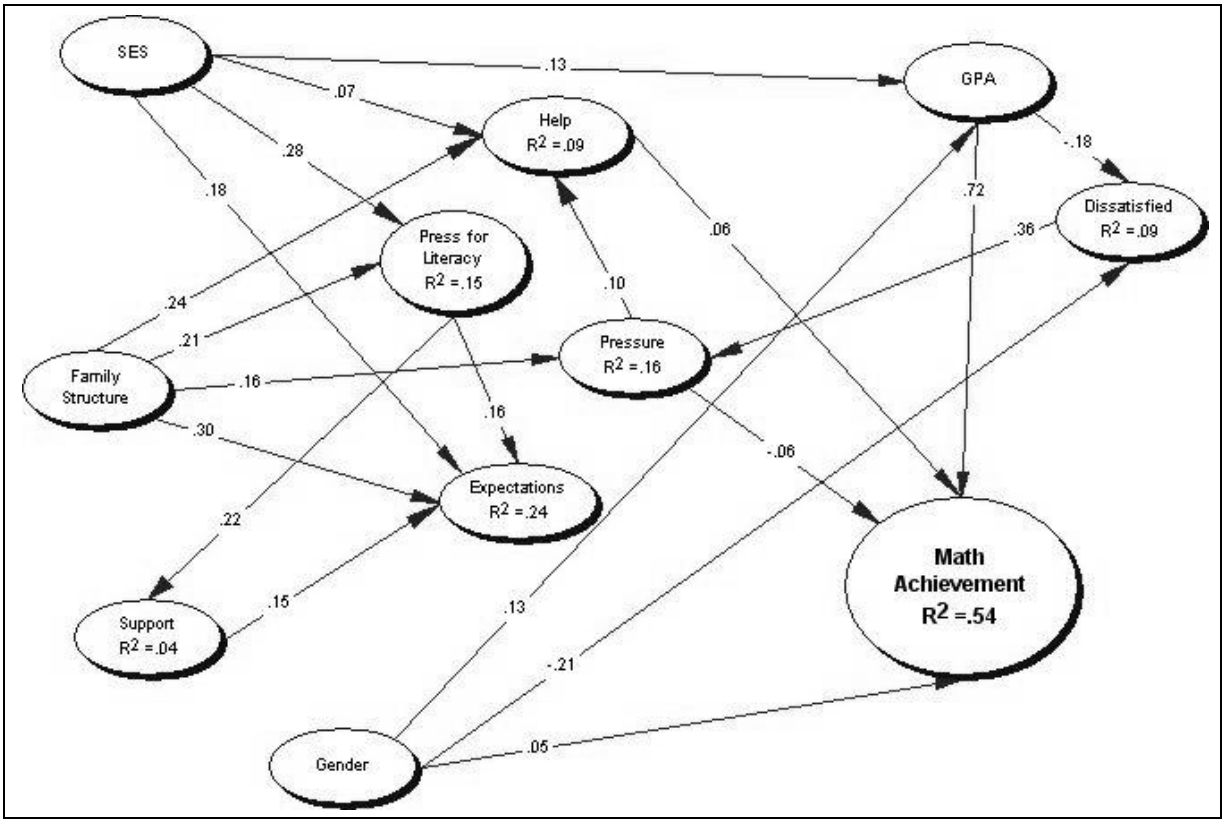

Figure 3. International mothers' significant path coefficients and R^2 values.

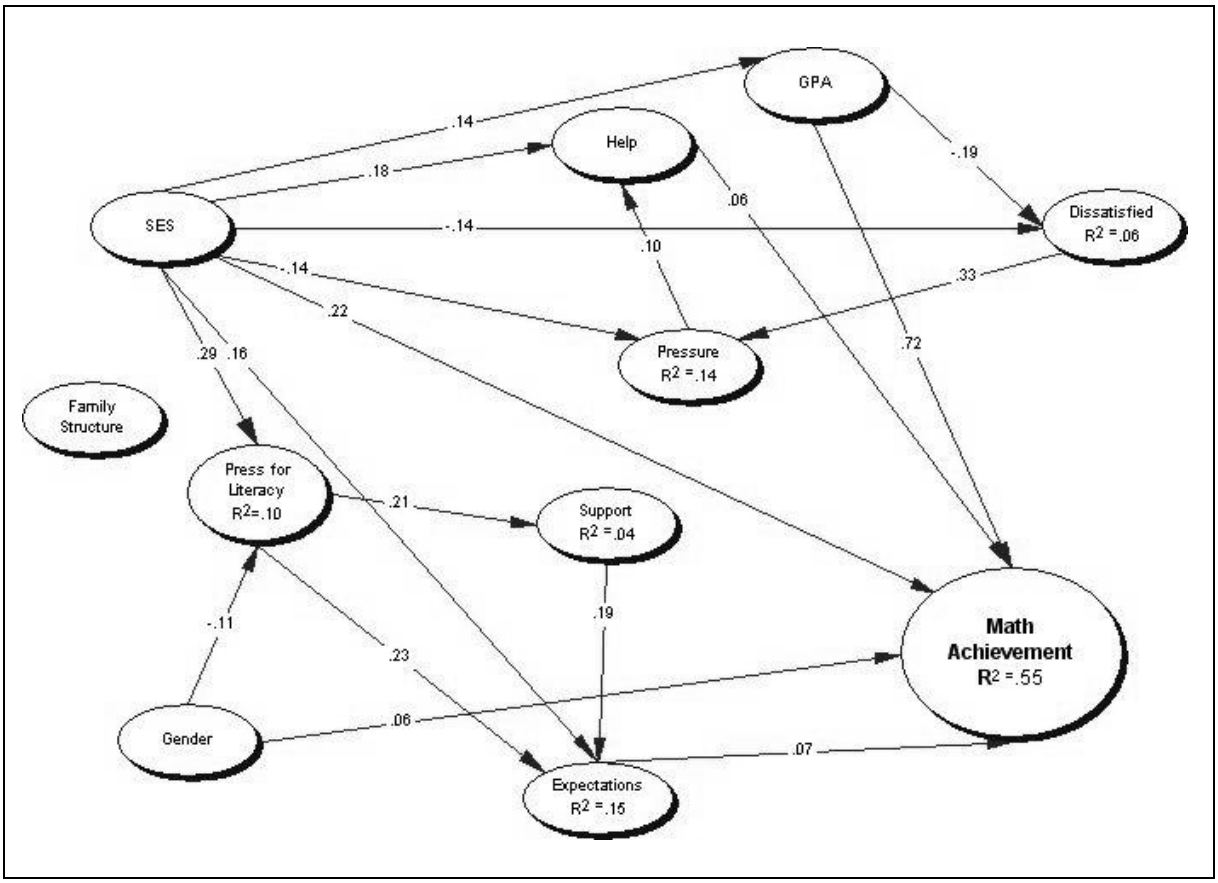

Figure 4. International fathers' significant path coefficients and R^2 values.

American High School Samples

The path models for the American high school parents (see figures 5 and 6) explain a moderate amount of achievement variance (mothers' R^2 = .26; fathers' R^2 = .31). In both models girls have better GPAs, and in both models the child's level of ability is the strongest predictor of math achievement. Likewise, pressure is a positive predictor with achievement in both models. Therefore, higher pressure is associated with high achievement. Furthermore, in both models SES is positively related to the child's ability and to the press for literacy. Higher SES families have children that do better in school and have more press for literacy in their homes. However, the fathers' model shows more significant path coefficients for a number of variables.

The fathers' model shows that high SES fathers help more, and this help is a positive predictor of achievement. In this model a triangle of significant connections exists among three factors – the press for literacy, and the support and expectations factors. At the apex of the triangle is the press for literacy factor. Significant path coefficients exist between the support factor (one of the arms of the triangle) and between the expectations factor (the other arm of the triangle). The press for literacy factor predicts both of these factors. High levels of literacy lead to more support and higher expectations. Finally, expectations are a significant predictor for achievement.

Gender has more significant connections in the fathers' model than in the mothers' model. Fathers have lower expectations for their girls despite the fact they have higher SAT scores (ability). They are also more satisfied with their girls' academic productivity.

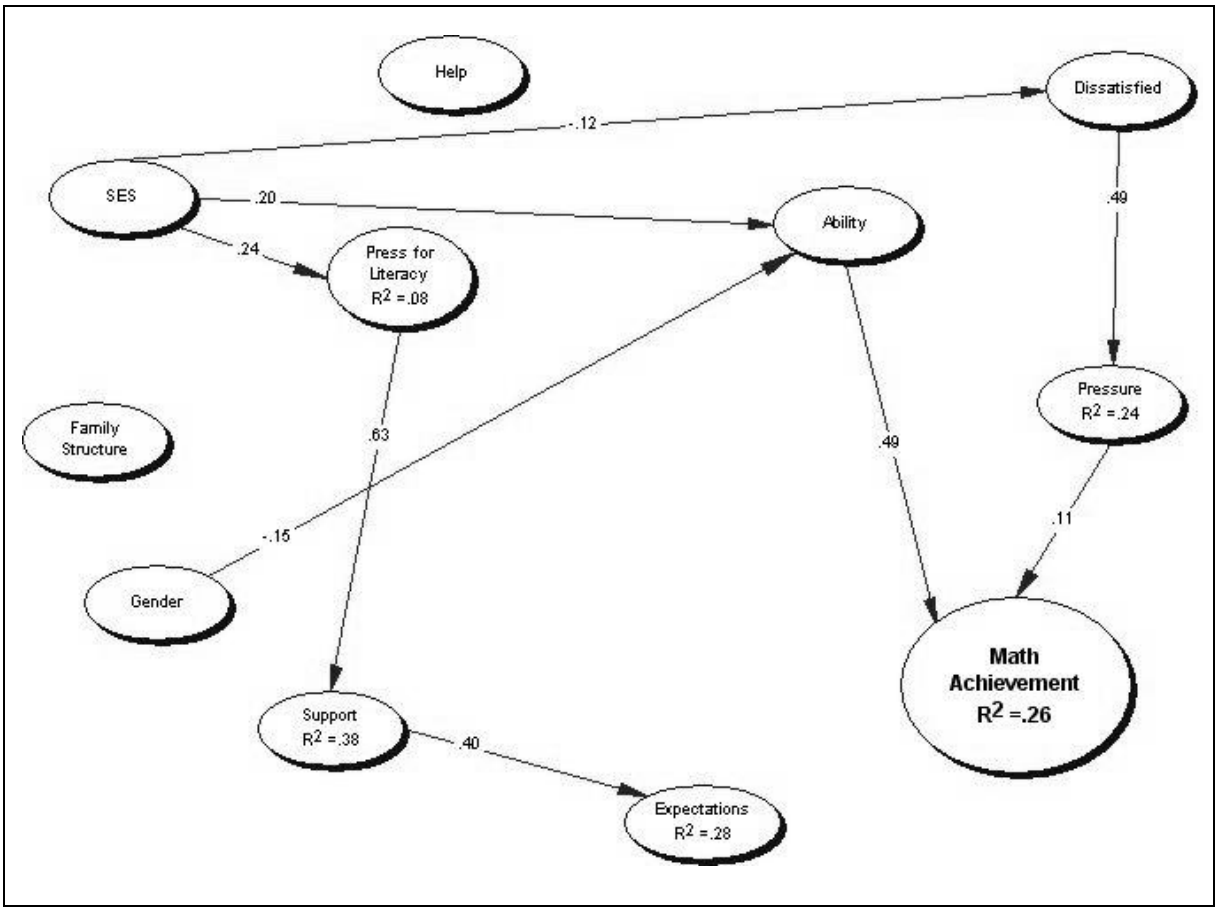

Figure 5. American mothers of high school gifted students significant path coefficients and R^2 values.

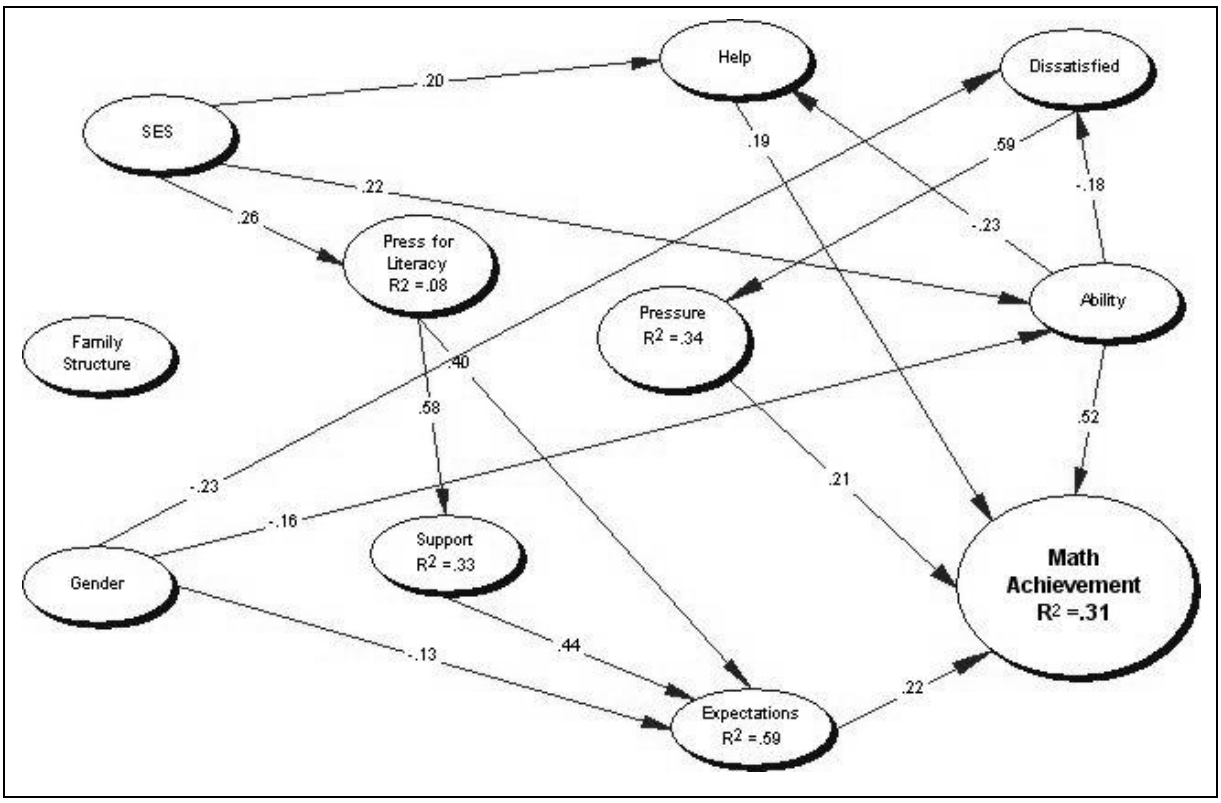

Figure 6. American fathers of high school gifted students significant path coefficients and R^2 values.

American Elementary Samples

The American elementary school models (see figures 7 and 8) explain not that much math variance (mothers' R^2 = .10; fathers' R^2 = .14). The findings from the mothers' path model will be analyzed first. In this model the positive family dynamic variables show that higher SES mothers provide more literacy resources to their children. Moreover, mothers with more literacy resources are more supportive. Finally, mothers that provide more support have higher expectations for their children. But this network of influences does not end in higher achievement.

For the negative family dynamics, dissatisfied mothers pressure their child, and such pressure positively contributes to the child's low math achievement. Furthermore, mothers that are dissatisfied with their child's performance at school are accurate in their perceptions because the negative path coefficient with math achievement verifies that view.

The fathers' model is leaner than the mothers' model. In terms of positive family dynamics, the press for literacy is a significant predictor of support, but support is a negative predictor to achievement. This indicates that Latino fathers who give high levels of support to their children's actually predicts lower levels of math achievement.

Cho and Yang (2011) reported similar findings with New York City Latino samples. They did follow-up work with Latino fathers and discovered that within the Latino family all talk is considered supportive even if it had no academic focus. This ethnic group views support differently than other U.S. ethnic groups and differently from the countries where we have used the IPI. Campbell and his research colleagues have conducted ethnic group studies (see Campbell, 1994c) in the hope of capturing the subtleties of the constructs in different subcultures. For this ethnic group a new set of support items are needed to capture the support factor.

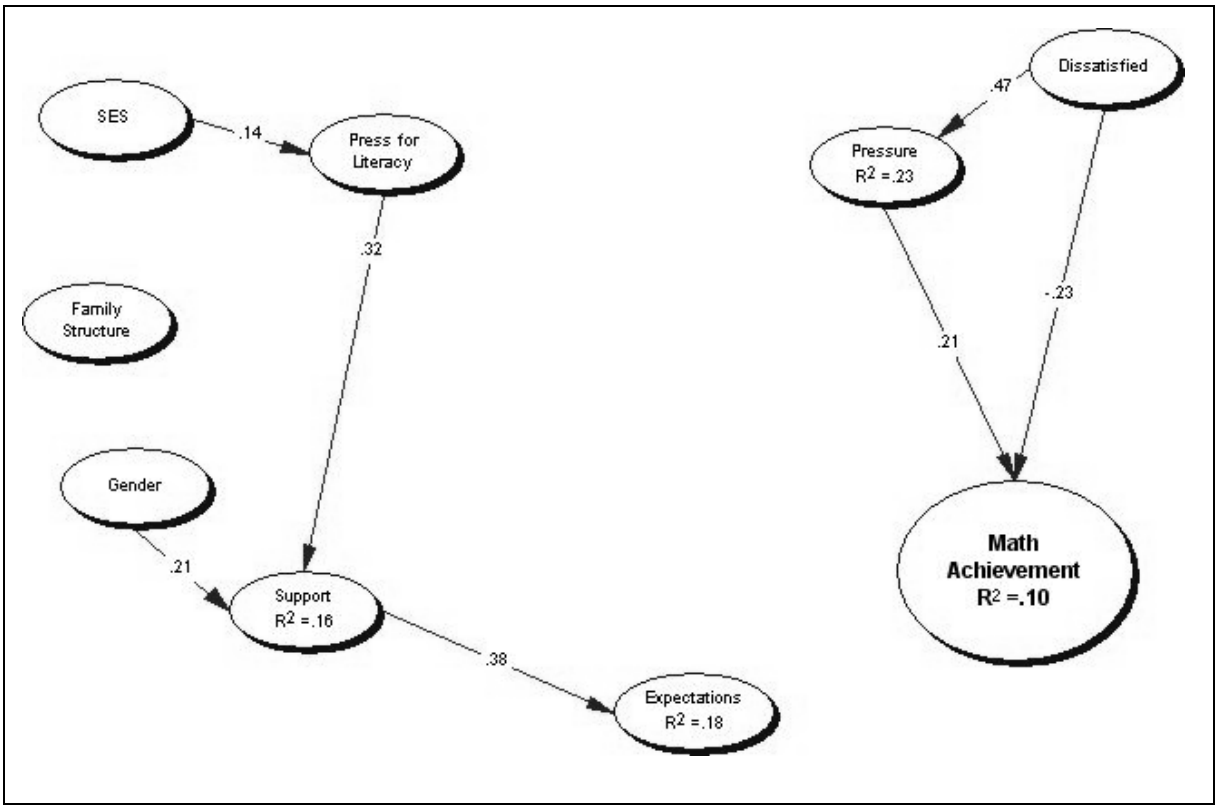

Figure 7. American minority mothers of elementary students significant path coefficients and R^2 values.

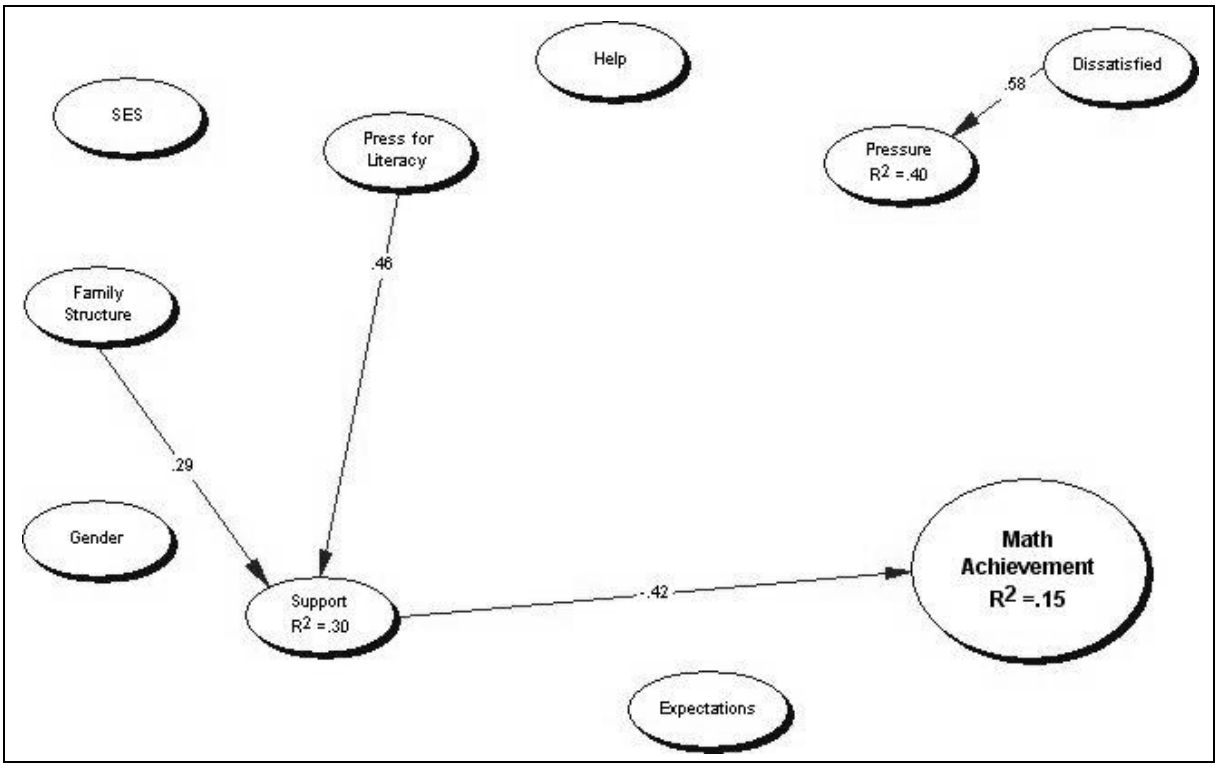

Figure 8. American minority fathers of elementary students significant path coefficients and R^2 values.

Discussion

Contrasting Children's and Parents' Perceptions

In answering the research questions posed earlier in this article, the first question addressed the issue of the IPI home-based academic climate in the home. Do children and their parents have the same perspectives about the factors that make up this climate? We complicated these comparisons when we used second-order molecular modeling with the pressure and support factors (Chin, 1988) to create two additional factors (dissatisfied parents and expectations).

As reported above, our studies dealing with children's perceptions of their parents' school-related activities found that low levels of pressure were associated with higher math and reading achievement. The pressure factor in both international samples has significant negative path coefficients between pressure and math achievement; therefore, with these parents, lower levels of pressure are associated with higher math achievement. These parents' perceptions are the same as their children's perceptions (Campbell & Wu, 1994; Koutsoulis & Campbell, 2001; O'Connor, 1997).

By contrast, the four American samples have positive path coefficients between pressure and achievement. For the American gifted high school students in the fathers' sample and the elementary school Latino mothers, these connections are significant predictors. Therefore, in these samples, higher levels of pressure are associated with higher math achievement. Essentially, these parents disciplined their children, and their efforts produced positive results.

The dissatisfaction factor is negatively related to achievement in all six samples, which means that parents dissatisfied with their child's academic output accurately reflect reality because the children's achievement is lower.

In our studies with children's perceptions, the family's support and their press for literacy are positively associated with achievement, but the regression beta weights were never significant. The parents' data likewise shows nonsignificant results for both of these factors with the one exception being the Latino fathers' support.

To answer the research question about perceptions of the family processes from parents' and children's points of view, except for parental pressure, the perceptions are congruent. Parents and their children view school-related activities along the same lines.

Assessing Explanations for Parental Help and Ability

The next research question concerns the help parents provide. As mentioned above, previous research studies involving student data show that parental help is negatively associated with achievement. Our question is "why." Lee and Bowen's (2006) explanation is that children doing poorly are the ones that get more help, and this is the reason for the negative correlations. Our study tests this explanation by examining the path coefficients between children's ability and the help they get from their parents. If this explanation is valid then low ability children should have significant negative path coefficients between their ability and the help factor. Those with low ability should get much more help. This relationship was tested for four of the samples, and for all of them there were negative path coefficients, but only one was significant (American fathers of the gifted). In the other three samples, the path coefficients are close to zero, meaning there is no relationship at all between these variables. The Lee and Bowen explanation is the most widely accepted, but our finding calls it into question.

Family Dynamics

Combining the negative and positive combinations of parental factors from the six samples, we are able to answer the research questions posed above. How important are these family dynamics? Do either of these sets of parental factors contribute to the academic home climate?

We examined the negative combinations by considering the child's ability as central with hypothesized connections going to the help factor on one side and to the dissatisfaction factor on the other side. Children with lower levels of prior achievement or lower standardized test achievement would be more likely to have dissatisfied parents and get more help. Dissatisfied parents could also be expected to pressure more and then to offer more help. Our findings confirm these predictions. The strongest path coefficients are for the paths between dissatisfied parents and pressure. All six samples have positive and significant associations between these factors. Parents who are dissatisfied pressure their child significantly more.

The connections between the pressure and help factors produce significant path coefficients for the mothers and fathers in the international samples. These international families exert more pressure and give more help. But for the American samples, these path coefficients are not significant and quite small.

The pressure factor, in addition to its connections to other factors, also has significant path coefficients to math achievement in three samples. For the mothers in the international samples, low pressure is associated with higher math achievement. However, for the American samples, pressure is a positive contributor to achievement for the fathers of gifted students and for the Latino mothers of elementary school students; therefore, for the Americans higher pressure is associated with higher achievement.

The help factor has significant connections between help and achievement in three samples (international mothers and fathers; American fathers of the gifted). In all cases the children whose parents gave more help had higher achievement.

Do the negative combinations undermine the child's motivation? We believe that parents use these combinations of family processes to get the child to work harder and generate some form of commitment toward achievement. How does the child react to these stimuli? It depends on what the parents are able to offer. If the parent is knowledgeable about the problems that the child is having at school, there is a better chance that they can provide meaningful solutions. Parents that can hire tutors at just the right time when they are needed may essentially solve the immediate problem. In this case their actions will not

reduce motivation. But if their dissatisfaction leads to a cycle where pressure is exerted without providing meaningful help, they will hinder the child's academic progress. For this child the negative combinations will hurt the child's motivation and result in lower achievement.

In analyzing the positive set of combinations, the connection between SES and the press for literacy is significant in five of the six samples. High SES families supply more resources that promote literacy. Similarly, the connection between support and expectations is significant in five of the six samples indicating that supportive families also have high expectations. The path between the press for literacy and support is significant for all six samples signifying that high levels of literacy are associated with high levels of support. Consequently, these combinations are well established in all of these samples. From our studies with the children's data, we find that these variables do not usually produce significant connections with achievement but may contribute indirectly through their interconnections with other endogenous variables. Are the positive combinations helpful in providing the child with a positive home atmosphere for learning? It is our belief that this positive network creates a home atmosphere where the child feels comfortable about academic learning.

How do both sets of combinations contribute to the child's achievement? Pressure and help are the prime movers in the negative set, and expectations is the most important factor among the positive set. Campbell (2011) found expectations to be a strong predictor in the American national studies and is recognized to be important by a number of other researchers (Kyriakides, 2009; Lee & Bowen, 2006; Okagaki & Frensch, 1998; Scott-Jones, 1995), especially in the national studies done with U.S. databases (Fan, 2001; Fan & Chen, 2001; Hong & Ho, 2005; Keith et al., 1993; Muller, 1998).

However, our findings for pressure and help depend upon how parents exert the pressure and how much or how little they help. Some parental pressure is useful, but excessive or harsh pressure can backfire and cause the child to rebel with less effort or motivation.

Isolating the Roles Mothers and Fathers Play

Mothers' roles in child-rearing are better understood than fathers' roles both by the public and by the scholarly community. The fathers' traditional role as the family's breadwinner is no longer as dominant as for former generations now that both parents work. However, the mothers' role as chief communicator, nurturer, and day-to-day provider of emotional support is still accepted in the cultures involved in this study. What roles do fathers play?

In teasing out the distinctive roles each parent exhibits, the most informative contrast is between the mothers and fathers of the American gifted. These models (figures 5 & 6) illustrate the dynamic roles played by fathers. The negative set of variables is especially revealing. In the fathers' model the significant path coefficients radiate out in all directions in contrast to the paucity of significant connections in the mothers' model. In the fathers' model pressure becomes another significant predictor for achievement. This does not occur in the mothers' model. Moreover, the amount of variance (R^2 values) explained for some of the most important constructs are also larger in the fathers' model.

The R^2 for pressure is .34 (fathers) vs. $R^2 = .24$ (mothers). In the fathers' model the connection between pressure and help is not significant, but help is a significant predictor for achievement. One of the reasons for this finding is that fathers in this sample have much higher levels of education. Most of them attended 1–3 years of college, while the fathers in the other samples are mostly high school graduates. This social capital enabled the fathers to provide help to low ability students, and this extra help proved to be the right kind of help because it is a significant predictor for higher math achievement.

These fathers also give less support and by doing so offer less sympathy for poor performance. In the fathers' model the expectations factor is another significant predictor for achievement. In the mothers' model expectations is not a significant predictor. The R^2

for expectations is .59 (fathers) vs. R^2 = .28 (mothers). Consequently, the fathers' expectations are more sharply defined. To a lesser extent the same finding is true for the pressure factor, which really concerns a level of discipline.

It is important to scrutinize expectations for all of the samples. This factor was not significantly related to achievement for all of the mothers' samples, but it was significantly related for the international fathers and the American fathers of the gifted. Why were expectations only significant for the fathers? Our explanation is that mothers in all of the cultures represented in this study put in the time-consuming tasks that child-rearing requires and spend a lot more time with their children than the fathers. They communicate more with their children and are more directly involved with their schooling. By contrast, fathers do not have as much opportunity to communicate with their children and, in many cases, leave much of the day-to-day parenting to the mothers. We believe their role is different. Consequently, when they do communicate their expectations, their children make more of an effort to listen. We are sure that mothers also stress expectations, but these messages get drowned out amid so much more dialogue. *Fathers say less and are listened to more*.

In conclusion, a father's role is one where expectations are emphasized, and some degree of discipline is being applied. It is our contention that the fathers in our study are more interested in trying to prepare their children for the rigors of the real world that they will encounter later in their adult lives. A mother's role is one of providing emotional support and nurturing as her child grows up.

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The Authors

Dr. James Reed Campbell is an established researcher on the national and international scene. He has authored six books, and more than 250 articles and research reports. He is best known for his books for parents. He is currently a professor at St. John's University in New York and was formerly a faculty member at the University of Pennsylvania in Philadelphia. Dr. Campbell has 43 years experience as an educator. Among the gifted research community he is recognized as the originator of the International Academic Olympiad studies. In 2012 he received an AERA Lifetime Achievement Award for scholarship and service.

Dr. Mary Ellen Freeley is an Associate Professor in the Department of Administration and Instructional Leadership at St. John's University where she teaches graduate and doctoral level classes. She has served as a New York City teacher and as an elementary principal and assistant superintendent in Nassau County. Subsequently, Dr. Freeley worked as a Superintendent of Schools for 12 years in Nassau County. She is the past president of International ASCD and currently faculty advisor to the St. John's Chapter of PDK and an executive board member of the Metropolitan Council of Educational Administration Professors (MCEAP).

Sharon A. O'Connor-Petruso is known for her work in both instructional technology and secondary analysis of large national and international databases. Her research interests include exploring predictor variables that lead to high achievement in the hard sciences, the dearth of female mathematicians and scientists worldwide, and integrating Web 2.0 tools and source ware into teacher education training. Her publications focus upon pedagogical and parental involvement, gender paradigms, and preparing teachers with global age skills. As the 2007–09 Childhood Education MSED & BA Program Head, she created the data aggregation assessment system and achieved National Council of Accreditation of Teacher Education.

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Development of Leadership of Former and Prospective Science Olympians and General Students: Examining Contributions of Personal Characteristics and Family Processes

Seokhee Cho[1*], Suksil Han[2] and Mary E. Freeley[1]

Abstract: Purpose of the study was to evaluate the possibility for scientifically talented students to grow up to be leaders by examining the predictive relationships among personal and environmental characteristics on their leadership development based on the Munich Dynamic Ability Achievement Model (MDAAM). 1261 students including 633 scientifically talented future Olympians and 628 general education students in grades 4 to 12 and 25 Olympians were surveyed on giftedness, intrinsic motivation, extrinsic motivation, confidence in intelligence, incremental belief about intelligence, family processes, and leadership. It was found that family process has the greatest direct effect, followed by intrinsic motivation, followed by confidence in one's own intelligence. Among various sub factors of family processes, pressure for literacy was the greatest predictor for younger scientifically talented students, whereas family cohesion was the best predictor for older scientifically talented students. The validity of the MDAAM has been confirmed again with respect to the developmental aim of this study.

Keywords:

leadership, scientifically talented, motivation, confidence in intelligence, belief about intelligence, family processes, talent development model

Renzulli (2004, p. 66) emphasized the need to recognize "leadership roles that potentially gifted young people will play in all walks of life and a need to use their gifts in ways that will make a better world," asking, "What causes some people to use their gifts and talents in socially constructive ways?" Modern projects from stem cell research to the movie industry require collaboration and communication among professionals of various ages, experience, and fields with different perspectives to solve problems through convergence and integration of various scientific fields (National Academies of Science, 2007; Partnership for 21st Century Skills, 2004). Future policies at the national or state-level also require scientific insights and leadership (Levine, 1979; Office of Science and Technology Policy, 2006), where science, technology, engineering, and mathematics (STEM) professionals can understand and solve modern problems from STEM perspectives. Educational programs and activities geared towards the development of STEM professionals and STEM literacy call for STEM leaders as well. Therefore, it is necessary to examine what factors can contribute to the leadership development of the scientifically talented, such as future Olympians.

Sisk (1993) warned that society cannot survive without intelligent and imaginative leadership. In 1972, Marland defined leadership as one of six areas of giftedness. Using this definition, giftedness in leadership is specified as a separate domain in 40% of the states in the U.S. (Matthews, 2004). Yet, leadership has not received much attention, either

[1] *St. John's University, New York, USA*
[*] *Corresponding author: Department of Administrative and Instructional Leadership, The School of Education, St. John's University, 8000 Utopia Parkway, Jamaica, 11439, NY, U.S.A. Email: chos1@stjohns.edu*
[2] *Youngdong University, Korea*

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in terms of research or program development in gifted education (Hays, 1993; Matthews, 2004; Smyth & Ross, 1999). Only recently some studies were conducted on leadership of academically or intellectually gifted students (Chan, 2007; Landau, 2008; Lee & Olszewski-Kubilius, 2006, 2007), but little attention has been paid to leadership in specific domains, such as in science.

Theoretical Background

Leadership is often studied as a category of giftedness (Chan, 2007; Lee & Olszewski-Kubilius, 2006, 2007; Landau, 2008; Oakland, Falkenberg, & Oakland, 1996; Shore, Cornell, Robinson, & Ward, 1991), rather than as a necessary competency that gifted or talented individuals in science should be equipped with to produce social benefits. While military leadership (Horey, Fallesen, Morath, Cronin, Cassella, Franks, Smith, 2004; Sheppes, 1977), managerial leadership in the business world (Bass & Avolio, 1993), and political leadership (Cheng, 2011; Nye, 2004) have been studied extensively, research on the potential leadership roles of future Olympians and their development is scarce, even though future Olympians have great potential to contribute to the betterment of social welfare using their talents in the STEM fields. Future Olympians are defined as scientifically talented students who are admitted to the science gifted education centers or science high schools where most of the former Olympians were educated with advanced and challenging programs.

Relationship Between the Competencies of Future Olympians and Those of Leaders

In the existing literature, two leadership behaviors emerge: Leader behaviors that target productivity and behaviors that target group affect. Variations of these labels include the terms directive and supportive (Blanchard, Zigarmi, & Zigarmi, 1985), focus on production and focus on people (Blake & Mouton, 1985), initiation of structure and consideration (Hellriegel, Slocum, & Woodman, 1995) and transactional and transformation leadership (Bass & Avolio, 1990).

Leadership in gifted individuals who strive for a better future in our society involves presenting a vision and inspiring team members to work towards that vision by establishing connections with members, understanding the members' needs, helping members reach their potential, and contributing to the development of the team (Fitzgerald & Schutte, 2010; Horey et al., 2004; Renzulli, 2004). Leadership transforms the organization by motivating people to accomplish organizational goals (Bass & Avolio, 1990; Kotter, 1990) and influences other people substantially through interaction in real-life situations (Lee & Olszewski-Kubilius, 2006). The transformational leadership model focuses on connections between leaders and team members (Fitzerald & Schutt, 2010), where an effective transformational leader understands the needs and motivations of others and tries to help them reach their full potential (Bass & Avolio, 1994).

Podsakoff et al. (1990) identified six key transformational leadership characteristics: Identifying and articulating a vision, providing an appropriate model, fostering the acceptance of group goals, communicating high performance expectations, providing individualized support, and high levels of charisma. Likewise, Sisk (1993) claimed competencies such as setting goals, responding to the future, developing a success syntax, gaining self-knowledge, becoming interpersonally competent, and coping with value differences and conflicts should be included in the leadership. The definition and competencies of transformational leadership are used in this study, since transformation of the team or society may be a major task for leaders in the sciences to bring positive change to society.

Personal Characteristics Related to Leadership of Future Olympians

It is believed that scientists generally lack leadership skills (Jones, Simonetti, & Vielhaber-Hermon, 2001) "because many of the characteristics which make a good scientist are not

those which make a good leader" (p. 371). However, recent findings on the development of giftedness implies that leadership competencies can also be developed through the moderation of personal and environmental characteristics through which giftedness is transformed into a talent in a specific domain. The Munich Dynamic Ability Achievement Model (MDAAM; Heller, 2010a, p. 8) provides a frame of reference to examine how gifted individuals pursue excellence in leadership. The model can be used to answer questions such as: "Do moderators differ in effectiveness as gifted individuals get older or as novices become expert leaders?" and "Which moderators lead individuals to continue their autonomous and self-regulatory learning processes?" By understanding the relative importance of factors at different developmental stages, parents and educators can focus on nurturing those features needed to reach an expert level of leadership.

Several recent studies have found a positive relationship between leadership and giftedness (Landau, 2008; Lee & Olszewski-Kubilius, 2006), emotional and successful intelligence (Chan, 2005, 2007; Lee & Olszewski-Kubilius, 2006), and traditional academic intelligence (Landau, 2008). Chan (2007) found practical abilities and management of emotions as common and significant predictors for leadership competencies, suggesting that applied and pragmatic skills, tacit knowledge, and ability to manage and regulate one's emotions were all important in leadership. Landau (2008) found a strong correlational relationship between self-confidence and decisiveness and daring on the one hand and leadership on the other hand. In fact, Stodgill's (1948) extensive review on leadership traits confirmed some personal characteristics that yield reliable differences between those who are leaders and those who are followers. For example, military cadets who had greater confidence in their leadership abilities were rated as superior performers (Chemers, Watson, & May, 2000).

Family, an environmental characteristic, has also been shown to be a critical feature of leaders. Family cohesion (Chan, 2005; Karnes & D'Ilio, 1989) was positively related to the leadership competencies, whereas authoritative parenting practice was negatively related to the emergence of leadership roles (Avolio, Rotundo, & Walumbwa, 2009). Karnes and D'Ilio (1989) discovered that family cohesion was perceived more than family conflicts by student leaders and their parents, suggesting that how parents interact with their children can be a significant moderator of leadership development.

For a person's potential to be transformed into excellent performance, an optimum combination of multiple personal and environmental components at specific time points is critical (Heller, 2010a, 2010b). Non-cognitive personal factors (achievement motivation, coping with stress, self-concept, test anxiety, control expectations, etc.) and social environmental factors (family and school climate, quality of instruction, critical life events, classroom climate) are important moderators in transforming giftedness into leadership talent. Since the development of leadership talent is a function of an individual's developmental stage (Heller, 2010a, p. 8), it is necessary to examine whether the predictive power of relevant variables varies depending on one's developmental stage. In the MDAAM, it is implied that an accumulation of experiences is a critical predictor for leadership.

This study was conducted in Korea at the national level with cohorts from three school levels to examine the developmental differences between scientifically talented students and general education students as well as the predictive relationships among personal and environmental factors involved in the leadership development of the scientifically talented future Olympians.

Methods

Participants

A total of 846 future Olympians were selected through stratified random sampling throughout Korea, including scientifically talented 4th to 9th graders from 51 science gifted

education centers and 10th to 12th graders from 18 science high schools. Science gifted education centers provide scientifically talented students with accelerated maths and science enrichment programs on weekends and during vacation. Science high schools are self-contained specialized high schools for scientifically talented students with an emphasis on nurturing science talent. To examine group differences between future Olympians and general education students, a corresponding number of general education students were selected through stratified random sampling across the country by selecting two to three students from 277 schools in each region of each province.

The scientifically talented future Olympians were identified through a series of steps, including teacher recommendations based on behavioral observation and previous achievement records, screening based on written test scores, and final selection based on performance test scores. Written and performance tests evaluate logical thinking and creative problem solving in maths and science. Nominated students seat for testing at the end of grades 3, 6, and 9 and, once admitted to the Science Gifted Education Centers or Science High Schools, they stay in the program for three years, in general. Instruments for identification were developed nationally, but each institution decides the cut off scores depending on the number of available seats and financial resources.

After visual inspection of missing responses, only those with a complete set of data were included for analyses. The final sample size for analyses was 633 future Olympians from grades 4 to 12, 191 elementary students in grades 4 to 6, 297 middle school students in grades 7 to 9, and 145 high school students in grades 10 to 12, with missing rates per variable ranging from 0.0% to 3.7%. A total of 628 general education students participated in the study with 198 elementary, 240 middle school, and 190 high school students. There was no observed systematic pattern among the missing responses. Reliability estimates of the inventories were mostly acceptable, ranging between $\alpha = .71$ to .93 (*Mdn* $\alpha = .83$).

Instruments

Leadership Competencies Scale. The leadership competencies scale measures leadership characteristics on 24 items for six factors: four items for vision, four items for communication, two items for collaboration, two items for management of organization, seven items for sensitivity to others, and five items for contribution to the society. Students respond to each item on a scale from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*) on their perception of their leadership characteristics. Cronbach's α calculated for elementary, middle and high school students were found to be mostly high (ranging from .76 to .82 for vision, .77 to .87 for communication, .64 to .78 for management of organization, .76 to .81 for sensitivity to others, .72 to .75 for contribution to society), except for collaboration, which ranged from .53 to .66, revealing that the six factors can yield reliable data.

Family Processes – The Korean Inventory of Parental Influence (KIPI). The Korean version of Campbell's (1994) Inventory of Parental Influence consists of 44 items on six factors. Participants responded on a scale from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*) on their perception of family processes during school years. Family process factors of Support (e.g., "My parents respect my decisions."), Pressure for Intellectual Development (e.g., "My parents took me to the library."), Parents' Discussion (e.g., "When my mom had to decide about my education, she discussed with my dad."), and Father's Involvement (e.g., "At home, my father explained about what I asked.") were combined to create an index named Positive Family Processes. Cronbach's α ranged from .91 to .93 with high reliability. Confirmatory factor analyses were conducted for each factor and the goodness-of-fit and lack-of-fit indices showed that the model is reasonably adequate, with GFI ranging from .920 to .983 and RMR from .036 to .086. RMR and GFI for each factor were .033 and .975, respectively, for Psychological Support; .058 and .928, respectively, for Pressure for Intellectual Development; .042 and .956, respectively, for Parents' Discussion; and .051 and .953, respectively, for Father's Involvement.

Giftedness. This checklist was developed by Cho and Han (2004) based on Renzulli's (1972) three ring conception of giftedness. Students were asked to respond using a scale from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*) on six items about each of ability (e.g., "I read various books."), creativity ("I like to think of new ways of doing things."), and task commitment (e.g., "I continue working on a project until I am satisfied, even if my teacher tells me it is already good."). The higher the total score is, the higher the students' giftedness. Exploratory factor analyses showed one factor of giftedness with all items having reasonably high loadings ranging from .78 to .93. Split half reliability was .85 for students attending science gifted education centers in Korea. Internal consistency was reasonably good with Cronbach's α of .86 for students attending science gifted education centers (Cho & Han, 2004).

Belief About Intelligence. The BAI scale was developed by Dweck and her colleagues (Dweck, Chiu, & Hong, 1995). Incremental BAI was measured by seven items, three of which were reverse-coded (e.g., "My intelligence is good, but there is nothing much that I can do to improve my intelligence."). The incremental BAI score is the average rating on the seven items using a scale from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Reliability of this scale was moderately good with Cronbach's α ranging from .75 to .83. Goodness of fit demonstrated the model was reasonably adequate (χ^2 (14) = 569.02, $p < .001$, GFI = .872, RMR = .099).

Confidence in Intelligence Scale. This scale was modified from the initial six items developed by Dweck (1999) in which students report the strength of their subjective convictions that their intelligence is high (e.g., "I am confident that I am smart enough to be successful.") using a scale from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Reliability of this scale was moderately good with Cronbach's α between .83 and .88. Goodness of fit was reasonably adequate (χ^2 (20) = 466.304, $p < .001$, GFI = .905, RMR = .068).

Intrinsic Motivation and Extrinsic Motivation. This scale was developed by Cho and Han (2004) based on Dweck's (1986) achievement motivation theory and consists of nine items on intrinsic motivation and eight items on extrinsic motivation. Intrinsic motivation items (e.g., "I am happy when I learn something new and interesting") measure aspiration for ability development and actualization of their ability. Extrinsic motivation items (e.g., "I am happy when I can show that I do well on certain things.") measure desire for demonstration of ability. Intrinsic motivation is related to constructing cognitive structure and content, whereas extrinsic motivation is related to getting external recognition of one's ability (Pintrich & Schunk, 1996). Principal component analyses with orthogonal varimax rotation confirmed two independent factors: Intrinsic and extrinsic motivations. Split half reliability coefficients with elementary to high school students ranged from .64 to .73 for intrinsic motivation and .82 to .88 for extrinsic motivation. Internal consistency reliability coefficients measured by Cronbach's α ranged from .74 to .77 for intrinsic motivation and from .74 to .89 for extrinsic motivation, suggesting that the reliability of the instrument is acceptable.

Procedure and Statistical Analyses

This study is part of a Korean national longitudinal study on talent development in science. The Ministry of Education sent letters to 51 science gifted education centers and 18 science high schools in 16 metropolitan cities and provinces in Korea to request their assistance in the research. The letter included a description of how to sample students, implement the inventories for data collection, and secure consent from parents and children. Teachers in each center administered, collected, and returned the students' responses to the researchers. Only portions of the national research data relevant to the research questions in this study were analyzed. Correlational and stepwise multiple regression analyses examined the relationships among variables related to leadership. Multiple regression analysis was determined to be the most effective model for predicting leadership among several predictors.

Results

Findings are presented in order of group differences in leadership and moderators between future Olympians and general education students at the three school levels. Next, predictive relationships among personal and environmental characteristics of all students and then future Olympians are presented.

Group Differences in Leadership between Future Olympians and General Education Students

Olympians showed the highest leadership score. Future Olympians demonstrated significant differences from students in general in all of the leadership characteristics at the $p < .001$ level. Future Olympians were higher in vision, communication, management, sensitivity to others, and devotion to society than the normative group, but exhibited lower scores in collaboration than the normative group of students (see table 1).

Group Differences Between Future Olympians and General Education Students in Leadership and Relevant Characteristics

Between future Olympians and general education students, there were significant differences in family processes, giftedness, intrinsic and extrinsic motivation, incremental BAI, and confidence in intelligence at $p < .01$ (see table 2) at all school levels except incremental BAI of high school students.

Group Differences Among School Levels in Leadership, Personal, and Environmental Characteristics

Only in leadership and family processes, significant differences were found among all participants in all grade levels (see table 2). Leadership of all elementary school children was significantly lower than that of all middle school students ($p < .001$) and all high school students ($p < .001$). There was no significant difference between middle and high school students. Scheffé tests found that all high school students perceived their family processes significantly less than all elementary ($p < .001$) and middle school students ($p < .05$).

Table 1. Group Differences on Leadership Competencies Between Future Olympians and General Education Students

Leadership competencies	Groups	*N*	*M*	*SD*	*d*	*df*	*t*
Leadership total	General education	628	16.75	2.50	-.95	1664	-7.31***
	Future Olympians	633	17.70	2.78			
Vision	General education	628	3.33	.79	-.21	1718	-5.35***
	Future Olympians	633	3.58	.81			
Communication	General education	628	3.33	.78	-.26	1721	-6.68***
	Future Olympians	633	3.58	.81			
Collaboration	General education	628	3.30	1.00	.17	1733	3.67***
	Future Olympians	633	3.13	.98			
Management of organization	General education	628	3.03	.81	-.21	1729	-5.09***
	Future Olympians	633	3.24	.88			
Sensitivity to others	General education	628	3.63	.58	-.16	1723	-5.66***
	Future Olympians	633	3.78	.59			
Devotion to society	General education	628	3.35	.65	-.15	1736	-4.85***
	Future Olympians	633	3.50	.66			

Note. *** $p < .001$

Instead, BAI was significantly different between all elementary and all high school students. All high school students demonstrated significantly less incremental belief about intelligence than all elementary school students ($p < .05$) and all middle school students ($p = .05$). There was no significant difference among school levels in confidence in intelligence and giftedness regardless of student group (see table 2).

Olympians showed higher leadership competencies than all of the future Olympians, implying that it is a developmental trait acquired through experience (see table 3). One way ANOVAs and Scheffé tests among future Olympians revealed significant differences in leadership between elementary and middle school students ($p = .05$) with higher leadership scores in middle school students. Among regular students, elementary school students demonstrated significantly lower leadership than middle school students ($p < .05$) and high school students ($p < .01$).

Table 2. Descriptive Statistics of Leadership, Family Processes, Confidence in Intelligence, Incremental BAI, and Giftedness of Future Olympians and General Education Students by School Level

		All			**Future Olympians**			**General education students**			**Difference**		
		N	***M***	***SD***	***N***	***M***	***SD***	***N***	***M***	***SD***	***t***	***df***	***p***
Leadership	Elementary	389	16.78	2.81	191	17.27	2.95	198	16.31	2.58	4.13	387	.000
	Middle	537	17.44	2.68	297	17.94	2.72	240	16.91	2.53	5.14	535	.000
	High	335	17.44	2.44	145	17.89	2.56	190	17.08	2.28	3.38	333	.001
	Total	1261	17.22	2.69	633	17.70	2.78	628	16.74	2.50	7.31	1259	.000
Family Processes	Elementary	389	14.05	2.33	191	14.37	2.37	198	13.73	2.24	3.27	387	.001
	Middle	537	13.87	2.34	297	14.20	2.26	240	13.49	2.37	3.94	535	.000
	High	335	13.48	2.27	145	14.23	2.10	190	12.89	2.23	6.14	333	.000
	Total	1261	13.83	2.33	633	14.27	2.26	628	13.41	2.31	7.55	1259	.000
Confidence in Intelligence	Elementary	389	3.10	.58	191	3.16	.64	198	3.03	.52	2.67	387	.008
	Middle	537	3.02	.65	297	3.09	.71	240	2.95	.57	2.89	535	.004
	High	335	3.07	.64	145	3.20	.69	190	2.96	.58	3.78	333	.000
	Total	1261	3.06	.62	633	3.21	.70	628	2.94	.65	-8.51	1259	.000
BAI Incremental	Elementary	389	3.91	.59	191	4.00	.61	198	3.82	.55	3.82	387	.000
	Middle	537	3.94	.62	297	4.05	.59	240	3.83	.64	4.76	535	.000
	High	335	3.89	.61	145	3.91	.65	190	3.87	.58	.647	333	.518
	Total	1261	3.92	.61	633	3.82	.62	628	3.69	.56	4.51	1259	.000
Giftedness	Elementary	389	3.42	.61	191	3.58	.60	198	3.25	.52	7.13	387	.000
	Middle	537	3.43	.61	297	3.63	.56	240	3.22	.58	8.93	535	.000
	High	335	3.42	.58	145	3.62	.58	190	3.26	.53	6.66	333	.000
	Total	1261	3.43	.60	633	3.61	.58	628	3.24	.56	13.16	1259	.000
Intrinsic motivation	Elementary	389	3.91	.54	191	3.97	.54	198	3.84	.55	2.83	387	.005
	Middle	537	4.10	.52	297	4.12	.48	240	3.87	.54	6.50	535	.000
	High	335	4.05	.49	145	4.12	.45	190	4.00	.51	2.57	333	.010
	Total	1261	3.98	.53	633	4.07	.50	628	23.90	.54	-6.86	1259	.000
Extrinsic motivation	Elementary	389	3.98	.72	191	4.05	.73	198	3.92	.72	2.26	387	.024
	Middle	537	3.86	.76	297	3.98	.73	240	3.72	.76	4.61	535	.000
	High	335	3.83	.73	145	3.89	.73	190	3.78	.74	1.66	333	.098
	Total	1261	3.90	.74	633	3.99	.72	628	3.69	.55	-5.14	1259	.000

Table 3. Descriptive Statistics of Leadership, Family Processes, Confidence in Intelligence, Incremental BAI, Intrinsic and Extrinsic Motivation of Olympians and Future Olympians by School Level

						d (Scheffé)	
			N	***M***	***SD***	**Elementary**	**Middle**
Leadership	Future Olympians	Elementary	191	17.27	2.95		
		Middle	297	17.94	2.72	-.658 ***	
		High	145	17.89	2.56	-.657 **	.167
	Olympians		25	24.94	3.22		
Family Processes	Future Olympians	Elementary	191	14.37	2.37		
		Middle	297	14.20	2.26	.182	
		High	145	14.23	2.10	.579 **	.387 *
	Olympians		25	12.89	2.13		
Confidence in Intelligence	Future Olympians	Elementary	191	3.16	.64		
		Middle	297	3.09	.71	.132	
		High	145	3.20	.69	.163	.031
	Olympians		25	3.80	.83		
BAI Incremental	Future Olympians	Elementary	191	4.00	.61		
		Middle	297	4.05	.59	-.012	
		High	145	3.91	.65	.067	.080
	Olympians		25	3.73	.52		
Giftedness	Future Olympians	Elementary	191	3.58	.60		
		Middle	297	3.63	.56	-.015	
		High	145	3.62	.58	-.004	.010
	Olympians		25	4.33	.52		
Intrinsic Motivation Incremental	Future Olympians	Elementary	191	3.97	.54		
		Middle	297	4.12	.48	-.150 **	
		High	145	4.12	.45	-.150 **	-.000
	Olympians		25				
Extrinsic Motivation	Future Olympians	Elementary	191	4.05	.73		
		Middle	297	3.98	.73	.068	
		High	145	3.89	.73	.155	.087
	Olympians		25				

Note. * $p < .05$, ** $p < .01$

Pearson correlations were computed to examine the inter-correlations of giftedness, intrinsic motivation, extrinsic motivation, confidence in intelligence, incremental beliefs about intelligence (BAI), positive family processes, and leadership. Table 4 reveals that the correlations between the variables were all significant, ranging from, $r = .105$ to $r = .525$. The strongest correlation, which is considered a large effect size, was between positive family process and leadership, $r = .525$, $n = 633$, $p < .001$. This means that students who perceived more positive family processes were likely to have a higher level of leadership. The results also show that students who have higher intrinsic motivation ($r = .505$, $n = 633$, $p < .001$), confidence in intelligence ($r = .343$, $n = 633$, $p < .001$), extrinsic motivation ($r = .318$, $n = 633$, $p < .001$), and incremental BAI ($r = .308$, $n = 633$, $p < .001$), and giftedness ($r = .268$, $n = 633$, $p < .001$) are most likely to have higher leadership, with medium to large effect sizes.

Table 4. Zero-Order Correlation Coefficients of Leadership and Personal Characteristics (N = 633)

Variables	*M*	*SD*	1	2	3	4	5	6
1.Leadership	17.70	2.77	–					
2.Giftedness	3.62	.57	.268***	–				
3.Instrinsic Motivation	4.08	.49	.505***	.141	–			
4. Extrinsic Motivation	3.99	.72	.318**	.105**	.439***	–		
5.BAI incremental	3.82	.62	.308***	.164***	.294***	.150***	–	
6. Confidence in Intellig.	3.21	.72	.343***	.226***	.167***	.186***	.269***	–
7. Positive Family Process	14.27	2.30	.525***	.186***	.346***	.239***	.293***	.260***

Note. *** $p < .001$

Predictive Relationship Among Personal and Environmental Characteristics for the Development of Leadership Competencies Examined by Stepwise Multiple Regression Analyses

Regression analyses on the predictors for leadership were conducted. For all students, $F(5,1255) = 181.699$, $R^2 = .420$. Initial $R^2 = .282$ with only family processes in the model increased to .385,.408, .416, and .420 when intrinsic motivation, confidence in intelligence, giftedness, and extrinsic motivation were added, respectively, to the model.

For general education students, a combination of predictors – family processes, intrinsic motivation, confidence in learning ability, extrinsic motivation, and giftedness – was entered into the model, resulting in $F(5,622) = 73.155$, $R^2 = .370$. Initial $R^2 = .261$ with only family processes in the model increased to .350, .361, .366 and .370 when intrinsic motivation, confidence in intelligence, extrinsic motivation, and giftedness, respectively, were added.

For future Olympians, significant predictors were found to be a combination of family processes, intrinsic motivation, confidence in intelligence, and giftedness, $F(4,628) = 124,106$, adjusted $R^2 = .441$. Initial $R^2 = .275$ for only family processes in the model increased to .394 and .428, and .441 by adding intrinsic motivation, confidence in intelligence, and giftedness, respectively. Family processes were the most important predictor for leadership of all students regardless of whether they belonged to the normative group or the future Olympian group. The next most significant predictor was intrinsic motivation.

The most significant predictors for each group of future Olympians including Olympians were examined. For Olympians, confidence in intelligence was found to be the only significant predictor variable, explaining 39.2% of the variance in their leadership.

When analyzed separately by school level, the number of predictors and their order for entering into the model were different for the future Olympians at each school level. For future Olympian elementary school students, significant predictors entered into the model were a combination of family processes, extrinsic motivation, incremental BAI, intrinsic motivation, and giftedness, $F(5,185) = 53.102$, adjusted $R^2 = .589$. Initial $R^2 = .390$ for only family processes increased to .502, .544, .579, and .589 by adding extrinsic motivation, incremental BAI, intrinsic motivation, and giftedness, respectively, to the model.

For future Olympian middle school students, significant predictors were a combination of family processes, intrinsic motivation, giftedness, and incremental BAI $F(4,292) = 49.851$, adjusted $R^2 = .406$. Adjusted $R^2 = .257$ for only family processes increased to .364, .397, and .406 when intrinsic motivation, giftedness, and incremental BAI, respectively, were added.

For future Olympian high school students, significant predictors were a combination of intrinsic motivation, family processes, confidence in intelligence $F(3,141) = 29.204$,

adjusted R^2 = .384. R^2 = .234 for only intrinsic motivation in the model increased to .323 and .384 by adding family processes and confidence in intelligence, respectively, to the model. Results of the regression analyses revealed, with moderate to large effect sizes, that leadership of younger future Olympians is mainly explained by family processes, whereas leadership of scientifically high school students was mainly explained by their intrinsic motivation rather than by other predictors.

Since family processes were found to be significant predictors of leadership for all of the subgroups in this study, the predictive power of the sub-processes of family processes were examined in more detail. Family processes include support, pressure, pressure for intellectual development (PID), parents' discussions, and supervision.

When the sub-factors of family processes were used to explain the variance of leadership of all students, family cohesion, support, and PID were entered into the model, $F(3,1257) = 211.99$, R^2 = .297. Initial R^2 = .228 with family cohesion increased to .273 and .297 with additional factors entered into the model, respectively. For all elementary school students, $F(3,385) = 39.43$, adjusted R^2 = .354. Initial R^2 = .313 increased to .323 and .354 by adding PID and support, respectively. For all middle school students, PID, cohesion, and support were entered with $F(3,533) = 109.494$, R^2 = .339 and .252, .319, .339, when PID, cohesion, and support, respectively, were added. For all high school students, $F(4,330) = 89.465$, R^2 = .244 from .142, .205, .235, and .244 when cohesion, support, supervision, and PID, respectively, were added. This shows that younger students need more PID, whereas secondary school future Olympians need more family cohesion for higher leadership.

For all future Olympians, the sub-factors of family processes were a combination of family cohesion, support, PID, and pressure, $F(4,628) = 80.31$, R^2 = .299. Initial R^2 = .221 for family cohesion increased to .275, .296, and .299 by adding support, PID, and pressure, respectively. For all general education students, $F(3,624) = 93.07$, R^2 = .268. Initial R^2 = .220 for family cohesion increased to .250 and .268 by adding PID and support, respectively. There was no difference in the best predictor of leadership for the groups of future Olympians and general education students. Family cohesion explained the greatest variance in leadership.

Predictive Relationship Among Personal and Environmental Characteristics for the Development of Leadership Competencies Examined by Structural Equation Modeling

Covariance structure analyses using the program AMOS were conducted to determine whether the hypothesized model following MDAAM explained the predictive relationships among the predictors and leadership. Of the six predictors, incremental BAI and extrinsic motivation were excluded because of their low correlations with leadership. Family processes, intrinsic motivation, giftedness, and confidence in intelligence were selected for structural equation modeling analyses, since these were frequently found to be significant sets of predictors in the results of the stepwise multiple linear regression analyses, explaining most of the variance in leadership.

Results showed that the proposed model (see figure 1) has a good fit, $\chi^2 = 1.646$, $df = 1$, $p > .05$, $CFI = .999$, $TLI = .994$, $NFI = .998$, $RMSEA = .023$, $AIC = 39.646$. Results (see table 5) of this study revealed that all four predictors – confidence in intelligence (β = .139), family process (β = .363), giftedness (β = .093), intrinsic motivation (β = .320) – positively influence leadership. More specifically, confidence in intelligence, which is a positive predictor of leadership, was positively influenced by giftedness (β = .219) and family process (β = .220). Intrinsic motivation, another predictor of leadership, was also positively influenced by family process (β = .314) and giftedness (β = .141).

Direct, indirect, and total effects of family process, giftedness, confidence in intelligence, and intrinsic motivation were found to be substantial (see table 6). Overall influence for leadership is manifested by the total effect, which consists of direct and indirect effects.

Direct effect means direct path coefficient between leadership and family process, giftedness, confidence in intelligence, and intrinsic motivation. In the hypothesized model, the highest total effect was from family process (.494) followed by a relatively high total effect from intrinsic motivation (.320). Total effects of giftedness and confidence in intelligence were .168 and .139, respectively. Indirect effects to leadership were found in family processes (.131) and giftedness (.076). The hypothesized model explained 41% of the total variance of leadership.

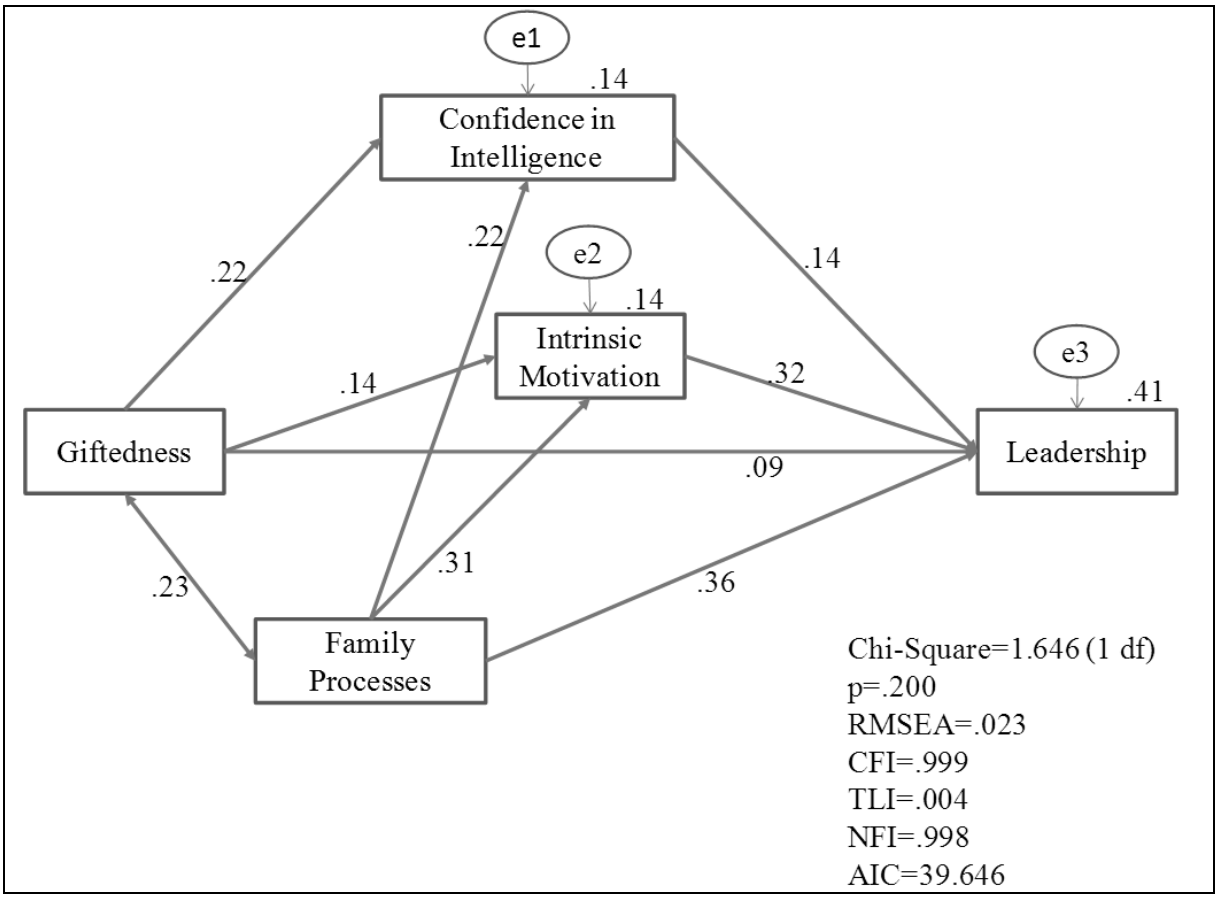

Figure 1. Predictive relationship among giftedness, family processes, personal characteristics and leadership.

Table 5. Estimates Between Predictor and Outcome Variables

Variables			*B*	β	*S.E.*	*C.R.*
Outcomes		**Predictors**				
Confidence in Intelligence	←	Giftedness	.261	.219***	.032	8.064
Confidence in Intelligence	←	Family Process	.066	.220***	.008	8.109
Intrinsic Motivation	←	Family Process	.069	.314***	.006	11.698
Intrinsic Motivation	←	Giftedness	.123	.141***	.023	5.264
Leadership	←	Confidence in Intelligence	.520	.139***	.086	6.058
Leadership	←	Family Process	.107	.363***	.027	15.219
Leadership	←	Giftedness	.413	.093***	.102	4.041
Leadership	←	Intrinsic Motivation	1.639	.320***	.119	13.759

Note. *** $p < .001$; C.R. = Critical Ratio

Table 6. Direct, Indirect, and Total Effects (Standardized Beta Weights) of Predictive Variables on Leadership

	Direct Effect	Indirect Effect	Total Effect
Family Process	.363	.131	.494
Intrinsic Motivation	.320	.000	.320
Giftedness	.093	.076	.168
Confidence in Intelligence	.139	.000	.139

Discussion

This study was conducted in order to examine the predictive relationship among personal and environmental characteristics of leadership development based on the MDAAM (Heller, 2010a, 2010b). Unlike previous studies which examined the relationship between giftedness and leadership focused on giftedness in general, such as intellectual or academic giftedness (Chan, 2007; Karnes & D'Ilio, 1989; Landau, 2000; Lee, Olszewski-Kubilius, 2006), this study investigated the leadership development of the scientifically talented individuals. Results demonstrate that future Olympians have a higher possibility of becoming leaders than the general education population. In addition, as they become experts in science, their leadership scores increased. This finding is consistent with findings shown with gifted students in Hong Kong (Chan, 2007), which showed that age is a good predictor of leadership since students become clearer about their life goals with time.

Contrary to the concerns of Jones, Simonetti, and Vielhaber-Hermon (2000), who claimed that scientists do not have leadership characteristics, these results illustrated that future Olympians revealed higher or more personal and environmental characteristics that can facilitate the development of leadership competencies compared to the general education population. This study attempted to explore the possibility of developing talents both in leadership and in science, which differs from previous studies that examined leadership as a category of giftedness (Chan, 2007; Lee & Olszewski-Kubilius, 2006; Landau, 2008; Oakland, Falkenberg, & Oakland, 1996; Shore, Cornell, Robinson, & Ward, 1991).

At each developmental stage, the combinations of predictors were found to be slightly different. The influence of family processes for leadership development was greatest for young future Olympians and decreased at later stages of development. Intrinsic motivation and confidence in intelligence became better predictors for older future Olympians. This can be interpreted that as students get older, the influence of family processes is internalized into intrinsic motivation and confidence in intelligence (Heller, 2010a, 2010b). Parents' effort for providing resources for their children's intellectual development is critical for leadership development at the elementary school level. However, as they grow older, family cohesion becomes more important. This finding implies that when children are young, parents need to provide intellectual resources to help them develop intelligence (Chan, 2005). However, as they get older, parent cohesion becomes more important most likely because students develop communication skills and sensitivity to others through their parents' role modeling. This finding indicates that home is the essential environment where leadership can be nurtured the most, especially when children are young (Avolio, Rotundo, & Walumbwa, 2009; Chan, 2005; Karnes & D'Ilio, 1989).

The importance of family environment, particularly the sub-factor of family cohesion, was repeatedly found in previous studies (Chan, 2005; Karnes & D'Ilio, 1989). In this study, the relative importance of various family sub-factors is clearly shown. Family support was an important sub-factor of family processes, which is consistent to Avolio, Rotundo, and Walumbwa (2009), who found that children of authoritative parents did not display high leadership behaviors. The more parents support and respect the autonomous decisions of

their children, the better they may learn about how to behave as a leader. In this study, the result that parents' effort in facilitating their children's intellectual development is an important predictor of leadership development is consistent with suggestions from Karnes and D'Ilio (1989), who claimed that children and youth should be encouraged to read extensively in areas such as current events through the newspapers and weekly and monthly magazines, biographies and autobiographies of leaders and others who have influenced society, and books and other materials on historical perspectives.

A limitation of this study was the small number of Olympians, and the various aspects of leadership development of Olympians could not be analyzed in many different ways. In addition, the leadership competencies measured in this study were related more to transformational leadership than other types of leadership.

Conclusions and Future Research

This study was an initial attempt to study the leadership of scientifically talented individuals and examine the predictive relationship among personal and environmental characteristics for leadership development along developmental stages. In this study, the high validity of the MDAAM (Cho, Lin, & Hwang, 2011; Heller, 2010b) as a talent development model was confirmed again. It was demonstrated that environmental characteristics (family processes) moderated and personal characteristics (intrinsic motivation and confidence in intelligence) mediated leadership development.

In future studies, the mediator roles of personal characteristics should be studied more intricately. In addition, gender differences in the predictive relationship among personal and environmental characteristics should be examined in detail. It is also necessary to determine what kinds of educational programs should be provided for young future Olympians in order for them to become adult STEM leaders. Essential competencies and developmental factors of the individuals whose contribution to the facilitation of STEM advancement have been recognized may need to be studied further.

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The Authors

Dr. Seokhee Cho is an Associate Professor at the School of Education, St. John's University. She is currently conducting three research projects funded by the US Department of Education. She has written numerous books and articles on creative problem solving and gifted education. She has been the Director of the National Research Center on Gifted Education in Korea, the President of the Asia Pacific Federation of the World Council for the Gifted and Talented (WCGTC), and a member of the Korean Presidential Advisory Council for Educational Innovation. She is serving as the Editor-in-Chief of the AP *Journal of Gifted and Talented Education* of the Asia Pacific Federation of WCGTC. She is also serving as Review Board Member of *Gifted Child Quarterly*, *Gifted Education International*, the *Journal of Gifted/Talented Education* by the Korean Society for the Gifted, and the *Turkish Journal of Giftedness and Education*.

Dr. Suksil Han is an Associate Professor in the Department of Early Childhood Education at Youngdong University, Republic of Korea. She worked as a researcher for three years at the National Research Center for Gifted and Talented Education, Korean Educational Development Institute. She is currently an executive board member of The Korean Society for Early Childhood Education.

Dr. Mary Ellen Freeley is an Associate Professor in the Department of Administration and Instructional Leadership at St. John's University where she teaches graduate and doctoral levethe l classes. She has served as a New York City teacher and as an elementary principal and assistant superintendent in Nassau County. Subsequently, Dr. Freeley worked as a Superintendent of Schools for 12 years in Nassau County. She is the past president of International ASCD and currently faculty advisor to the St. John's Chapter of PDK and an executive board member of the Metropolitan Council of Educational Administration Professors (MCEAP).

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Ethical Thinking Skills of Mathematically Gifted Finnish Young Adults

Kirsi Tirri[1]* and Petri Nokelainen[2]

Abstract: This study investigated ethical thinking skills of mathematically highly gifted Finnish young adults (*N* = 13) and their relation to general intelligence (WAIS-III) and moral reasoning (DIT). Results showed that mathematically gifted young adults who had highest FSIQ scores reported higher ability to tolerate different ethical views, take another person's position when facing a conflict situation and recognise new important ethical problems than their lower achieving peers. Further, individual differences in general intelligence did not differentiate one's ability to express different feelings to other people, take care of other people's well being, control own prejudices when making ethical evaluations and create alternative ways to act when facing ethical problems in everyday life. Results further showed that mathematically gifted young adults who scored highest and lowest in DIT were more neglective about their interpersonal relationships than those with mid scale DIT scores. Further, highest order ethical sensitivity was positively related to moral reasoning.

Keywords:

moral reasoning, Defining Issues Test (DIT), moral and ethical sensitivity, mathematically gifted

According to earlier empirical research we know that intelligence tends to correlate with high levels of moral reasoning (Narvaez, 1993; Räsänen, Tirri, & Nokelainen, 2006). However, the relationship between intelligence and morality is a very complex one and needs more detailed studies (Tirri & Nokelainen, 2007). Results of a recent study in a private and independent boarding school in Finland showed that although mathematically gifted young adults (*N* = 20) scored exceptionally high on both intelligence (WAIS-III, see Wechsler, 1997) and moral reasoning (DIT, see Rest, 1986) tests, there was no statistical dependency between the two test scores (Tirri, Nokelainen, & Mahkonen, 2009). Results also showed that the most intelligent young adults of the "A group", whose full-scale intelligence quotient (FSIQ) score from the WAIS-III test was more than 130, were more against the lowest and highest forms of religious judgment (RJT, see Räsänen, Tirri & Nokelainen, 2007) than their less intelligent peers ("C group", FSIQ from 111 to 120). Finally, the study showed that the level of moral reasoning was negatively related to lowest and highest stages, but positively related to the middle stage, of religious orientation.

This study explores those mathematically gifted young adults' mindsets further by adding an ethical sensitivity component to the design. According to Muriel Bebeau and her colleagues (1999), moral sensitivity is about the awareness of how our actions affect other people. Thus, without moral sensitivity it is difficult to see what kind of moral issues are involved in everyday life. However, to respond to a situation in a moral way, a person must be able to perceive and interpret events in a way that leads to ethical action. In this study, we consider the terms moral and ethical sensitivity synonymous. An ethically sensitive person notes various situational cues and is able to visualize several alternative actions in

[1] *University of Helsinki, Finland*
[*] *Corresponding author: Department of Teacher Education, Faculty of Behavioral Sciences, University of Helsinki, P. O. Box 9 (Siltavuorenpenger 5 A), FI-00014 University of Helsinki, Finland. Email: kirsi.tirri@helsinki.fi*
[2] *University of Tampere, Finland*

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response to that situation. He or she draws on many aspects skills, techniques and components of interpersonal sensitivity. These include taking the perspective of others (role taking), cultivating empathy for a sense of connection to others, and interpreting a situation based on imagining what might happen and who might be affected.

We have operationalized ethical sensitivities into the Ethical Sensitivity Scale Questionnaire (ESSQ, see Tirri & Nokelainen, 2007) containing seven sets of skills based on Darcia Narvaez's (2001, 2006, 2011) research: (1) Reading and expressing emotions, (2) Taking the perspectives of others, (3) Caring by connecting to others, (4) Working with interpersonal and group differences, (5) Preventing social bias, (6) Generating interpretations and options, and (7) Identifying the consequences of actions and options.

In this paper, we analyze the relationships between ethical sensitivity (ESSQ), general intelligence (WAIS-III) and moral reasoning (DIT) in a sample of mathematically gifted young adults ($N = 13$, $M_{AGE} = 16.3$, $SD_{AGE} = .48$). The research questions are: (1) Is ethical sensitivity of mathematically gifted young adults related to their general intelligence (WAIS-III Full Scale IQ)? (2) Is ethical sensitivity of mathematically gifted young adults related to their moral reasoning (DIT P index)?

This paper is organized as follows: First, we give an overview of the existing research on measurement of moral reasoning and ethical sensitivity. Next, we describe the sample and our research instruments. Finally, we present the results and discuss their practical implications.

Theoretical Background

Research on Moral Reasoning

Most of the studies in the area of moral development are based on the cognitive-developmental theory of Lawrence Kohlberg (e.g., 1969). The Defining Issues Test (DIT) is a well-documented measure of moral judgment that has been used all over the world (Rest, 1986). The index most frequently used is the "P index," which reflects a person's principled reasoning (stages 5 and 6 in Kohlberg's theory). Kohlberg's procedures have been criticized for lack of diversity in the moral dilemmas that have been used in the interviews (Yussen, 1977). The hypothetical dilemmas can also be seen as being too abstract and removed from the daily experiences of most people (Straughan, 1975). Recognition of these aspects of hypothetical dilemmas has led educational researchers to study real-life moral problems identified by people (Walker, de Vries, & Trevethan, 1987). The research conducted in this area shows that the adolescents formulate dilemmas, which are very different from the hypothetical dilemmas used by Kohlberg and his colleagues to assess moral reasoning (Yussen, 1977; Binfet, 1995). Most of the dilemmas formulated by Kohlberg focus on issues of ownership, public welfare and life-and-death. In Yussen's (1977) study, the moral dilemma themes formulated by adolescents focused most frequently on interpersonal relations. Colangelo (1982) and Tirri (1996) found the same tendency with gifted adolescents.

Andreani and Pagnin (1993) provided a comprehensive review of the literature in their article . According to these authors, the gifted students are presumed to have a privileged position in the maturation of moral thinking because of their precocious intellectual growth. Terman's (1925) sample of gifted children showed superior maturity in moral development in choosing socially constructive activities and in rating misbehaviour.

In the 1980's, Karnes and Brown (1981) made an initial investigation on moral development and the gifted using Rest's DIT. Their sample included 233 gifted students (9 – 15 years in age) who were selected for a gifted program. The results of the DIT were compared to the students' results in a test that measured their intellectual ability (WISC-R). The empirical results of the study showed a positive correlation between the two tests. According to researchers, intellectually gifted children appear to reach a relatively high stage of moral reasoning earlier than their chronological peers (Karnes & Brown, 1981).

Other studies of moral judgment using DIT P indexes have shown that gifted adolescents scored higher than their peers as a group (Tan-Willman & Gutteridge, 1981; Janos & Robinson, 1985; Narvaez, 1993). However, the data with high-achieving adolescents has indicated that the relationship between apparent academic talent and moral judgment indexes is more complex. According to Narvaez's study, high academic competence is necessary for an unusually high P index, but it does not necessarily predict it. The high achievers can have average to high moral judgment index, whereas low achievers cannot be high scorers in moral judgment (Narvaez, 1993).

Ikonen-Varila (2000) reported DIT P indexes of Finnish 9th graders (N = 1631). According to her, the proportion of post-conventional moral reasoning was 22.6 %. Ikonen-Varila found a positive connection between academic competence and moral reasoning. The school success classified into three groups (satisfactory, moderate, and excellent) produced the average DIT P indexes of 15.4, 24.2 and 29.7, respectively. She concluded that because cognitive factors regulate moral reasoning in childhood and adolescence, it is natural that school success is one of the main background factors explaining moral reasoning abilities. Her results support the connection between giftedness and moral reasoning: the more gifted, the more capable of doing principled moral reasoning.

Tirri and Pehkonen (2002) explored the moral reasoning and scientific argumentation of Finnish adolescents who are gifted in science. These 16 girls and 15 boys (14–15 years of age) participated in a gifted program at the University of Helsinki. The design contained the following research instruments and procedures: (1) Raven's Standard Progressive Matrices (SPM) were used to provide a test for comparing students' capacities for observation and clear thinking; (2) students' moral reasoning was measured with DIT; (3) students were asked to write essays on scientific moral dilemmas; (4) researchers interviewed the students. The results show that the average DIT P index was 41, representing the average score for a heterogeneous group of 18-year-olds. Scores ranged from 7 to 78, indicating quite high variance (SD = 15.8); some students really represented post conventional moral reasoning, some did not at all. An interesting finding was that the correlation between DIT and SPM was near zero (Tirri & Pehkonen, 2002).

In a recent Finnish study, DIT P indexes of 51 academically gifted 9th grade students and their average-ability peers (N = 77) were compared (Räsänen et al., 2006). Räsänen and his colleagues investigated the DIT P index distribution separately for the male (n = 21) and female (n = 25) sub samples. The score average for the gifted males was 35.0 with a standard deviation of 15.5. The lower bound of 95 % confidence interval was 26.7 and the upper bound was 43.3. The DIT P indexes ranged from 16 to 79 in the male sub sample. The score average for the gifted females was 35.9 with a standard deviation of 15.4. The lower bound of 95 per cent confidence interval was 29.5 and the upper bound was 42.3. DIT score values range from 15 to 75 in the female sub sample. These results are in parallel with those of an earlier Narváez (1993) study. She found that standard deviation increased together with the level of giftedness concluding that academic competence is a necessary but not sufficient condition for principled thinking.

Räsänen and his colleagues (2006) further classified the DIT scores into four classes on the basis of the quartiles: 1st quartile (25 %, DIT score values below 25.0), 2nd quartile (50 %, DIT score values from 25.0 to 33.9), 3rd quartile (75 %, DIT score values from 34.0 to 44.4) and 4th quartile (100 %, DIT score values above 44.4). However, no statistically significant difference between the DIT scores of male and female respondents was found, $\chi^2(3,\ n = 41) = 4.733,\ p = .192$. Existing research shows that the absence of gender differences with gifted students is not unusual. Narváez (1993) did not find significant differences between gifted female and male students as girls had an average P index of 28.2 while the boys had an average P index of 25.6. Also Rest (1986) concludes, on the basis of meta-analysis of 56 DIT studies, that although females usually gain higher P indices than males, gender accounts only for 0.9 per cent of the variance. According to him, age and education are 250 times more powerful than gender in explaining the P index variance.

Research on Ethical Sensitivity

Ethical sensitivity is closely related to a new suggested intelligence type, social intelligence, which can be defined as the ability to get along well with others and get them to cooperate with you (Albrecht, 2006; Goleman, 2006). Numerous tests of ethical sensitivity have been developed over the years, but most of them are very context-specific, for example, relating to medicine and dental education (Bebeau, Rest, & Yamoor, 1985) or to the racial and gender intolerance (Brabeck, Rogers, Sirin, Handerson, Ting, & Benvenuto, 2000).

Darcia Narvaez (2001, 2006, 2011) has operationalized ethical sensitivity to include seven sets of skills that operate in more general level. Those ethical skills guided development work of the Ethical Sensitivity Scale Questionnaire (ESSQ, Tirri & Nokelainen, 2007) that is applied in this study.

Tirri and Nokelainen (2007) examined ethical sensitivity self-evaluations of two Finnish urban schools 7th–9th grade students with the ESSQ. The sample (n = 249) consisted of 132 (53 %) females and 116 (47 %) males, age median was 14 years. The study showed that psychometric properties of ESSQ were satisfactory for scientific work as the Cronbach's alpha values range from .50 to .78. According to the results, female students estimated their ethical skills higher than their male peers. This tendency was explained by the nature of items which mostly measure caring ethics with emotional and social intelligence. Academically gifted students (GPA above 8.4 on a scale from 4 to 10) estimated their ethical skills higher than average ability students (GPA below 8.5). The finding supported research (e.g., Andreani & Pagnin, 1993; Karnes & Brown, 1981; Terman, 1925) suggesting that gifted students hold a privileged position in the maturation of moral thinking because of their precocious intellectual growth.

Method

Sample

The sample (N = 13) consists of seven female and six male first year upper secondary school students in an independent and private boarding school in Finland. The school is specialized on Mathematics education and competitions. Participant's age was from 16 to 17 years (M = 16.31, SD = 0.480). All the measurements were completed during 2008–2010.

Measurements

An experienced licensed psychologist measured students' general intelligence (containing verbal and performance indexes) with the Wechsler Adult Intelligence Scale III (WAIS-III, Wechsler, 1997). In addition, students responded on two scales: Defining Issues Test (DIT, Rest, 1986) and Ethical Sensitivity Scale Questionnaire (ESSQ, Tirri & Nokelainen, 2007).

WAIS-III is one of the most well known intelligence tests world-wide. The test contains two main components, Verbal IQ (VIQ) and Performance IQ (PIQ) that form together the general level full-scale intelligence (FSIQ). In the following analysis, we used the FSIQ score to represent participant's measured intelligence. The "A group" consisted of students, who had the highest FSIQ scores in the sample (131–136), students in the "B group" had scores from 121 to 130, and the "C group" consisted of students who had the lowest FSIQ scores (111–120) in the sample.

The Defining Issues Test (DIT) is based on Kohlberg's (1969) research on moral judgment. It contains six dilemmas: (1) Heinz and the Drug; (2) Student Takeover; (3) Escaped Prisoner; (4) The Doctor's Dilemma; (5) Webster; (6) Newspaper. According to Rest (1986), people at different points of development interpret moral dilemmas differently, define the

critical issues of the dilemmas differently and have different intuitions about what is right and fair in a situation. Respondents' task is to consider 12 issues for each dilemma and then indicate which ones are the most important in making a decision about what one ought to do. The P index ("principled morality") is the most widely used score from the DIT (also including D index, M score, A score, Utilizer score and Action Choice index). According to Rest (1986), it is calculated by summing the number of times that Kohlberg's stage 5 and 6 items are chosen as the first, second, third, or fourth important consideration, weighting these ranks by 4, 3, 2, and 1, respectively. The score ranges from zero (lowest) to 95 (highest). Test-retest reliability ranges between .70–.80 and the DIT typically takes 35–50 minutes to complete (Narváez, 1993). There is also a new version of the test (DIT 2) available, but it is shown to correlate positively with the DIT test (.53–.70) (Thoma, Rest, Narváez, & Derryberry, 1999). In this study, DIT P index, ranging from 0 to 95, was discretized into three classes (1 < 40, 2 = 40–49, 3 > 49).

Ethical sensitivity is measured with ESSQ (Tirri & Nokelainen, 2007), a 28-item multiple choice questionnaire based on Darcia Narvaez's model (2001, 2006, 2011). The scale for each item ranges from 1 (totally disagree) to 5 (totally agree). The ESSQ items have been designed in a way that they apply to people from different backgrounds and cultures. The seven dimensions of ethical sensitivity are as follows: (1) Reading and expressing emotions (e.g., "In conflict situations, I am able to identify other persons' feelings."); (2) Taking the perspectives of others (e.g., "I am able to cooperate with people who do not share my opinions on what is right and what is wrong."); (3) Caring by connecting to others (e.g., "I am concerned about the well-being of my partners."); (4) Working with interpersonal and group differences (e.g., "I take into account other peoples' viewpoints before making any important decisions in my life."); (5) Preventing social bias (e.g., "I try to take my own bias into account when I take a stand on ethical issues."); (6) Generating interpretations and options (e.g., "I contemplate the consequences of my acts when making ethical decisions."); and (7) Identifying the consequences of actions and options (e.g., "I notice that there are ethical issues involved in the contacts between people."). ESSQ was analyzed with the summative scores of the seven ethical sensitivity dimensions.

In addition, student's gender, school achievement (self-reported 9th grade marks in mathematics, religion, native and foreign languages) and mathematical giftedness (boarding schools' entrance examination test) were used as control variables in the analysis.

Statistical Analyses

Due to a small sample size and uncertainty of linear variable dependencies (Marini, Li, & Fan, 1996), we applied non-linear and non-parametric Bayesian statistical techniques to answer the research questions. Bayesian theory, based on a concept of subjective probability, was initially developed by a British reverend Thomas Bayes in the 18th century and published posthumously (Bayes, 1763). The essential benefits of using discerete Bayesian methods in this study are as follows: They work robustly with small samples and discrete indicators, are able to analyze both linear and non-linear statistical dependencies, and allow prediction with the model derived from the data (Gill, 2002; Nokelainen, Silander, Ruohotie, & Tirri, 2007).

In this study, Bayesian models were calculated with the B-Course computer program (Myllymäki, Silander, Tirri, & Uronen, 2002). Bayesian dependency modelling (BDM) predicts the most probable statistical dependency structure between the observed variables (Nokelainen, 2008.). It visualizes the result in a form of Bayesian network (Heckerman, Geiger, & Chickering, 1995) allowing the user to probe the model by adjusting the values of all variables and examining the effects to other variables included in the best model.

Results

Overall Results of WAIS-III, DIT and ESSQ

Participants' VIQ and PIQ scores were as follows: $M_{VIQ} = 124.46$, $SD_{VIQ} = 6.293$; $M_{PIQ} = 124.06$, $SD_{PIQ} = 7.984$. We conclude that the sample consists of highly intelligent young adults as most of the participants ($n = 11$, 85 %) were above the "slightly better than average" level (111–120 points) in FSIQ ($M_{FSIQ} = 125.85$, $SD_{FSIQ} = 5.655$).

DIT P index represents the relative importance that participants attribute to stage 5 and 6 items of Kohlberg's theory (Level 3, post-conventional: "Social Contract Orientation" and "Universal Ethical Principles"). Participants completed the DIT within 20–50 minutes ($M = 38.46$, $SD = 11.435$). The resulting P index, 38.62 ($SD = 10.153$), is according to Narvaéz (1993), above the normal senior high level ($M = 31.80$, $SD = 13.500$) and resembles more a typical college students' P index ($M = 42.30$, $SD = 13.200$). This finding indicates that the sample represents an exceptionally high level of moral reasoning in their age cohort.

Young mathematicians' ESSQ scores were recorded on the seven dimensions: (1) Reading and expressing emotions ($M = 3.81$, $SD = .512$); (2) Taking the perspectives of others ($M = 4.23$, $SD = .616$); (3) Caring by connecting to others ($M = 4.35$, $SD = .689$); (4) Working with interpersonal and group differences ($M = 3.87$, $SD = .775$); (5) Preventing social bias ($M = 4.15$, $SD = .564$); (6) Generating interpretations and options ($M = 4.23$, $SD = .450$); and (7) Identifying the consequences of actions and options ($M = 3.58$, $SD = .703$). These score averages ranging from 3.8 to 4.4 are clearly higher than those reported by Tirri and Nokelainen (2007) in their study with 249 Finnish 7th–9th grade students (3.3–3.9). This finding supports their notion that academically gifted students tend to estimate their ethical skills higher than average ability students. However, this finding should be interpreted with caution as age is an important cause for variance in P index (participants in our sample are older as their age range is from 16 to 17 years).

RQ 1: Is ethical sensitivity of mathematically gifted young adults related to their general intelligence?

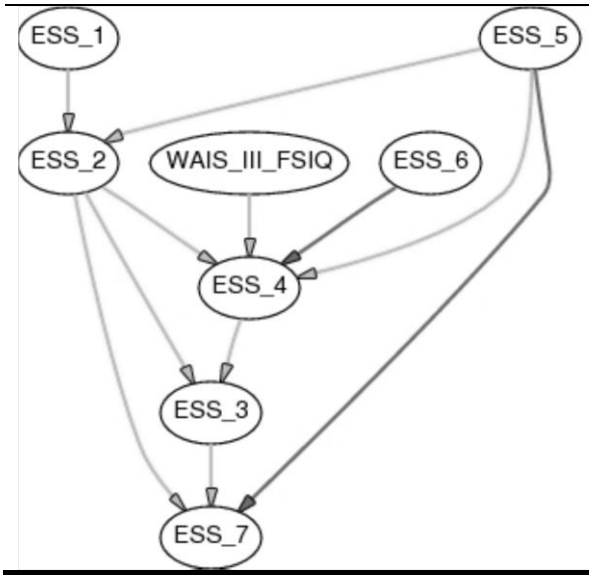
Our hypothesis regarding the first research question is that intelligence and ethical sensitivity should be positively related concepts (e.g., Andreani & Pagnin, 1993; Karnes & Brown, 1981; Terman, 1925). This assumption is supported by our earlier empirical finding of academically gifted students estimating their ethical skills higher than average ability students (Tirri & Nokelainen, 2007). However, we expect to find, in parallel with Narvaéz (1993) that above average level of intelligence is not a linear but non-linear positive predictor of above average level of ethical sensitivity.

The most probable model produced with BDM is presented in table 1. The left hand side of the table is the visualization of the Bayesian Network where nodes represent variables and arches represent statistical dependencies between them. The WAIS-III FSIQ score is directly related to one ESS dimension, namely (4) Working with interpersonal and group differences. The strength of each dependency on the model is indicated with a colour; a darker colour indicates a stronger statistical relationship between the two variables.

Importance ranking corresponding to the colour of the arcs in the final model is presented in the second column in table 1. Probability ratios indicate how removing an arc affects the probability of the model. If the removal makes the model much worse, that is, less probable, it can be considered as an important dependency. If removing the arc does not affect the probability of the model much, it can be considered to be a weak dependency. The probability ratios (1 : X) should be read as follows: the final model is X times as probable as the model that is otherwise identical, but in which the dependency has been removed.

Table 1 shows that the most important dependencies in the model are the ones between ESS dimensions five (Preventing social bias) and seven (Identifying the consequences of

Table 1. Bayesian Network Model of the Dimensions of Ethical Sensitivity and General Intelligence

Network Model	Dependence	Probability ratio
	ESS_5 → ESS_7	1 : 2418
	ESS_6 → ESS_4	1 : 2287
	ESS_2 → ESS_7	1 : 333
	WAIS_III_FSIQ → ESS_4	1 : 254
	ESS_2 → ESS_4	1 : 254
	ESS_3 → ESS_7	1 : 225
	ESS_1 → ESS_2	1:21
	ESS_5 → ESS_4	1 : 9.76
	ESS_5 → ESS_2	1 : 3.67
	ESS_2 → ESS_3	1 : 2.1
	ESS_4 → ESS_3	1 : 1.89

Note. WAIS-III FSIQ = Wechsler Adult Intelligence Scale III Full Scale IQ, ESS 1 = Reading and expressing emotions, ESS 2 = Taking the perspectives of others, ESS 3 = Caring by connecting to others, ESS 4 = Working with interpersonal and group differences, ESS 5 = Preventing social bias, ESS 6 = Generating interpretations and options, and ESS 7 = Identifying the consequences of actions and options.

actions and options), and four (Working with interpersonal and group differences) and six (Generating interpretations and options). Both represent positive statistical dependencies.

The initial value distributions, that is, without making any prediction with the three FSIQ value classes, are shown on the left-hand column of the figure 1 (labelled "0"). Technically speaking, when the A group members are selected (FSIQ value prediction is set to "3" equalling 131–136), we see from the rightmost column (labelled "3") that the highest scoring young adolescents in WAIS-III test are predicted to use less the lowest response option (3) in the questionnaire than their peers in two other groups. However, the following results should be interpreted with caution as the respondents used only positive response options (3,4,5) of the response scale (from 1 "totally disagree" to 5 "totally agree"). On the other hand, the effect of social desirability is always present in measurements conducted with self-report instruments (e.g., Fowler, 1995).

Behavioural patterns of the conditional distributions in the Bayesian network suggest a positive relation between general intelligence and three ethical sensitivity dimensions: (3) Caring by connecting to others, (4) Working with interpersonal and group differences and (7) Identifying the consequences of actions and options. Mathematically gifted young adults who had highest FSIQ scores in the sample ($FSIQ_{A\ group}$ = 131–136) had better self-reported ability to tolerate different ethical views, take another person's position when facing a conflict situation and recognise new, right at the moment important ethical problems than their peers in two lower achieving groups.

Results also showed that the intelligence test score was not related to the four other ethical sensitivity dimensions in the sample: (1) Reading and expressing emotions, (2) Taking the perspectives of others, (5) Preventing social bias and (6) Generating interpretations and options. In other words, individual differences in intelligence did not differentiate one's ability to express different feelings to other people, take care of other peoples' well being, control own prejudices when making ethical evaluations and create alternative ways to act when facing ethical problems in everyday life.

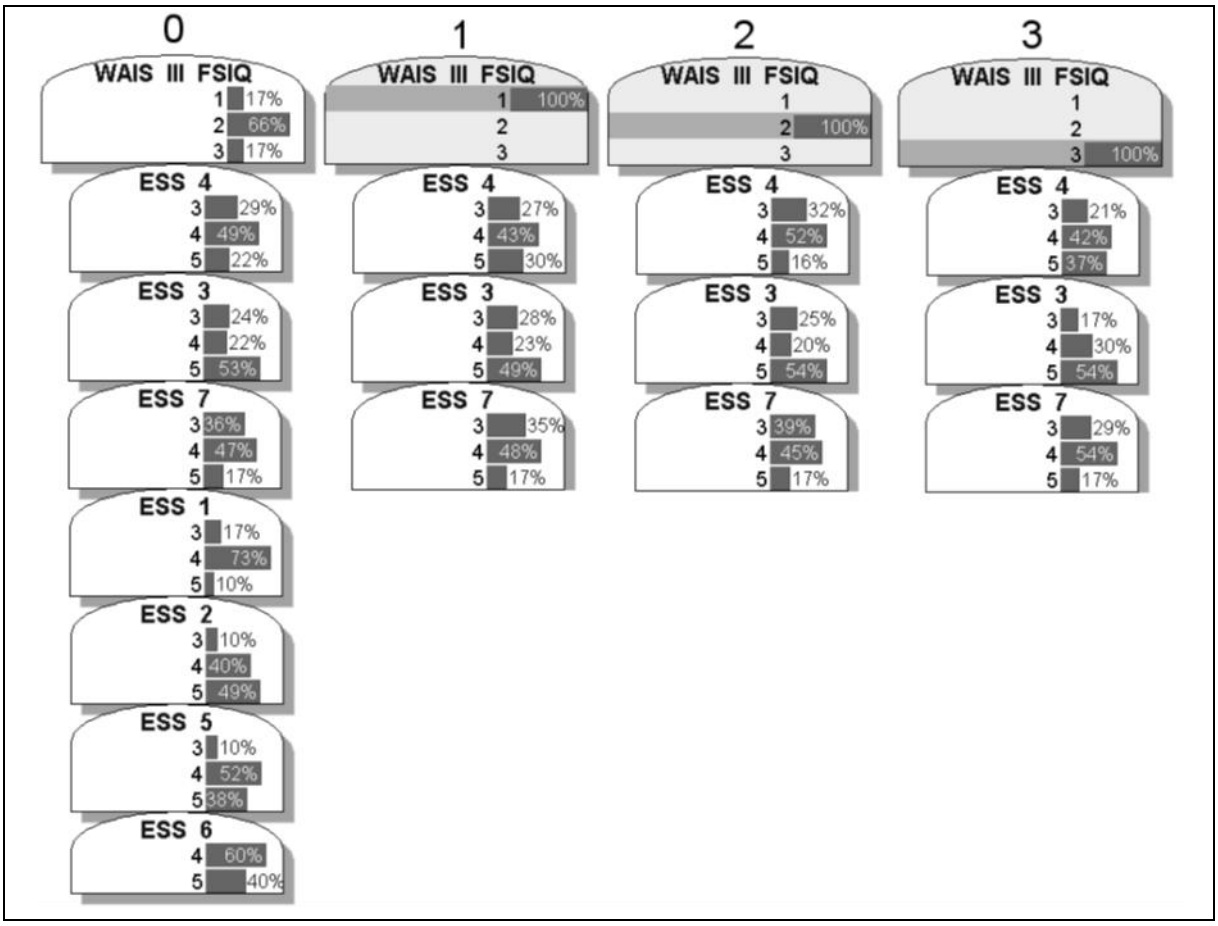


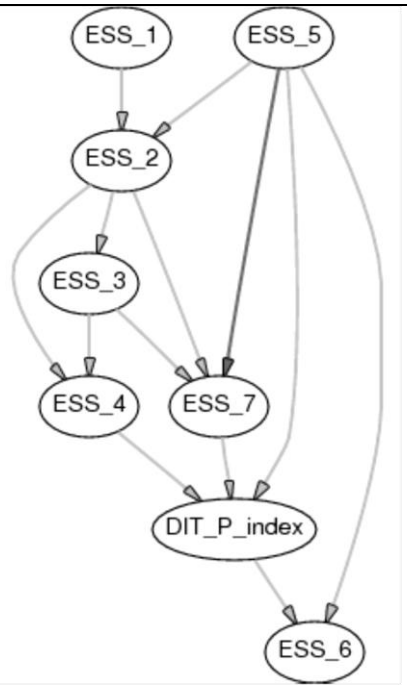
Figure 1. Bayesian dependency model of intelligence and ethical sensitivity. 0 = None of the Wechsler Adult Intelligence Scale III (WAIS-III) full-scale IQ (FSIQ) values are fixed and, thus, no prediction is made about the behavior of the Ethical Sensitivity Scale (ESS) values in the model. 1 = FSIQ value is fixed to represent the lowest achieving "C group" (scores < 121) and the model shows the students' corresponding value distributions on the seven ESS scales. 2 =FSIQ value is fixed to represent the "B group" (scores 121–130). 3 = FSIQ value is fixed to represent the highest achieving "A group" (scores > 130). ESS 1 = Reading and expressing emotions, ESS 2 = Taking the perspectives of others, ESS 3 = Caring by connecting to others, ESS 4 = Working with interpersonal and group differences, ESS 5 = Preventing social bias, ESS 6 = Generating interpretations and options, and ESS 7 = Identifying the consequences of actions and options.

RQ 2: Is ethical sensitivity of mathematically gifted young adults related to their moral reasoning?

Our hypothesis regarding the second research question is that moral reasoning and ethical sensitivity are synonymous concepts which comes to principled reasoning. On the other hand, we have earlier differentiated the two concepts in a sense that ethical sensitivity is more related to the concept of social intelligence (Albrecht, 2006; Goleman, 2006). In that sense, the first four ethical sensitivity dimensions ("Reading and expressing emotions", "Taking the perspectives of others", "Caring by connecting to others" and "Working with interpersonal and group differences") should be less tied to moral reasoning (DIT P index in our study), operationalizing the fifth and sixth stages of Kohlberg's theory (1969), than the remaining two dimensions ("Generating interpretations and options" and "Identifying the consequences of actions and options").

The most probable model of ethical sensitivity and DIT variables is shown in the first column ("Network Model") of table 2. The visualization of the Bayesian Network shows that the DIT P index is directly related to the four ESS dimensions, namely (4) Working with interpersonal and group differences, (5) Preventing social bias, (6) Generating interpretations and options, and (7) Identifying the consequences of actions and options.

Table 2. Bayesian Network Model of the Dimensions of Ethical Sensitivity and Moral Reasoning

Network Model	Dependence	Probability ratio
	ESS_5 → ESS_7	1 : 2418
	ESS_5 → DIT_P_index	1 : 641
	ESS_2 → ESS_7	1 : 333
	ESS_3 → ESS_7	1 : 225
	ESS_1 → ESS_2	1:21
	DIT_P_index → ESS_6	1:11
	ESS_7 → DIT_P_index	1 : 8.64
	ESS_4 → DIT_P_index	1 : 5.9
	ESS_5 → ESS_2	1 : 3.67
	ESS_2 → ESS_4	1 : 2.96
	ESS_5 → ESS_6	1 : 2.1
	ESS_2 → ESS_3	1 : 1.98
	ESS_3 → ESS_4	1 : 1.89

Note. DIT P index = Defining Issues Test P index, ESS 1 = Reading and expressing emotions, ESS 2 = Taking the perspectives of others, ESS 3 = Caring by connecting to others, ESS 4 = Working with interpersonal and group differences, ESS 5 = Preventing social bias, ESS 6 = Generating interpretations and options, and ESS 7 = Identifying the consequences of actions and options.

The second column in table 2 ("Dependence") shows the statistical dependencies (relations) between variables and the third column ("Probability ratio") shows the importance of these dependencies.

Table 2 shows that the most important dependency in the model is the one between ESS dimensions five (Preventing social bias) and seven (Identifying the consequences of actions and options). The probability ratio of this dependency is 1:2418, which means that the Bayesian Network with a connecting arc between these two variables is 2418 times more probable than a network without this dependency. According to the network in table 2, the DIT P index acts as a mediator between ESS dimensions four (Working with interpersonal and group differences) and six (Generating interpretations and options) with a probability ratio of 1:11. Figure 2 shows the direction of this dependency: High P index values (3 = P index > 49) predict high reasoning abilities related to ethical sensitivity (sixth dimension), but lower empathy-related abilities (fourth dimension). In other words, if we wish to predict ethical sensitivities of a person, who has scored more than 49 points in the DIT, we fix the DIT value to "3" (see the fourth column in Figure 2) and learn that there is a 86% probability that s/he would use response option 5 ("totally agree") to all four items measuring the sixth ESS dimension.

Figure 2 shows that the participants average scores (rounded to integers) for the seven ESS dimensions range from 3 to 5 (totally agree). However, predicted response patterns still give us some useful information about the relationship between ethical sensitivity and moral reasoning. First, the figure suggests that our presupposition about weak relationships between the first four ESS dimensions and moral reasoning is true. However, there seems to exist a non-linear dependency between moral reasoning and ability to put other people's needs before one's own needs (fourth ethical sensitivity dimension). Students who scored highest and lowest in the DIT were more neglective about their interpersonal relationships than students with mid scale DIT scores. When interpreting

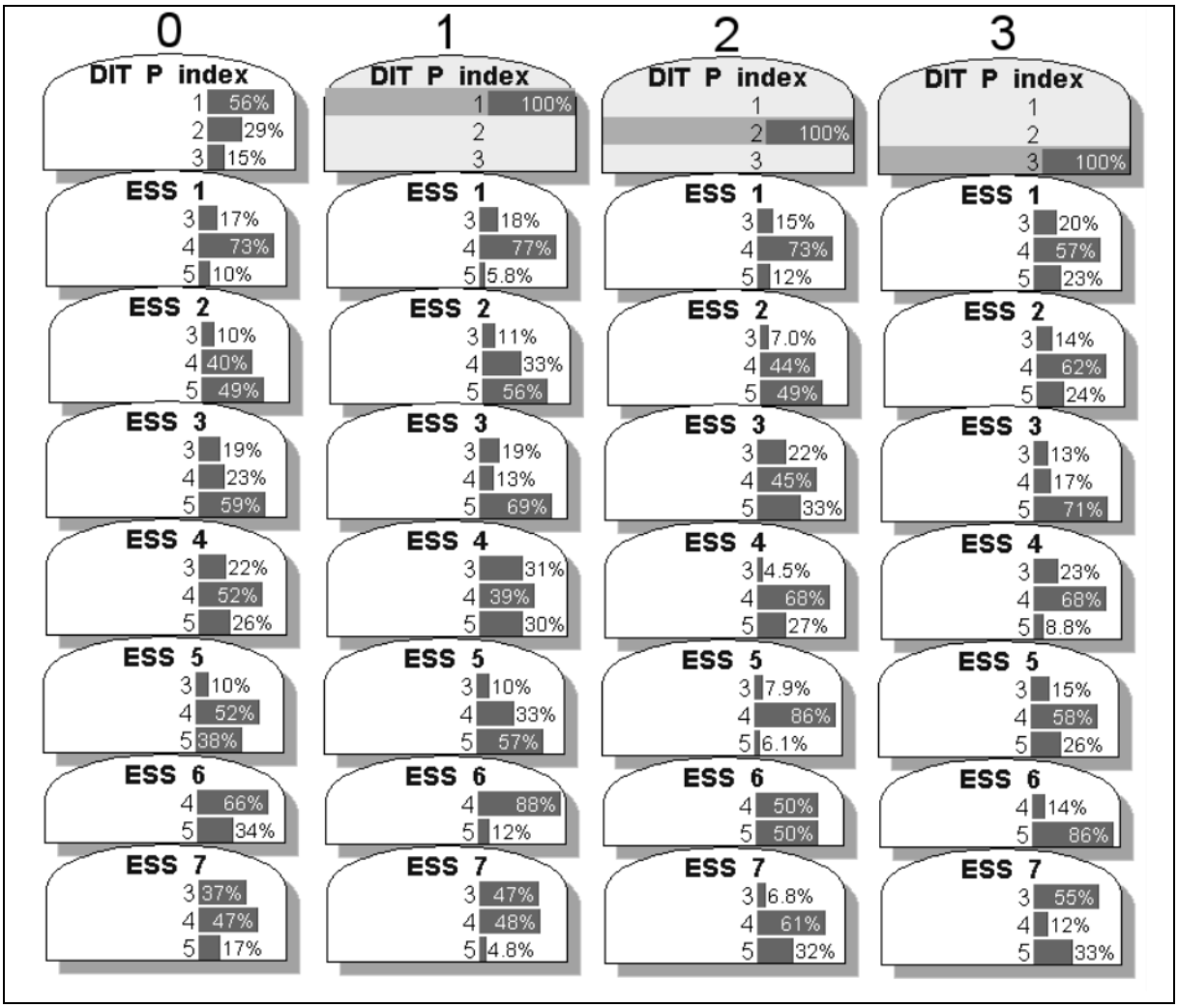


Figure 2. Bayesian dependency model of moral reasoning and ethical sensitivity. 0 = None of the Defining Issues Test (DIT) values are fixed and, thus, no prediction is made about the behavior of the Ethical Sensitivity Scale (ESS) values in the model. 1 = DIT value is fixed to represent the lowest scoring group (P index < 40) and the model shows the students' corresponding responses on the seven ESS dimensions. 2 = DIT value is fixed to represent the middle scoring group (P index 40–49). 3 = DIT value is fixed to represent the highest scoring group (P index > 49). ESS 1 = Reading and expressing emotions, ESS 2 = Taking the perspectives of others, ESS 3 = Caring by connecting to others, ESS 4 = Working with interpersonal and group differences, ESS 5 = Preventing social bias, ESS 6 = Generating interpretations and options, and ESS 7 = Identifying the consequences of actions and options.

this finding we should bear in mind that all students in our sample scored higher than their average peers in the DIT. The second finding was that both the sixth and seventh ESS dimension were positively related to DIT scores. This evidence also supports our earlier set hypothesis that advanced level of moral reasoning is positively related to higher order ethical sensitivity skills.

Conclusions

In this paper, we discussed theoretical issues related to intelligence, morality and ethical sensitivity, and tested their relationships with a mathematically highly gifted sample of Finnish upper secondary school students. Intelligence was measured with WAIS-III (Wechsler, 1997), morality with DIT (Rest, 1986), and ethical sensitivity with ESSQ (Tirri & Nokelainen, 2007). Initial results showed that participants' general intelligence (FSIQ), moral reasoning (P index) and ethical sensitivities were clearly above the average level of their age cohort.

The following two research questions were analysed with Bayesian methods: (1) Is ethical sensitivity of mathematically gifted young adults related to their general intelligence?; (2) Is ethical sensitivity of mathematically gifted young adults related to their moral reasoning?

Results regarding the first question showed that mathematically gifted young adults who had the highest FSIQ scores reported higher ability to tolerate different ethical views, take another person's position when facing a conflict situation and recognise new important ethical problems than those who had lower FSIQ scores. Further, individual differences in intelligence did not differentiate one's ability to express different feelings to other people, take care of other people's well being, control own prejudices when making ethical evaluations and create alternative ways to act when facing ethical problems in everyday life.

Results regarding the second question showed that students who scored highest and lowest in DIT were more neglective about their interpersonal relationships than students with mid scale DIT scores. Further, the highest order ethical sensitivity (sixth and seventh ESS dimensions) was found to be positively related to DIT scores.

The first hypothesis on the positive relationship between intelligence and ethical thinking was partly confirmed: Third, fourth and seventh ethical sensitivity dimensions were positively related to the general intelligence, the four other ethical sensitivity dimensions were not. This finding is in parallel with Narvaéz (1993) study showing that above average level of intelligence is not a linear but non-linear positive predictor of above average level of ethical sensitivity.

The second hypothesis on the positive relationship between moral reasoning and ethical thinking was affirmed: Results regarding the second research question showed that DIT scores of mathematically highly gifted students were positively related to their responses to items measuring higher order ethical sensitivity dimensions. This finding supports other researchers' notion that gifted students hold a privileged position in the maturation of moral thinking because of their precocious intellectual growth (Andreani & Pagnin, 1993; Karnes & Brown, 1981; Terman, 1925).

Discussion

Our study has important implications for moral education. According to ethical competence theory (Narvaez, Bock, & Endicott, 2003), morality can be taught. Moral character is viewed as a set of skills (Narvaez, 2006, 2011; Narvaez & Endicott, 2009) that can be honed towards expert levels of performance. Persons of good character, then, have better developed skills in four areas: moral sensitivity, moral judgment, moral motivation, and moral action (Bebeau et al., 1999). For example, the skills of moral sensitivity enable one to 'read' a moral situation more quickly and accurately to determine what role one might play. The skills of moral judgment include many tools for solving complex moral problems in different contexts. The skills of moral motivation include the cultivation of an ethical identity that leads one to prioritize ethical goals. The skills of moral action include the ability to keep the goal orientation, to stay on task and take the necessary steps to get the ethical job done. Persons of character have specific moral skills that can be divided into these four categories (sensitivity, judgment, motivation, action). The moral person is guided by a personal moral commitment that calibrates moral perception and awareness.

Moral education for the high ability students should include a deliberative process to determine a just and caring solution to a moral issue at hand. This process should include (a) better and worse interpretations of the moral issues discussed (moral sensitivity); (b) better and worse justifications for actions (moral judgment); (c) expectations for behavior in particular contexts, for example, "the good citizen", "the just student" (moral identity) and indicators of commitment to moral ideals; as well as (d) indicators to judge courage, persistence, and follow through (moral character) and prototypes for effective responses to problematic contexts (e.g., "just say no"; Bebeau et al., 1999). According to our

empirical findings, the real-life moral conflicts and the interpersonal relationships should be among the topics used in these discussions.

Limitations of the Study

Whether we use traditional frequentistic parametric (or non-parametric) methods, or any non-parametric approach, like neural networks (self-organizing maps), fuzzy logic, minimum description length calculation or Bayesian methods, the power (Murphy & Myors, 1998) of the study remains a relevant question: How do we know for sure that if we reject our null hypothesis (H_0), it is false, too, in the real world? Traditional power analysis is impossible to carry out with statistical techniques that are based on the concept of subjective (i.e., non-frequentistic) probability. The justification is simple: Bayesian statistics that we have applied in this paper do not include the concepts of statistical significance, alpha (Type I) or beta (Type II) error levels (Hoijtink & Klugkist, 2007). Our conclusion is that the current results are applicable to the mathematically highly gifted adolescent population, but should be interpreted with caution.

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The Authors

Dr. Kirsi Tirri is a Professor of Education and Research Director at the Department of Teacher Education at the University of Helsinki, Finland. She is also a visiting scholar with the Stanford Center on Adolescence. Tirri has been the President of ECHA (European Council for High Ability) for the years 2008-2012. She is the President of the SIG International Studies at AERA (American Educational Research Association). Her research interests include moral and religious education, gifted education, teacher education and cross-cultural studies. She has published 12 monographs and numerous journal articles related to these fields. She has led the Finnish team in many national and international research projects.

Dr. Nokelainen is a Professor of Education at the School of Education at the University of Tampere, Finland. He is also Adjunct Professor at the University of Helsinki, Finland (Methodology), and the Tallinn University, Estonia (Education). His research interests include professional growth and learning, the gifted and talented, research methodology and educational technology. He has over one hundred scientific publications, including books, book chapters and journal articles on these topics.

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Chess Players' Performance Beyond 64 Squares: A Case Study on the Limitations of Cognitive Abilities Transfer

Christoph Bühren[1*] and Björn Frank[1]

Abstract: In a guessing game experiment (known as the beauty contest) with over 6,000 chess players, ranked from amateur to world class, we found that Grandmasters act very similar to other humans. This even holds true when they play exclusively against players of approximately their own strength. In line with psychological research on chess players' thinking, we argue that they are not more rational in a game theoretic sense per se. Their skills are rather specific for their game.

Keywords:
chess, cognitive ability, experience level, experimental design

It is often a good idea to ask experts for help in solving certain problems. The trick is to find the right expert. Many auctions have optimal strategies and equilibria that game theorists are educated to find, and hiring game theorists as consultants has helped governmental agencies or firms in a number of important auctions (e.g., Milgrom, 2004). But who is an expert in game theory, apart from game theorists? This is an important question, for two reasons. First, if we find that people, at least certain people, behave according to game theoretic predictions where others do not, this would help to understand to which extent and in which cases game theory can be used for predictive purposes, rather than just as a normative theory. Second, it is important to understand the extent to which we can expect experts in one field to transfer their expertise into other fields. Many hiring decisions are based not on the current knowledge and training of the prospective employee, but on the extent to which his or her expertise can be transferred into new areas. Probably Goldman Sachs had a hypothesis on this question when they hired chess Grandmaster Luke McShane as a trader. Gerdes and Gränsmark (2010) motivate their study on differences between female and male chess players (with respect to risk-taking) with the claim "that findings based on chess can be transferred to other professions that are characterized by a high level of expertise" (p. 5).

However, a look at a larger range of chess players' biographies does not reveal a clear complementary talent: among (current or former) top chess Grandmasters, we find a successful entrepreneur (Miguel Najdorf), a Harvard economist (Kenneth Rogoff), a papyrologist (Robert Hübner), a former member of Norway's national soccer team (Simen Agdestein), a world class pianist (Mark Taimanov), a paranoid antisemite (Bobby Fischer), a taxi driver (Nicolas Rossolimo), a psychoanalyst (Reuben Fine), and Soviet dissidents like Viktor Korchnoi. Do they have anything in common except for their ability to play chess?

Until recently there was no evidence supporting this point for the transfer of chess playing abilities to other strategic situations. In this paper, we provide evidence on the extent to which chess players' expertise can be transferred. The task we confronted them with was the beauty contest. In the next section, we discuss how our work relates to two streams of research: first, economists' experiments on cognitive transfer, and second, psychologists'

[1] *University of Kassel, Germany*
[*] *Corresponding author: University of Kassel, IVWL, Nora-Platiel-Straße 4, 34127 Kassel, Germany. Email: c.buehren@uni-kassel.de*

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research on chess players' thinking. The section "Chess Players in a Beauty Contest" reports our experimental findings, suggesting that a chess grandmaster is not necessarily a beauty contest grandmaster. The last section concludes.

Related Literature

It is not straightforward how the "size" or "difficulty" of a transfer should be operationalized, let alone measured. However, one important aspect to be considered is causation. Presume that we find that abilities in tasks X and Y correlate positively, then this correlation might be due to causation or not. Presume that we deal with a group of people with a lot of past experience in task (or occupation) Y. For the first time in their lives, we confront them with task X and find that they are particularly good at X. It is natural to presume that being good at Y causes being good at X, but this is not necessarily true. First, there might be a common cause for good performance in X and Y, and second, there might even be reverse causation: People who (surprisingly or not) turn out to be good at task X might for some reason have been more likely to survive in occupation Y. These different reasons behind observed correlations help us to organize experimental evidence on cognitive transfer.

Unclear Direction of the Cognitive Transfer

List and Haigh (2005) study decision making under risk with students and with professional floor traders and report that the latter violate the independence axiom slightly less often – and thus are arguably more rational – than the students. This is an interesting result, yet we do not know whether it is due to a common cause, like a certain sense of rationality, or whether trading provides training that eventually reduces violations of the independence axiom, or whether violating the independence axiom reduces the likelihood of being sufficiently successful as a trader. Another study with unclear causation is that of Potters and van Winden (2000), who compare the behavior of students and of professional lobbyists in an experiment that reconstructs certain aspects of lobbying, finding that the lobbyists are more rational in the game-theoretic sense and earn more money. Cooper (2006) finds that experienced managers are better able than students to overcome coordination failures. It is not clear, however, whether this finding is correctly classified as 'cognitive transfer', or whether it just confirms that managers are good in managing. Finally, Alevy et al. (2007) show that professional traders are "less Bayesian" than students in information cascades games, but perform better in other dimensions, whereas professional traders are subject to more, rather than less, myopic loss aversion than students according to Haigh and List (2005). These latter results serve to warn us that potentially not only cognitive abilities, but also their transfer might be rather specific and should not be generalized without complementing evidence.

Unambiguous Direction of the Cognitive Transfer

Some artificial field experiments suggest that there can indeed be cognitive abilities transfers in the causal sense: being good at Y causes an increased likelihood of being good at X. The reason for the unambiguous direction of the transfer is that task X is unlikely to have an impact on task Y. The prime examples are studies on soccer players' use of mixed strategies in simple experimental games. Task Y is playing soccer. Soccer players might be good at mixing strategies, as it is important to randomize, i.e., not to perform in a predictable way, in penalty kicks. However, the reverse causality is unlikely to be at work here: effectively mixing is only a small part of playing soccer, and certain players in a team can – and do – specialize in penalty kicks, hence not everyone has to be good at it.

There is convincing evidence that soccer players come close to randomizing optimally in penalty kicks (Chiappori et al., 2002; Palacios-Huerta, 2003; Azar and Bar-Eli, 2010). Evidence on the question whether this ability extends to the domain of other strategic

situations is mixed in an irritating way. Palacios-Huerta and Volij (2008) find that professional Spanish soccer players, unlike students, play (nearly) optimal mixed strategies in a 2x2 and in a 4x4 zero-sum card game in the laboratory, even avoiding serial dependence of their strategy choices.[1] However, Levitt et al. (2010) failed to replicate this result with American soccer players. They also, and more surprisingly, do not find that highly skilled poker players come close to the game-theoretic (minimax) predictions in a context that is unfamiliar to them. Sports that require intellectual, rather than physical, training provide attractive subjects for the study of cognitive transfers, as the transfer itself is part of the training. Professionals in intellectual sports such as poker should be able to understand and explain what they are doing, in stark contrast to, say, soccer players. (Consequently, some of the latter fail terribly as trainers.) Hence it was quite reasonable that Palacios-Huerta and Volij (2009) hypothesize that professional chess players would play rationally in games other than chess. An example in line with their hypothesis is one of the best female chess players Almira Skripchenko, who started playing poker no earlier than in 2003, but recently got the "French Poker Award 2009". Indeed, Palacios-Huerta and Volij (2009) report extremely uniform behavior of all 26 Grandmasters who participated in their centipede game – an experiment designed to investigate backward induction. All grandmasters in their sample

a) seemed to be aware of the game-theoretic solution, i.e., the subgame perfect Nash equilibrium,
b) seemed to presume that other chess players are highly likely to be aware of the logic of backward induction, and
c) were ignorant of the idea that starting by playing the non-equilibrium move "right" instead of "down" would update their opponent's belief about their rationality in the game-theoretic sense, which could make the opponent play "right" in turn.

Levitt et al. (2011) challenge this result in their replication: not a single Grandmaster out of 16 chooses the Nash equilibrium strategy at the first node. In contrast to these recent experiments, we chose one which allows a continuous strategy choice: the beauty contest.[2] In many ways, the beauty contest is more similar to chess than the centipede game: chess and the beauty contest are constant-sum games, as the sum of the payoffs does not depend on the outcome of the game, which is clearly different for the centipede game. Furthermore, chess and the beauty contest are practically impossible to solve with backward induction and they both have an almost infinite number of different outcomes – for chess, Simon's (1972, p. 166) estimate is 10^{120}, while Ewerhart (2002) argues that it is indeed ∞. The centipede game, as played by Palacios-Huerta and Volij (2009), has 7 and is solvable by backward induction. On the other hand, chess is a two-person game, while we played the beauty contest with a large number of players. And while the expected rationality of opponent(s) is only relevant for chess players' decisions in rare instances (e.g., when deciding whether to accept a draw offer in a slightly worse position), it is decisive in the beauty contest. Altogether, the beauty contest, just like the centipede game, requires a considerable cognitive transfer.

But what kinds of chess players' skills are likely to be transferable to the beauty contest? For the centipede game, Palacios-Huerta and Volij (2009) claim to have found the answer: backward induction. The next subsection summarizes psychologists' research on this issue.

How Chess Players Think

In order to get an impression of how likely it is, ex ante, that chess players are able to transfer their abilities to other cognitive tasks, it is important to understand what actually goes on when they are sitting at the chessboard. Figure 1 displays perhaps the best researched chess position with regard to the cognitive processes of chess players. De Groot (1965) reports on thinking-aloud protocols from 18 players, including the then-world champion[3], his predecessor and four other Grandmasters. Newell and Simon (1965)

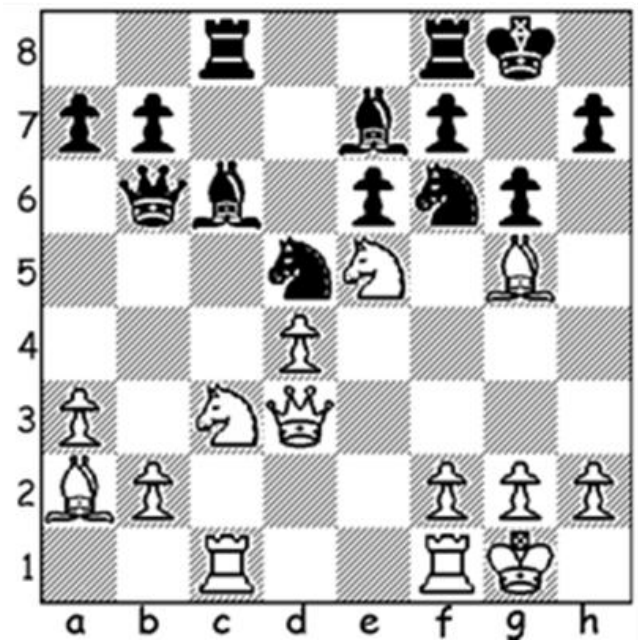

Figure 1. Position from de Groot versus Scholtens April 10, 1936, after move 16.

provide one further protocol, with more extensive documentation and detailed transcripts as parts of a game tree.

The position in figure 1 is typical and gives a good impression of the number of possible continuations at the beginning of the middlegame. White (to move) has 56 different moves, and Black's number of legal moves depends on what White does, though it is approximately 40. There are about 3,000,000 possible ways for the game to proceed in the next two moves (i.e., four plies in a game theoretic sense). What is more, restricting the calculations to only two moves makes no sense. Backward induction thus becomes plainly impossible when the game tree is almost infinitely large and the relevant end nodes are unknown; there are also no traces of backward induction in the protocols reported by de Groot (1965) and Newell and Simon (1965).[4]

With some knowledge of typical patterns, a reasonable aim emerges (i.e., forking the queen on b6 and the rook on f8), with a possible means to permit the knight on e5 to move there. Only strong players will see this possibility though. In this case, it is not backward induction that makes the difference but rather the ability to spot the relevant end node among millions of others that remain unobserved. It thus makes sense that Herbert Simon often used chess playing as an example of satisficing (i.e., his alternative to the presumption that individuals seek and reach the optimum, see for example Simon, 1955, 1972); players calculate forward and then stop when they find a reasonable path. Satisficing, not backward induction, represents the practical solution to an intractable game tree in chess.

The question of whether stronger players calculate more moves than weaker players, and how much farther they look ahead, remains subject to debate (de Groot, 1946, 1965; Campitelli & Gobet, 2004; Bilalić et al., 2008). There is no doubt, however, that what really makes the difference is the stronger players' ability to "see" and calculate the relevant moves. By measuring players' eye movements, Charness et al. (2001) show that expert chess players fixate more on the relevant pieces than do players of intermediate skill. Klein et al. (1995) find that better chess players consider fewer potential moves from a chess position than do players with a medium skill rating, but those they do consider are more relevant, i.e. better, moves. This is possible because expert chess players have stored a lot of positional and tactical patterns or "chunks", which is known because they are much better than amateur players or beginners at reconstructing chess positions

shown to them for only a few seconds – but only if it is a "realistic" position, not a random placement of the pieces (Chase and Simon, 1973; Gobet and Simon, 1996). In support of this interpretation, Amidzic et al. (2001) find in a magnetic imaging study that Grandmasters, compared with amateur chess players, exhibit markedly more brain activity in the frontal and parietal cortices, which indicates that they use their long-term memory.

This is in line with Kelly's (1985) research on the personalities of 2,209 chess players. The results of his questionnaires indicate that the latent variable "intuition" is very strongly related to chess playing strength. Kelly (1985, p. 284) concludes that "chess is much more of an intuitive than a thinking game, especially at master level."

Psychologists' research has been nicely summed up by one participant of our experiment (on which we report in the next section), who offered the following brilliant analogy: "Have you ever looked for mushrooms with an expert mushroom searcher? Where you see only leaves and dirt, the mushroom searcher immediately spots the mushrooms: Would you say that, for this reason, the mushroom searcher is more intelligent than you?" To a beginner, a chess game is as messy as leaves and dirt, whereas strong chess players can spot the relevant aspects and use chess-specific patterns that they have stored in their minds. Nevertheless, playing tournament chess might provide chess players with a kind of training that has effects beyond the sphere of chess, effects which have been overlooked so far by psychologists. Together with the fact that recent field experiments with chess players led to mixed results, this motivates our own experimental investigation with a large number of chess players.

Chess Players in a Beauty Contest

All Against All

In June 2009, 6,112 chess players accepted our invitation posted on www.chessbase.de and www.chessbase.com to take part in an online experiment. They were asked to state a number (not necessarily an integer) between 0 and 100, the winning number being the one closest to two-thirds of the average. We did not tell them that this game is known as the beauty contest. The prize for the winner was a €200 Chessbase voucher, and those in second and third places received €100 and €50 vouchers, respectively. We used Chessbase vouchers instead of cash prizes to increase the credibility of our experiment. Furthermore, unlike cash prizes, Chessbase vouchers can be delivered internationally quite easily, and they are as good as money to chess players, considering the products and services offered by Chessbase.

The target number in our first round equaled 21.43, that is, two-thirds of the average guess of 32.15 and far from the Nash equilibrium of 0. A comparable online beauty contest with students (Rubinstein, 2007) yielded a very similar result of 24.13. Likewise, the first round in Rosemarie Nagel's (1995) first beauty contest experiment resulted in a target number of 24.49. Playing the game as a newspaper or magazine contest gives participants usually more time, and they often think one step further ahead. The target number calculated from a magazine experiment by Selten and Nagel (1998) was 14.7; for Financial Times readers it equalled 12.6 (Thaler, 1997), and for readers of the Spanish newspaper Expansión it was 17.0 (Bosch-Domènech et al., 2002). However, Schou (2005) reports a target number of 21.6 when playing with 19,196 readers of the daily newspaper Politiken. To conclude, the chess players' guesses fall within the range provided by other humans.

And what about the Grandmasters, of whom we have 28 in our sample? While the average guess in our complete sample was 32.15, the Grandmasters' average was slightly higher: 32.96! As the group of Grandmasters is a small subsample of our top-level players, their results only serve to give a first impression of our results. More generally, table 1 suggests no clear relationship between playing strength, measured using the Elo rating[5], and the number chosen in the beauty contest.[6] The OLS regressions[7] in table 2 confirm this

Table 1. Number Chosen in Round 1 of the Beauty Contest: Summary Statistics

r		*n*	Mean	Std. Dev.	Median	Min	Max
1	Rating < 1600+	2646	33.37	23.08	32	0	100
2	1600 ≤ Rating < 1800	664	32.01	21.68	30.0625	0	100
3	1800 ≤ Rating < 2000	1065	32.12	21.33	30	0	100
4	2000 ≤ Rating < 2200	1091	30.98	21.73	27.45	0	100
5	2200 ≤ Rating < 2400	551	29.15	20.15	25	0	100
6	2400 ≤ Rating *	95	30.56	22.47	22.8	0	100
	Grandmasters	28	32.96	25.03	26.175	0	100
	All	6112	32.15	22.22	29.6125	0	100

Note. r rating group, + Including unrated players, * Including Grandmasters

Table 2. Round 1 Regression Results

	Dependent variable: Chosen number			**Dependent variable:** Absolute difference between chosen number and target number		
	(1)	(2)	(3)	(4)	(5)	(6)
Rating	-.0048***	-.0032*		-.0031***	-.0017	
	(4.14)	(1.99)		(3.69)	(1.45)	
Guessing effort		-.5979***	-.6245***		-.4080***	-.4341***
		(13.08)	(16.06)		(12.39)	(15.42)
Constant	40.84***	90.63***	87.53***	24.15***	57.24***	57.00***
	(18.33)	(17.99)	(24.45)	(14.99)	(15.77)	(21.98)
n	4043	1739	2499	4043	1739	2499
Adj. R^2	.0040	.0931	.0933	.0031	.0841	.0866

Note. t-statistics in parentheses * significant at the 5% level; ** at the 1% level; *** at the 0.1% level

impression. While the numbers chosen by better chess players are significantly lower, this relation is minuscule in its extent: On average, chess players guess one integer lower if they have a rating that is about 210 points higher.[8]

An obvious objection to this result is that the strong chess players in our sample might have "seen" the theoretical solution, but presumed the average participant would make a less sophisticated guess. The better they are in chess, the better they might be in guessing other people's guesses, though this supposition sounds more applicable to poker than to chess. Anyway, as we report in table 2 (columns 4–6), better chess players are closer to the winning number, but the amount of difference is tiny; a rating that is 320 points higher brings the chess player one integer closer to the target number. If we control for guessing effort, this relation even becomes insignificant. Again, Grandmasters perform slightly below the average. For the whole sample, the mean absolute difference between the chosen number and the target number is 18.62, whereas for Grandmasters, it is 20.00.

Our sample includes only chess players, but their playing strength differs greatly: from the lowest level to world class (including a former world champion). While our beauty contest experiment does not allow a within-subject comparison of strategy choices across opponents, we asked the second round participants, ex post, to provide their guess what the chosen numbers in round 1 had been. They had knowledge of the *overall* target number from round 1 as well as the sizes of rating groups listed in table 1, and they guessed the target numbers within these groups. For every group, the person who offered the best guess received a €50 Chessbase voucher.

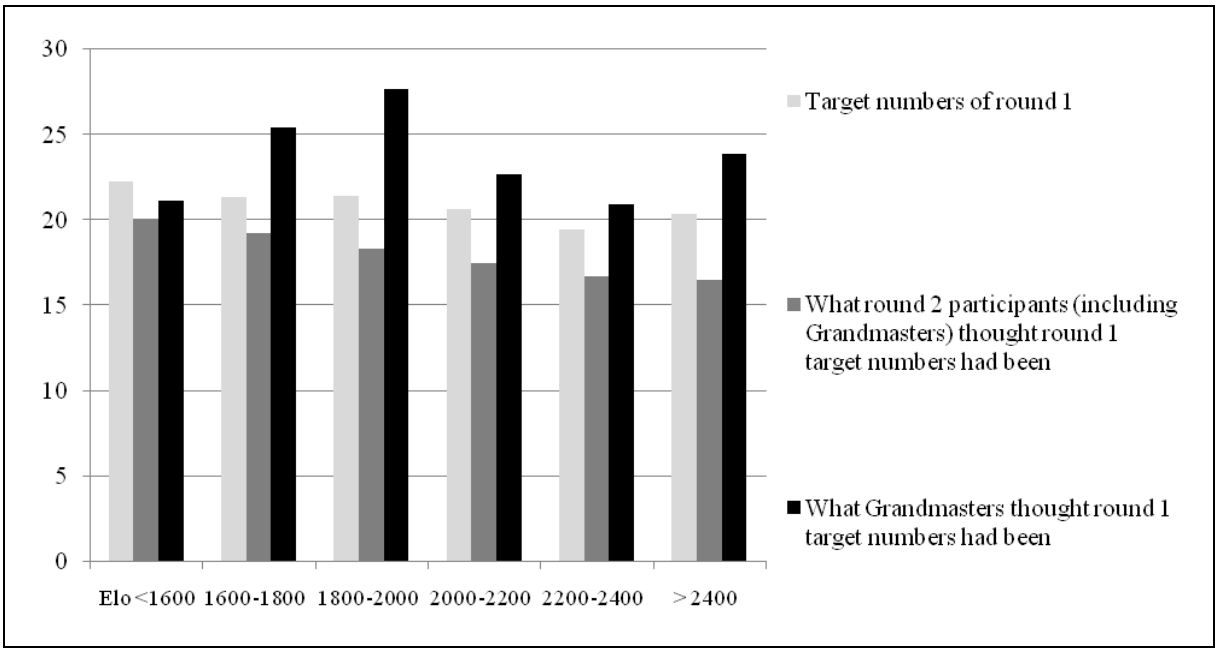

Figure 2. Estimation of round 1 results by round 2 participants.

Asking for target numbers separately for players with different ratings (e.g., rated under 1600 or over 2400) means rubbing the research hypothesis under the participants' nose. Yet the expected impact of rating on the number chosen was low, but not as low as the actual impact, as shown in figure 2. Our Grandmasters did not presume this relationship existed, but their guesses were worse than the average guesses.

These data pertaining to participants' guesses about the first-round results are useful for another purpose as well. Rubinstein (2007) has shown that thinking effort, proxied as the time taken to make a decision in an online beauty contest experiment, has a marked impact on the chosen number. We construct a different proxy and arrive at a similar result.

Specifically, if r denotes the rating group, n(r) is the number of people in the respective group, and G^r_i indicates subject i's guess for the respective target group, the weighted mean of the guesses should equal T, the actual overall target number for round 1. Hence the condition:

$$T = \sum_{r=1}^{6} \frac{n(r)}{\sum_{r=1}^{6} n(r)} \cdot G_i^r$$

Because T and n(r) are public knowledge for all r, guesses that do not fulfill this condition are dominated. Guessing effort usually reduces the difference between the left- and right-hand sides of the above equation. Therefore, we define the guessing effort GE_i as:

$$GE_i = 100 - \left| T - \sum_{r=1}^{6} \frac{n(r)}{\sum_{r=1}^{6} n(r)} \cdot G_i^r \right|$$

Less than 3% of our subjects simply stated T for every group. Because these answers could bias our proxy, we eliminate them from regressions that contain GE. The Pearson correlation coefficient between chess rating and GE turned out to be significant but negligible low, namely .067.

Table 3. Comparison with Rubinstein (2007)

Guess	Rubinstein (2007): One-period beauty contest	Chess players, round 1
51–100	20%	18%
50	16%	5%
35–49	11%	14%
33–34	11%	10%
23–32	10%	13%
22	4%	5%
16–21	6%	9%
14–15	2%	3%
2–13	9%	15%
0–1	11%	7%

In Rubinstein's (2007) experiment, students make more reasonable guesses when they take more time to make their decision. Similarly, we find a highly significant and sizable impact of GE on the chosen number (see table 2). When we compare Rubinstein's and our distribution of guesses, which represent different depths of reasoning (table 3), we find that the chess players in our study are similar to the students in Rubinstein's study with regard to both the mean and the distribution of chosen numbers.

Rubinstein (2007), who allowed only integers to be chosen, finds that students needed most time for answering 22, a number that is close to our winning number and is implied by a plausible expectation of others' degree of sophistication. In line with our previous results, we do not find that the likelihood of choosing 22 (in our case, a number between 21.5 and 22.5) depends strongly on the rating. Disregarding unrated players, those who chose 22 have an average of 1874, while the overall rating average is 1889.

Round 2 in One's Own League

For round 2 of our online beauty contest, we invited, via email, those first round participants who had agreed to take part in another round. In this round, they only played against players of their own rating group. For every group, €100 Chessbase vouchers provided incentives to win within that category.

As we noted previously, all respondents received information about the target number from round 1. Therefore, the average guess should decline in the subsequent round, like in all other multi-period beauty contests before. One should expect a strong negative correlation between beauty contest numbers and Elo ratings in the second round, because good chess players know that they are playing against only good players. That is, the belief that game theoretic rationality correlates with chess playing strength should result in low numbers for groups with high Elo ratings. Indeed, as for round 1, the descriptive statistics for round 2 (table 4) suggest a negative correlation,[9] but again the size of the effect is small. Furthermore, it might be partially due to the smaller group size for stronger players.[10]

We consider a further dimension of cognitive ability with our beauty contest, namely, information processing. In figure 3, we depict the differences between the first- and second-round guesses. Before round 2, players received two pieces of information: the average number for all players, and notification of the approximately equal strength of their competitors. If stronger chess players think more steps ahead in the beauty contest and presume that other strong players do so as well, then these pieces of information should lead to a greater difference between the second- and first-round guesses among stronger players. As we show in figure 3, however, no such pattern emerges. Starting with

Table 4. Beauty Contest Round 2, Summary Statistics

r		*n*	Mean	Std. Dev.	Median	Min	Max
1	Rating < 1600+	897	26.86	18.89	21.4769	0	100
2	1600 ≤ Rating < 1800	324	27.26	19.13	21.745	0	99.999
3	1800 ≤ Rating < 2000	486	25.75	18.51	21.4145	0	99
4	2000 ≤ Rating < 2200	483	24.14	18.64	18.332	0	100
5	2200 ≤ Rating < 2400	241	23.73	18.94	16.874	0	100
6	2400 ≤ Rating *	50	19.11	15.89	14.381	0	69
	Grandmasters	13	20.33	17.84	15.55	0	64.01
	All	2481	25.70	18.79	20.3785	0	100

Note. r rating group, + Including unrated players, * Including Grandmasters

comparable means in round 1 (table 1), the decrease in numbers in round 2 is highest, on average, for players with an Elo rating between 2000 and 2200 and lowest for Grandmasters.

If we regress the chosen number and measures of performance in round 2 on guessing effort (GE) and rating (table 5), we achieve results similar to those from round 1. The guesses of the better chess players in round 2 are significantly lower and nearer to the target number, but the extent of difference is still not very great. In the second round, chess players guessed one integer lower if their ratings were approximately 130 points higher (or 170 points higher if we control for GE). They come one integer nearer to the target number if their rating is 240 or even 330 points higher, depending on specification. The impact of the GE variable in our second round, unsurprisingly, is higher than that in round 1, because we used data from the round 2 participants to calculate this attribute. Nevertheless, these differences in the GE coefficients are not notable, which indicates a certain consistency in the decision-making processes across different periods. Chess players with a higher GE submit lower numbers, fall farther below their round 1 guesses, and come closer to the target number of round 2.

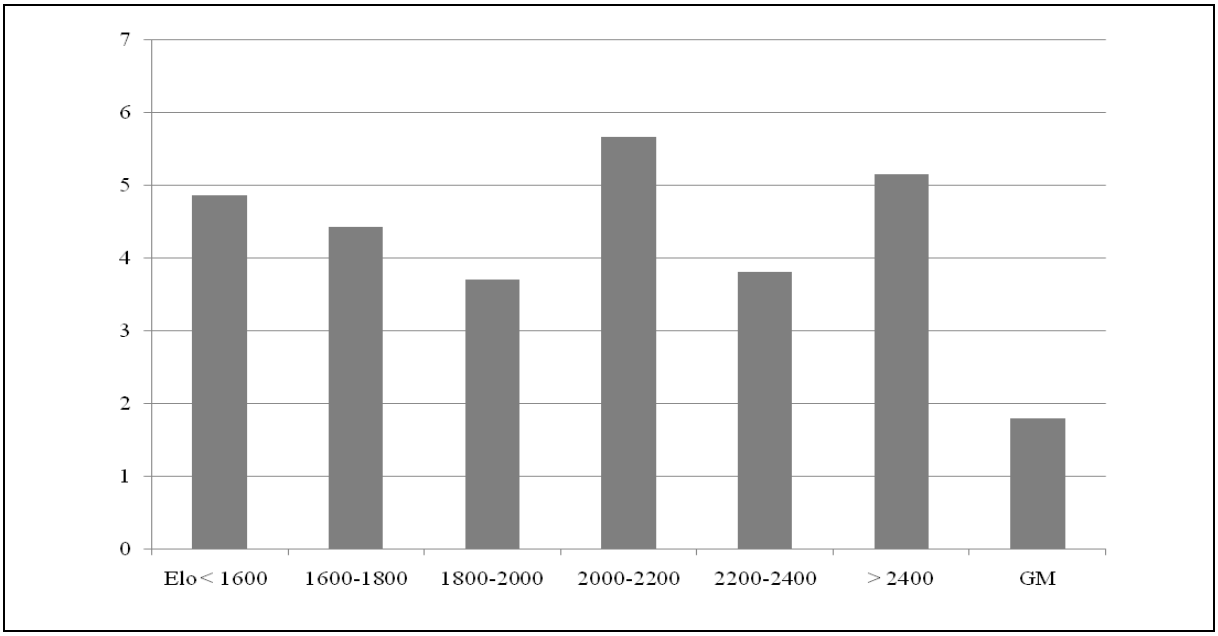

Figure 3. Average difference between first and second round. This figure is based not on a direct comparison of means from tables 1 and 4 but rather on the difference of the round 2 and round 1 numbers for those who took part in both rounds.

Table 5. Round 2 Regression Results

	Dependent variable: Chosen number in round 2			**Dependent variable:** Absolute difference between chosen number and target number in round 2			**Dependent variable:** Difference between first and second round guess		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rating	-.0075***	-.0060***		-.0042***	-.0030*		.0022	.0018	
	(-4.95)	(-4.22)		(-3.35)	(-2.52)		(1.37)	(1.14)	
Guessing effort		-.6938***	-.7503***		-.6001***	-.6558***		.1107*	.1161**
		(-16.87)	(-22.61)		(-17.71)	(-24.32)		(2.39)	(3.01)
Constant	39.69***	100.28***	94.13***	21.35***	73.82***	73.31***	.22	-8.66	-5.83
	(13.44)	(22.31)	(30.79)	(8.70)	(20.01)	(29.51)	(0.07)	(-1.83)	(-1.64)
n	1638	1558	2358	1638	1558	2358	1631	1554	2296
Adj. R^2	.0141	.1682	.1779	.0062	.1741	.2003	.0005	.0036	.0040

Note. t-statistics in parentheses; * significant at the 5%-level; ** significant at the 1%-level; *** significant at the 0.1%-level

Conclusion

Human Behavior in Chess Players

On ne joue pas aux échecs avec un bon cœur.

(Nicolas-Sébastien de Chamfort)

Our experiment provided the potential for cognitive abilities transfer from chess playing skills to game-theoretic rational behavior in a beauty contest. Two rounds with slightly different rules (all against all vs. in one's own league) and two different performance measures (chosen number and distance to target number) should have been able to reveal any abilities transfers. The results of our study, however, rather illustrate the boundaries of cognitive abilities transfer across different contexts (in line with Loewenstein, 1999, p. F28).

As discussed in our review of psychologists' research on chess, good players are supposed to have a fine intuition. In our beauty contest, guesses of better chess players failed to outperform. Further, chess playing skills are not strongly correlated to more rational choices in our experiment. Better chess players do not look more steps/moves ahead in the beauty contest. This also holds true in the second round where the assumption of common rationality can even be rejected for a small group of professional chess players with an Elo-Rating above 2400.

The results of our beauty contest are in line with those of Levitt et al. (2011) but in contrast to the findings of Palacios-Huerta and Volij (2009). Whereas Palacios-Huerta and Volij (2009) claim that chess players are brilliant in backward induction, Levitt et al. (2011) do not question the causal connection between chess playing and backward induction skills, but show that there is still no relation between the likelihood of conforming to the game-theoretic prediction in the centipede game and performance in a backward induction solvable constant sum game. In line with psychological research, we argue that backward induction is pretty useless for practical chess. The Nash-behavior of the Grandmasters in Palacios-Huerta and Volij (2009) could be the consequence of another characteristic of chess players: they are highly competitive, especially in two person games. That is, they might have focused on beating their fellows instead of maximizing their income.[11] In this sense, the beauty contest is different from the centipede game and from chess because it is typically a multi-person game.

Considering the results of our beauty contest experiment, we propose that it is hard to conclude that chess players are beings of supernatural rationality. (Note that recent experimental evidence due to Burnham et al., 2009, and Rydval et al., 2009, did show that cognitive abilities correlate with performance in guessing games.) A conclusion that tentatively hints how our results could go along with previous findings on chess players in the centipede game would be this: On the one hand, "intrapersonal spillovers" (Fennell, 2009, p. 96) from chess to game-theoretic understanding are negligible, hence typically strong chess players cannot be expected to see rational solutions where others do not. However, where both strong chess players and other subjects see the rational solution, chess players might be more likely to behave accordingly (i.e., to choose subgame perfect strategies) *under certain circumstances*. These circumstances were certainly missing in our beauty contest, where social preferences are irrelevant. Future research could shed more light on this hypothesis through within subject comparison of different experimental tasks, maybe not only with chess playing subjects, but also with, say, poker players or with professionals who succeed in both mind sports.

Acknowledgments

We are indebted to Chessbase for making our experiment possible and to the chess players who, apart from taking part in our experiment, provided valuable comments, as did Joel Sobel and participants of the GfeW 2009 conference, a workshop in Kassel, the Hohenheimer Oberseminar in Esbjerg 2010, especially Jürgen Zerth.

Notes

[1] But see Wooders (2010) for a critical reexamination of the data from Palacios-Huerta and Volij (2008).

[2] While the first proper beauty contest experiment was conducted by Nagel (1995), the game was invented and actually used in a newspaper contest by Ledoux (1981, 1983); see Bühren et al. (2012) for a historical account of the birth of the beauty contest.

[3] Alexander Alekhine; the investigations took place in 1938/1939 and 1943, they were first published in Dutch in de Groot (1946), but without the full protocols.

[4] This is in line with the examples of thinking aloud by British Grandmaster Daniel King, recorded on a DVD (Fritztrainer power play 10, Hamburg, Chessbase 2009).

[5] Henceforward, "rating" refers to the international Elo rating (see Elo, 1978) if players have one. If they lack this rating, we use national ratings, such as DWZ in Germany, which are equally scaled. With some practice, amateurs can earn 1200 rating points quickly. The group with the lowest rating (≤ 1600) includes unrated participants, whose exact playing strength is unknown to us. However, if it corresponded to an Elo rating over 1600, the player would, in most cases, actually have a rating. Ratings above 2000 require intensive training, preferably at a young age. The world champion is rated approximately 2800. The difference between a Grandmaster and an International Master is about 200. The expected result of a player against someone with 200 Elo points more is 2.5 points out of a maximum of 10 in a 10-game match.

[6] However, the mean ranks of the rating groups listed in table 1 are not equal according to a Kruskal-Wallis test ($p<0.01$).

[7] We also calculated two-limit Tobit models for the first and second rounds; the regression coefficients and marginal effects are nearly identical to the OLS regression. Thus, the OLS coefficients, which are easier to interpret, seem to be robust. The coefficients do not change if we only look at chess players who took part in both rounds

[8] Or even 310, if we control for "guessing effort", a variable measuring consistency in round 2 and will be explained later.

[9] Mean ranks of the rating groups (with respect to number chosen) are not equal according to a Kruskal-Wallis test ($p<0.001$).

[10] We are indebted to Oliver Kirchkamp and Karim Sadrieh for alerting us to this effect: As the guesser's number is also taken into account, the weakly dominating strategy is not $(2/3)\cdot 100$, but approximately 66.644 for a group size of 1000, and slightly less, namely about 66.216, for a group of 50, see Nagel (1999), p.109.

[11] The replication by Levitt et al. (2011) deviates from the design by Palacios-Huerta and Volij (2009) in that the former let their participants play more than once, reinforcing motives like reciprocity.

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The Authors

Christoph Bühren is visiting professor for behavioral economics at the Helmut-Schmidt-University in Hamburg and works as a post doc at the University of Kassel at the chair of applied microeconomics that is held by Björn Frank. He has a diploma in business administration from the Julius-Maximilians-University of Würzburg and a doctor of economics from the Friedrich-Schiller-University of Jena. His main research fields are experimental economics, behavioral economics, and sports economics.

Björn Frank holds a professorship for applied microeconomics at the University of Kassel, Germany. Previous affiliations include Clausthal University of Technology and the German Institute for Economic Research (DIW Berlin). His main areas of research are cultural and media economics and experimental economics. In various studies, he applied behavioural and institutional economics to chess and chess players' behaviour.

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The Phenomenon of the "Abortion" of New Ideas and the Impact of "Saved" Ideas and thus Implemented Innovations on the Economy in the Case of Gifted Innovators

Larisa V. Shavinina*

Abstract: The conventional practice of economy and innovation science concentrates on the implemented innovations (such, for example, as iPod and iPhone) and counts the revenues received from them. However, neglecting the fact of the "killed" ideas and, consequently, the value of lost innovations is a huge blank spot in research. When people intentionally or unintentionally abandon their ideas without a wish to develop them any further and finally implement them into practice, they thus abort potential innovations. This is what the phenomenon of the abortion of ideas is all about. The article focuses on the well-known cases when individuals resisted abandoning their creative ideas and eventually implemented them. These cases shed light on what today's children, adolescents, and adults can learn from outstanding innovators in order to be able to save, develop, and implement their ideas into practice in the form of new products, processes, and services.

Keywords:

phenomenon of the abortion of ideas, "killed" ideas, lost innovations, economy, distinguished innovators, innovation education

Never give up! Never, never,
never, never, never, never,
never!
Sir Winston Churchill

Some people are concerned with abortion killing potential human beings. However, nobody appears to concern themselves with the "abortion" of new ideas resulting in the killing of potential scientific, technological and societal innovations. Being implemented into practice in the form of innovative products, processes, or services, creative ideas thus lead to enhanced economic growth and competitiveness by increasing employment and prosperity for all. Consequently, the "abortion" of ideas is dangerous for any society. All means should, therefore, be used to develop and implement new ideas into practice.

During many years of work on the bestselling *International Handbook on Innovation* (Shavinina, 2003), I discovered that no one teaches people how to implement their ideas into practice in the form of innovative products, processes, and services. It was also discovered that today nobody evaluates the potential impact of "killed" ideas and, therefore, unborn or lost innovations on the economy. It has never been studied. The world can recover from an economic recession and avoid future economic downturns only through innovations and every effort should hence be made to prevent the "abortion" of ideas and to ensure their implementation into practice. After the invited presentation on how to develop the next generation of innovators in science, technology, engineering, and mathematics (STEM) disciplines at the US National Science Board, with a subsequent report to Congress and President Obama in August 2009, I came to believe that the time is

* *Département des sciences administratives, Université du Québec en Outaouais, Pavillon Lucien-Brault, 101, rue Saint-Jean-Bosco, Case postale 1250, succursale Hull, Gatineau, Québec, J8X 3X7, Canada. Email: Larisa.Shavinina@uqo.ca*

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right for initiating this new research direction. Innovation education has an important role to play in teaching everyone how to implement his or her ideas into practice in the form of new products, processes, and services.

This article will describe the renowned cases of talented innovators who resisted abandoning their great ideas and eventually implemented them. Akio Morita, Fred Smith, Richard Branson, Herbert Kelher, Bill Gates, Michael Dell, and Jeff Bezos, just to mention a few, are among such outstanding innovators, which will be considered in the article. They are characterized by a unique ability to both generate great ideas and to implement them into practice. These cases have significant implications for gifted and innovation education, namely: they shed light on what can today's children, adolescents, and adults learn from eminent innovators in order to be able to save, develop, and implement their ideas thus making innovations happen.

What is the Phenomenon of the "Abortion" of New Ideas?

While the traditional practice of economic and innovation sciences focuses on implemented scientific and technological innovations (such, for example, as iPod or iPhone, just to mention two) and the counting of revenues received from them, I found that neglecting "killed" ideas and, consequently, the value of lost innovations represents a huge gap in research. When people intentionally or unintentionally abandon their ideas without any desire to further develop them and to eventually implement them into practice, they also abort potential innovations. This is the phenomenon of the "abortion" of new ideas.

There are many well-known cases of individuals resisting abandoning their creative ideas and finally successfully implementing them. Akio Morita, a co-founder and the former Chairman of *Sony*[1], is an excellent example. He insisted on the idea to develop the 'Walkman' when everyone else at *Sony* resisted his idea including senior executives. They based their decisions on the results of marketing research, which had shown that nobody wanted to buy this future product. Relying on his intuition and courage, Akio Morita insisted. "Everybody gave me a hard time. It seemed as though nobody liked the idea" (Morita, 1987, p. 79). He could have easily given up, but he did not. When the resistance from senior management reached its height, Akio Morita threatened to leave his position of the Chairman if *Sony* did not sell 100,000 Walkman in the first half a year. When the Walkman was eventually developed, it became *Sony's* best-selling product. Moreover, in the next 12 years of its production *Sony* pioneered a hyper strategy of innovation: the company developed 4 platforms and 122 incremental innovations! Nobody else in the whole industry ever matched this achievement, which resulted in profit for and increased prosperity at *Sony*.

Fred Smith is another good example. While attending Yale University, he wrote a paper for an economics class, outlining an overnight currier service delivery in a computer *information age*. He received a C for this paper. However, Fred Smith insisted on his idea of creating such a service delivery despite of the professor's disapproval. Eventually, he founded *FedEx,* the first overnight express delivery company in the world, and the largest in the United States, as well as became its chairman, president, and CEO. Today, *FedEx* has more than 290,000 employees and is consistently ranked among the world's most admired companies. For instance, *FedEx* has been featured on *Fortune* magazine's "100 Best Companies to Work For" every year since 1998 and was ranked No. 91 on the 2010 list.

The ever-optimistic Richard Branson was reportedly depressed on his 40th birthday because he was not able to develop *Virgin Atlantic* as fast as he wanted (Branson, 2002). If he had abandoned his ideas, *Virgin* might never have happened and the 60,000 people the company now employs might not have had jobs (Branson, 2011c**).** Not every of his creative ideas was a great success, but he never gave up and persisted in implementing them into practice (Branson, 2008).

Herbert Kelleher did not give up either when competitors tried to keep the just-founded *Southwest Airlines* grounded. He overcame a year's worth of legal challenges from them and thus kept his idea implemented. *Southwest* has been an innovative enterprise just from its inception by using a 10 minute turnaround, airhostesses in hot pants, and free bottles of alcohol with every ticket. The company has never had an in-flight fatality. With its more than 37,000 employees, *Southwest* is consistently named among the top five Most Admired Corporations in America in *Fortune* magazine's annual poll. *Fortune* has also called Herbert Kelleher perhaps the best CEO in America.

Michael Dell is another excellent example who resisted abandoning his great idea. If he had followed his father's advice and his brother's steps and continued university studies, *Dell Computer Inc.* would not exist and 46,000 people would not have jobs. In contrast to parents' expectations, he left university and decided to "compete with IBM" by founding his own company and building better computers than IBM (Dell, 1999).

However, how many similarly remarkable ideas were abandoned and potential innovations lost? No one tried to estimate it. This article thus opens a new research direction with significant scientific potential and important practical implications.

Explaining the Phenomenon of the "Abortion" of New Ideas

Although innovation is exceptionally important for the economic development of any society, it should be acknowledged that innovation does not happen often. Why do people abandon their ideas? One of the possible explanations consists in the fact that there exist many constrains or factors inhibiting innovation. The concept of *innovation gap* is a critical one. It means that people have a lot of creative ideas, but they are not able to implement them into practice due to various reasons. There are multiple barriers to innovation.

A barrier to innovation is any factor that influences negatively the innovation process. Researchers found that the existence of barriers in innovation is the rule rather than the exception. In most cases market, government, societal, organizational, and business procedures work against both successful development and use of innovative products, processes, and/or services (Hadjimanolis, 2003). In contrast, facilitators are factors with a positive influence on the development of innovation. Barriers and facilitators are related. Research shows that many barriers exist due to lack of facilitators (Shavinina, 2003).

Richard Branson has been demonstrating many times how to overcome numerous obstacles on a way to implementing creative ideas into practice. For instance, in 1970 a new law had just been passed that allowed people to sell records at discounted prices, and Branson was among the first to take advantage. He thus launched his second major venture: a mail-order record business. Like his *Student* magazine before, Richard's new company was a great success. Sales skyrocketed, and Branson scrambled to find employees to keep up with the tremendous order load. When a postal strike crushed the mail-order endeavor, the ever-creative Richard Branson responded by opening a small, discount record shop on Oxford Street in London that was a hit as well. A chain of Virgin Record stores was the next.

Early setbacks, such as the postal strike, were representative of the great obstacles that Branson would be forced to overcome in the UK anti-business climate of the 1970s and even 1980s. Indeed, during the 1970s the United Kingdom was mired in economic malaise. Tax rates on unearned income were as high as 98 percent, and labor strikes such as the one that nearly destroyed Virgin were the norm. Furthermore, a general disdain for entrepreneurs and "new money" permeated the business and social environment, making it more difficult for would-be capitalists to get their ideas off the ground. A mid-1980s survey, for example, showed that 29 percent of the executives in the United Kingdom viewed business owners as having the lowest status in the country, while only 13 percent thought they had the highest status.

However, Britain's political, social, and economic environments were perfect for Richard Branson. A rebel by nature, he loved a good challenge from early childhood and enjoyed

bucking convention since school years. These characteristics were most conspicuously evidenced by the name that he chose for his company. He used Virgin to signify his lack of knowledge about the businesses into which he entered. While business convention demanded that entrepreneurs have experience in the ventures they began, Branson elected to enter businesses that interested him, regardless of his background; he would ask questions and invent his own route to success. Having no preconceived ideas about an industry, he was able to identify unnecessary hurdles that his competitors took for granted, as well as to recognize hidden opportunities and go ahead. Many of Richard's subsequent ventures testify to this.

For example, in 1984 he came across another industry that interested him and about which he knew relatively little: the airline industry. Critics effectively laughed off Branson's idea to begin providing long-haul air service between London and New York. Nonetheless, he purchased a Boeing 747 and began flying people back and forth between the UK and USA, offering improved service and unique features. Virgin Atlantic Airways wowed observers by posting a profit in its second year. "It's not so divorced from the music business," Richard Branson pointed out in the November 14, 1988, *Forbes,* noting that "if people are traveling for ten hours, they want to be entertained." Entertainment was, indeed, an important element of Virgin Atlantic's success during the 1980s and early 1990s. Passengers were entertained with videos and, in some cases, live performances. One can conclude that creativity helps innovators to overcome the existing obstacles and implement their ideas into practice instead of abandoning them.

Richard Branson is convinced that "obstacles and challenges are healthy for everyone, not just entrepreneurs. They force you to think outside the box, so to speak – to be creative. The challenge is to follow through on a great idea. I think if [you've] got a great idea, you need to just give it a try" (Branson, 2009b). And he lives up to this principle. Thus, after a failed around-the-world balloon trip, Branson said of his experience, "It has been like hitting up against a solid brick wall. All day and all night long, we battled to get through it" (Branson, 2009a). This battle is a familiar one to Richard Branson, who has seen his share of failed business ventures. But, in typical Branson fashion, he rebounds from his failures with the same youthful energy he had the very first day he created Virgin Records. His passion to generate original ideas and implement them into practice by creating new companies cannot be quelled by any barrier no matter how large. "He's not driven like other people. He's driven to do stuff," the *Virgin* executive Tom Alexander said. "The money is the byproduct. If it makes money, well, then great, because then he can go off and do more stuff. Doing nothing is not an option. If you've ever been on holiday with him, it's hard work" (Alexander, 2012).

Therefore, this section sheds light on why and under which circumstances people "kill" their ideas. It happens because there are multiple barriers to innovation.

Never Give Up! The Key Internal Obstacles to Innovation

The above-described external obstacles to innovation constitute one part of the explanation of the phenomenon of the "abortion" of new ideas. However, this is not the whole story. Another major group of barriers is related to personal factors such as a lack of courage, persistence, a wish to do the impossible, and all those distinguished characteristics of innovators and entrepreneurs discussed elsewhere (Shavinina, 2008), respectively. These qualities are highly developed in great innovators who never abandon their new and original ideas.

The case in point is Richard Branson again and the early years of Virgin Atlantic. The airline became his main focus during the 1990s. In July 1991 he reached his key goal of expanding service to London's Heathrow Airport. This achievement was a signal victory in Branson's bitter struggle with British Airways, which had sought to block Virgin Atlantic's growth through political influence and underhanded tactics. Among the latter was the establishment of an espionage unit to spy on Richard Branson and harass Virgin customers

in person and by telephone. Lord King, the *British Airways* chairman, spread rumors that his competitor was about to go bankrupt. Virgin's chronic cash flow problems lent credence to these stories. In 1992 Branson made the painful decision to sell Virgin Music Group to Thorn-EMI for approximately $1 billion to keep Virgin Atlantic aloft. This sale enabled him to upgrade the airline with such luxuries as seat-back video screens, full-sized sleeper seats, in-flight massages and manicures, and free ground transportation by limousine. Nevertheless, the ongoing battle with British Airways continued. The British press wondered whether Richard Branson had finally taken on a battle he could not win. An editorial in the *Sunday Telegraph* wondered whether Branson was "too old to rock 'n' roll, too young to fly" (March 15, 1992). Richard fought back, casting himself as an upstart David against a greedy Goliath. He continued to accuse British Airways of unethical tactics, prompting Lord King to question Branson's truthfulness publicly. Branson sued *British Airways* for libel in December 1992, and British Airways offered the highest uncontested libel payment (£610,000) in British history. Richard Branson shared the settlement with the *Virgin Atlantic* staff. The court victory marked a turning point for his airline. By the end of the 1990s it had become the third-largest European carrier and the most profitable company in the Virgin group.

What would have happened if Richard Branson had given up in his struggle with *British Airways*? Many thousands of people the *Virgin Atlantic* now employs might not have had jobs (Branson, 2011b) and the consumers from around the world might not have flown one of the best airlines. That would be a huge loss for the UK and global economy.

Bill Gates also did not give up, although he was extremely depressed by a lack of his company's success in its very early years. At one point, Gates wanted to sell the rights to his BASIC software language for just $6,500 because his products weren't selling well. Had he done that, *Microsoft* may never have come to exist (Wallace & Erickson, 1992). Up to now *Microsoft* created 92,000 jobs worldwide and had been recognized as the number one global workplace by the *Great Places to Work Institute* in 2011.

Akio Morita did not give up either when he could not find American distributors for *Sony* products in the 1960s – the same line of products that later included *Sony's* ubiquitous and highly profitable Walkman.

As discussed above, Herbert Kelleher did not give up in his battle with competitors and, as a result, there is one of the excellent airlines. In 2010 *Southwest Airlines* flew 86 million passengers, more than any other airline within the United States. It operates more than 3,300 flights a day and, as of January 2012, the company has scheduled service to 97 destinations in 42 American states.

The personality-related factors are thus an important group of character's traits, which help innovators to overcome the multiple barriers they face on the way of implementing their original ideas into practice in the form of new products, processes, and services.

Ignore Ney Sayers!

One of the attitudes that help talented innovators not to give up is their ignorance of ney sayers. For instance, when Michael Dell decided to expand his young computer company internationally, everyone told him he was out of his mind. So, he did what any innovator would: he went ahead with it anyway.

Dell's first international expansion was to the United Kingdom in 1987 and the business was profitable from its very first days. Now *Dell U.K.* is almost a $2-billion-dollar-a-year company. Michael Dell recalled later that all but one of the 22 reporters at the press conference announcing the expansion predicted failure. They said it was a bad idea, that the direct business model was an American invention that would not work in other countries. Even Dell employees believed it was silly.

So, what does Dell's success with international expansion say about innovators? In his own words, the lesson is "believe in what you're doing. If you've got an idea that's really

powerful, you've just got to ignore the people who tell you it won't work, and hire people who embrace your vision" (Dell, 1999, p. 4).

Richard Branson echoes this approach. According to him, every true entrepreneur has to love solving complex problems and wish to do what others believe is impossible. "A successful entrepreneur likes to prove that people around him are not right. 90 % of businessmen know that when a great idea comes to their mind and they discuss it with friends and colleagues; nobody ever supports them. Almost everyone will put arguments forward against the implementation of that idea. Good entrepreneurs are those who accept this as a challenge and want to demonstrate to all skeptics that they are wrong" (Branson, 2012). And he proved it on numerous occasions. Thus, even in bad times (e.g., in 2001) he continued to dream up new ventures. One project, *Virginstudent.com*, was a youth-oriented web site that recalled Branson's *Student* days. In interviews he dismissed talk that the *Virgin* brand had become overextended. "That's been said for about 30 years," he told the *Sunday Telegraph* (Branson, 2001a). It is amazing that such talks do not stop him.

The ability to never give up is, therefore, a distinguishing characteristic of outstanding innovators.

'It's Okay to Risk Making Mistakes, But It's Not Okay to Be Fearful'

Jeff Bezos, the founder of *Amazon.com* is another impressive example, who, as Vandervert put it, seems to have the "almost did not do it, but did" magic (Vandervert, 2012). Although *Amazon.com* is an amazing success story today, during its accelerated growth the company had equally amazing problems. Sales were staggering from the beginning, but covering business expenses was costly. Whatever money the company made was already spent. Some shareholders grew impatient with Bezos's promises of profit. . . Amazon.com was spending more than they were earning. Or, as Bezos put it, "*Amazon.com* was actually profitable in December 1995. . . for, oh, about one hour"(Sherman, 2001, p. 62).

People, of course, were wondering if there was something wrong with the way *Amazon* was being run. How could the company have so many customers, they asked, yet not show a long-lasting profit? Definitely, Amazon's customers seemed to be happy with what Amazon was offering. But the "problem" was that Bezos was continuing his practice of turning most of the company's earnings back into Amazon to pay for improvements rather than showing a profit (Sherman, 2001). The future of the company was thus uncertain. There was a possibility it would not survive (Garty, 2003).

Skeptics, critics, and doubters fully expected that brick-and-mortar retailers like *Barnes & Noble* or *Borders* would soon shoulder the young start-up out of the online book market. Others said the company was burning through its cash too quickly. It was facing lawsuits from competitors and partners. *Walmart* claimed that *Amazon.com* was hiring away employees, while Toys "R" Us sued to end its partnership with *Amazon.com*. Many were sure the company would fail (Robinson, 2010).

However, Bezos did not back down. "We want to build something the world has never seen" (Ryan, 2005, p. 73) and "we are going to be unprofitable for a long time. And that is our strategy," Bezos told *Inc*. magazine in 1997. He and his chief financial officer, Joy Covey, made it clear to investors that *Amazon.com* was different. "The Company believes," stated the plan they presented, "that it will incur substantial operating losses for the foreseeable future, and that the rate at which such losses will be incurred will increase significantly from current levels" (Ryan, 2005, p. 54). That is, they warned the investment worlds that Amazon.com was not a profitable operation even though it intended to be one someday. In September 1999, *Fortune* magazine credited Joy for "convincing Wall Street that a profitless company was worth $22 billion" (Ryan, 2005, p. 77). This overall outcome sums up the value of one of Bezos's basic beliefs: It's okay to risk making mistakes, but it's not okay to be fearful.

Jeff did not give up. The doom-and-gloom predictions turned out to be wrong. *Amazon.com* earned its first full-year profit in 2003 and, by 2008, the company's revenue had reached $4 billion. *Amazon.com* succeeded in large part because of Bezos's vision that mostly consisted in quickly embracing e-commerce innovations that improved its customer experience. Such standard operating procedures as one-click shopping, e-mail verification of orders, and customer product reviews were not on the radar until *Amazon.com* adopted them. In order to implement his vision, Jeff had used whatever was earned from sales to expand the business. This is why in 1999 alone he purchased 9 smaller Internet companies, opened 7 new online stores, and built 5 huge warehouse distribution centers. He preferred to focus on investing in new and wider markets, which totaled 13 million customers, rather than declaring profits which Wall Street would applaud (Ryan, 2005). Bezos proved the powerful intuitions behind his strategy were correct, and he won. Today, *Amazon.com* hires 65,600 employees.

The Impact of "Saved" Ideas and Thus Implemented Innovations on the Economy

If one looks at the end results of those ideas, which great innovators implemented into practice by founding or co-founding new companies, one can see a tremendous impact on the economy. Together, Akio Morita, Fred Smith, Richard Branson, Herbert Kelher, Michael Dell, Bill Gates, and Jeff Bezos created 758,800 jobs worldwide. It is quite remarkable both for national and global economies. Plus, taxes paid from the billions of dollars in annual revenues. Besides that, their companies became the leaders in their respective areas of business thus introducing and defining the rules of the game in those industries.

Moreover, innovators not only created many new jobs; they created the best places to work. It reflects itself, for instance, in a great number of résumés that their companies receive every year. It demonstrates how much people want to work in those organizations. Thus, as it follows from the company's website, in 2009 *Southwest Airlines* received 90,043 résumés but hired a mere 831 people. In 2010, it received 143,143 résumés but hired only 2,188 people, making it harder to get a job at *Southwest* than to get into a prestigious *Ivy League* college.

Therefore, the impact of innovators' implemented ideas on the economy is great.

Summing-up

This article introduced and described the phenomenon of the "abortion" of new ideas. It presented one of the possible explanations regarding why people abandon their ideas. It also roughly estimated the impact of "saved" ideas and, therefore, implemented innovations on the economy in the case of prominent innovators known for their ability to both generate creative ideas and to put them into practice in the form of new products, processes, and services. The considered case-studies of Akio Morita, Fred Smith, Richard Branson, Herbert Kelleher, Michael Dell, Bill Gates, and Jeff Bezos demonstrated how they did not give up in the face of multiple obstacles and implemented their ideas.

Further research is definitely needed. It should be related to the evaluation of the potential value of innovators' abandoned or aborted ideas (they all had such ideas in addition to the implemented ones) by estimating the possible profit from them and then counting the potential impact of "killed" ideas and, consequently, lost innovations on the economy. This is new, groundbreaking research with a great potential to advance knowledge in innovation science, education, economy, entrepreneurship, business, and public policy.

The "abortion" of ideas is dangerous for any society. Therefore, every effort should be made in order to teach children, adolescents, and adults how to save, develop, and implement their ideas into practice. This is a vital goal of gifted and innovation education. By saving many potential innovations, we will thus fuel the global innovation-based economy.

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Note

[1] Together with Mr. Ibuka, Akio Morita implemented his idea of a company producing highly innovative products and thus founded *Sony,* which currently consists of 168,200 employees worldwide.

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The Author

Larisa V. Shavinina is a Professor of Project Management & Innovation at the Université du Québec en Outaouais, Canada. Her main research focus is the psychology of high abilities: the nature of giftedness, the child prodigy phenomenon, scientific talent in the case of Nobel laureates, entrepreneurial giftedness, managerial talent, new assessment procedures for the identification of the gifted, as well as high intellectual and creative educational multimedia technologies (HICEMTs) aimed at developing potential abilities of gifted and talented individuals.

Over the years Dr. Shavinina's research has expanded to encompass innovation. Her bestselling *International Handbook on Innovation* (1171 pages),

published by Elsevier Science in 2003, was the first and only book of its type, and is considered the beginning of innovation science. It is aimed at unifying the field on innovation: at merging psychological, management, and business perspectives together. She introduced innovation education as a new direction in gifted education. Innovation is also an important element in Dr. Shavinina's research on giftedness and economy.

Her publications have appeared in Gifted Child Quarterly, Journal for the Education of the Gifted, High Ability Studies, Creativity Research Journal, Review of General Psychology, New Ideas in Psychology, and others. She co-edited CyberEducation and Beyond Knowledge. Her *International Handbook on Giftedness* (1539 pages) has been recently published in 2 parts by Springer Science & Business Media. This Handbook sets a new standard for the field and will be essential to scholars' knowledge base for years to come.

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Cope and Grow: A Model of Affective Curriculum for Talent Development

David Yun Dai[1*] and Kim Speerschneider[1]

Abstract: A Cope-and-Grow Model of affective curriculum for talent development is introduced based on a dual process theory of expanding one's personal agency and horizon (Grow) while dealing with stressful events and negative emotions (Cope). Based on research, the Model specifies four stages of talent development and three contextual situations that have ramifications for issues related to talent development and affective growth. It distinguishes between enactive and reflective aspects of growing and coping experiences, and identifies tools and resources (experiential, social, and media) for both. Significance of the Model will be discussed in terms of promoting a more personalized agenda of talent development. Practicality of the Model will also be discussed in terms of the ease of implementation and specific procedures.

Keywords:
talent development, affective curriculum, enactive and reflective self, cope and grow, developmental corridors, milestones, trajectories

Talent development is a process involving prolonged formal and informal learning in one or multiple domains, with highly committed efforts, deliberate practice, and extended problem solving and self-improvement, resulting in a unique set of specialized knowledge, skills, and dispositions responsible for (a) outstanding performance in domains requiring execution of advanced skills and problem solving (e.g., piano virtuoso, neurosurgery, or computer troubleshooting), (b) production of novel and useful ideas and products (e.g., composing a piece of music, inventing a robot, or developing a scientific theory), and (c) major contributions to a particular line of human endeavor, be it intellectual, practical, or artistic in nature (Ericsson, 2006; Subotnik, Olszewski-Kubilius, & Worrell, 2011; Tannenbaum, 1997; Weisberg, 2006). Affect is an inclusive term referring to feeling aspects of one's mental life that distinguish themselves from thinking and cognitive skills. For the purpose of this exposition, affect includes any emotions, feelings, moods, attitudes, valuations, desires, aspirations, and personal meanings and valences of specific activities and objects that constitute one's lived experiences and substance of inner life.

A preponderance of evidence shows that affect is crucial for the psychological well-being (e.g., optimism, hope), adaptive functioning (e.g., the fight-flight-freeze effects of anxiety), and motivation (e.g., aspirations and interests that move the person forward or fear and apathy that produce behaviors of avoidance and disengagement; Davidson, 2001; Panksepp, 1998). In the subjective landscape of a personal life, affect is an integrating, organizing factor that helps shape a person's identity and career path (Block, 2002; James, 1997; Ciompi, 1991). Affect provides an ambience for any sustained efforts in short-term learning and long-term development (Barron, 2006; Beltman & Volet, 2007), and is thus an essential component of talent development.

When it comes to issues of individuals' optimal development, affect plays a crucial role, sometimes facilitative and instigative (e.g., strong intrinsic motivation, positive outlooks

[1] *University at Albany, State University of New York, USA*
[*] *Corresponding author: University at Albany, ED233 Educational Psychology, Albany, New York 12222, USA. Email: ydai@albany.edu*

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about the future), other times inhibiting and debilitating (e.g., injected perfectionism, frustration). Leveraging affective experiences for educational purposes is a strategy widely used in education (Goldin, 2000; McLeod, 1989) and is recognized as critical for gifted education as well (Hoekman, McCormick, & Gross, 1999; VanTassel-Baska, Olenchak, & Cross, 2009). Talent development without affective growth is like developing a strong body without a soul.

Finally, talent development is a means to the end of living a happy, productive, fulfilling life; for that matter, affective growth and personal fulfillment is the ultimate purpose of education. Yet systemic efforts to develop an affective curriculum as parallel to academic and cognitive ones in the context of talent development are still relatively rare. The Cope-and-Grow Model introduced in this article is meant to move in that direction.

The Need for an Affective Curriculum for Talent Development

There are many theoretical perspectives that can be used to build an affective curriculum (Moon, 2009). Olenchak's (2009) Bull's Eye Model focuses on four components: natural affect, world contexts, meta-affect, and personal niche. Renzulli (2009) focuses on a set of personal qualities such as optimism and sense of destiny as essential for long-term talent development. Folsom (2006) focuses on emotional learning as a distinct form of affective growth. Peterson (2009) formulated preventive and interventional approaches to gifted children's affective development from a clinical perspective. Piechowski (2009) and Gagné (2005) even consider affect as a domain in which some individuals excel (i.e., emotionally or affectively gifted). Dabrowski considered affective growth of gifted individuals as going through positive disintegration, a seemingly negative experience that facilitates one's reorganization of inner life and purpose (see Ackerman, 2009).

Although affect has been given some attention, elucidation of affective aspects of talent development from a truly developmental perspective is rare, let alone a model of affective curriculum for talent development. Current theories of talent development are by and large cognitive ones, focusing on specific requirements of a domain and what kinds of abilities and efforts are needed for advanced development (Ericsson, 2006; Gagné, 2009; Lubinski & Benbow, 2006; Subotnik et al., 2011). Although motivation and psychosocial skills are often considered crucial "catalysts" for developing advanced skills (e.g., Gagné, 2005; Subotnik et al., 2011), they are rarely elevated to the central issue of personal growth. For that reason, some scholars criticize talent development approaches as too "achievement-oriented" and not as concerned with issues such as self-understanding and self-actualization (Grant & Piechowski, 1999).

Ironically, while gifted education researchers do pay attention to "social-emotional" issues of gifted children, and even make social-emotional curriculum feature prominently (VanTassel-Baska et al., 2009), they usually consider social-emotional issues as an inherent part of being "gifted," rather than emergent issues with talent development. Therefore, affective issues of coping with setbacks and failures in talent development and growing in terms of building personal strengths, meanings, ambitions, and identities are somewhat obscured, except for some issues such as achievement-affiliation conflicts (Clasen & Clasen, 1995). Furthermore, while a clinical approach appropriately focuses on those negative emotions gifted students tend to experience (Peterson, 2009), what we need in an affective curriculum for talent development is a more growth-focused approach. Therefore, a model of affective curriculum for talent development fills in this gap in our curriculum.

The Cope-and-Growth Model was initially formulated in a grounded theory approach to studying early college entrants in a math and science program (authors, under review), and is now expanded in light of a broader range of research studies to include the whole spectrum of developmental stages, educational contexts, and coping and growing issues.

The Cope-and-Grow Model is intended to work in tandem with a cognitive agenda of

developing talents in the aim of promoting optimal development. How to make a coherent model of affective curriculum that supports deep engagement and sustained motivation to pursue a particular line of work is a central challenge from a talent development point of view. A critical feature of the Cope-and-Growth Model is that it defines affective development not as a separate agenda apart from cognitive one but as the part and parcel of talent development. This is based on an integrative understanding how the affective system regulates and organizes the cognitive system in goal-directed behaviors, including sustained efforts to develop competence and solve difficult problems along the way (Block, 2002; Ciompi, 1991; Dai & Sternberg, 2004; Shavinina, 2004). Defined this way, talent development becomes a highly personalized endeavor, involving interest development, on-going self-efficacy appraisal, gaining advanced experiences, making choices, forming personal identity and commitment, being sensitive to social contexts (opportunity and challenge, support and constraints) every step of the way. The Cope-and-Grow Model takes an explicitly developmental approach, fully in line with the developmental literature to ensure that an affective curriculum so designed echoes the developmental processes in scope and sequence.

Developmental Underpinnings of the Cope-and-Grow Model

Several key concepts constitute the developmental underpinnings of the Cope-and-Grow: age-related domain considerations, developmental corridors, milestones, trajectories, and pathways.

Age-Related Domain Considerations

The developmental framework should consider general developmental constraints (puberty, legal limits, social confines) as well as special considerations regarding unique developmental trajectories of talented children (e.g., precocity, non-universal paths). However, any talent development starts with a domain of human activity. When to usher a child into a realm of meanings and valences is an important decision; building a rocket or cleaning a river may be highly meaningful to an 8 year old, but building a technique to move molecules around or creating artistic expressions that are meant to shock rather than please may not. Children may start music training as young as 4 years of age, but serious engagement in theater will not occur until much later. How to provide the kind of domain experiences that develop deep interests, life themes, and personal commitment is as much an age-related as a domain-related issue. For example, social studies and language arts can afford personal appreciation of certain cultural values (e.g., empathy or social justice) more directly than, say, mathematics can. Motivationally speaking, arts are more expressive and can provide more immediate reward and gratification (i.e., positive affect) than sciences, which are more instrumental than expressive and entail epistemic motivation and intellectual curiosity (i.e., cognitive motivation; Csikszentmihalyi, Rathunde, & Whalen; 1993), but all these interests and valuations occur at certain ages. Thus *each domain has its own unique affordances in terms of affective rewards and motivations, and constraints in terms of prerequisites for benefiting from these affordances that are often related to maturity and precocity.*

In addition, formal and informal learning of domain knowledge and skills have different personal implications at different developmental stages: informal learning occurs in everyday transactions and leisure time, and is more relaxed and enjoyable, affording more freedom to stretch one's mind and expose oneself to a broad range of world knowledge; formal learning is more instrumental and focused, requiring more mental discipline and technical precision (Bloom, 1985; Ericsson, 2006; Whitehead, 1929). One's self-efficacy may not be an issue when engagement in a domain is mainly "for fun" but can become an issue when one is getting serious about "doing well" in that domain. These are questions that should be used to guide a model of affective curriculum.

Developmental Corridors, Milestones, and Trajectories

Besides developmental appropriateness of curriculum provisions, an affective curriculum should be commensurate with the cognitive and affective changes and transitions at particular junctures in development. Children's ability to be autonomous, to be capable of self-direction rather than other-direction increases over time; thus adult-structured activities such as an affective curriculum should also vary in terms of how much it should be adult-directed and student-directed (Larson, 2000). Talent development can be seen as negotiating one's pathway through *developmental corridors,* which are structured spaces and paths open to developing individuals, through which they traverse and developmental milestone events are experienced and trajectories formed. This does not mean the paths of talent development are fixed in a particular corridor; rather, talent development is constrained by what is offered and supported in the environment over time. For example, some schools or communities provide a wider developmental corridor than others. What matters developmentally is the range of learning experiences we provide to students at different junctures of development with their unique sets of sensitivities and sensibilities that eventually shape the way a person develops. The notion of developmental corridors fits Feldman's (1994; 2009) notion of universal and unique development: developmental corridors can be as *universal* as accommodating most people initially; but as one moves toward a unique niche in talent development, developmental trajectories become increasingly *differentiated and unique*. As figure 1 indicates, as one matures, and more opportunities open up, and the developmental corridor gets wider, allowing for more *developmental variability* in terms of trajectories and pathways, due to both genetic and environmental forces (McCraw, 1981).

When one traverses through a developmental corridor, milestone events will occur. *Developmental milestones* are significant and critical events that shape one's character, self-perceptions, interests, and commitments and mark important transitions or turning points while traversing the developmental corridor. For example, successful coping (i.e., overcoming internal and external barriers) can lead to stronger will power; successful completion of a major project can lead to higher self-confidence; winning an achievement-related award or science competition can lead to a stronger sense of identity and career commitment; getting to know a specific mentor can also be a life changing event that shapes one's destiny. All the above events, sometimes called "crystallizing experiences" (Walters & Gardner, 1986), can become significant turning points in one's life. Leveraging resources to create *developmental milestone events* is an important goal of an affective curriculum.

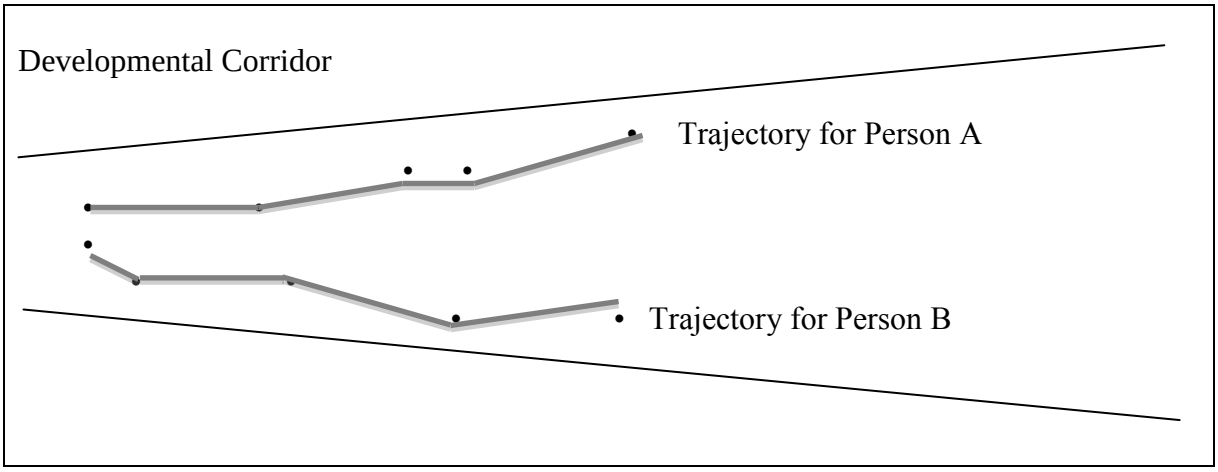

Figure 1. An illustration of developmental corridor, milestones, and trajectories. Dots represent milestone events that mark important transition or turning points, and a pattern and sequence of such transitions and turning points represent an individual trajectory. Persons A and B represent two divergent developmental trajectories over time.

Connecting these proverbial footprints and milestones of traveling through developmental corridors, we will find longitudinal patterns and meaningful sequences of developmental events. We call these patterns *developmental trajectories*. The notion of developmental trajectory suggests that talent development follows a tractable pathway in an orderly fashion. For example, one cannot develop a strong commitment without first developing an interest and self-efficacy (Armstrong & Vogel, 2009), and one cannot develop a personal vision without a strong self-identity, so on and so forth. Sometimes issues and conflicts in early development (e.g., self-doubts) can resurface at the later stage to disrupt higher-level development (e.g., relinquishing an earlier commitment), very much like how Erikson (1967) characterized personal development: new properties of mind at each stage build on developed components in the previous development but are also constrained by these components. What an affective curriculum does is to leverage personal strengths and facilitate milestone events in different phases of life to create a trajectory toward a productive and rewarding life.

Major Concepts and Theses of the Cope-and-Grow Model

The Cope-and-Grow Model is based on a dual process theory of expanding one's personal agency and horizon (Grow) while dealing with stressful events and negative emotions (Cope; Boekaerts, 1993; Dai, 2004; Dweck, 1999). Coping is defined as dealing with taxing situations that seem to exceed one's personal resources. Coping can be *active*, such as making an effort to solve problems, or *passive*, such as disengaging from the source of stresses and problems. Growing is defined as a process whereby one gains personal strengths and resources. Coping and growing are flip sides of the same coin of responding to environmental opportunities and challenges, depending on how individuals construe their experiences. To illustrate this point, an activity can be perceived by one person as opening a new horizon but perceived by another as too much to handle. Specifically, the Cope-and-Grow Model is based on the following three interrelated arguments:

Proposition 1: Human beings as active agents experience the world in terms of personal meanings and valences (e.g., opportunities and threats), and experience themselves as a form of personal agency capable of effecting changes (or for that matter as lacking in agency; James, 1997; Dai, 2004; Kihlstrom, 1999). This dynamic of personal meaning and effectiveness is the main source of positive and negative affects.

Corollary: An affective curriculum should be a cyclical process of action and reflection that promotes the human agency and the potential for growth (Grow) and supports coping efforts (Cope).

Proposition 2: The dual process of expanding oneself (open to the opportunity to expand one's personal agency and horizon) and preserving oneself (the need to maintain positive affect and self-worth, sometimes even at the cost of learning and growth) plays an important role in human development (Boekaerts, 1993; Covington, 1992; Fischer & Connell, 2003; Labouvie-Vief & Gonsalez, 2004). Successful coping with stressful situations and negative affects can become a growth experience in terms of gaining personal strength.

Corollary: An affective curriculum should turn coping efforts into growing experiences (i.e., Cope to Grow), and expand coping resources by helping students cultivate inner strength (i.e., Grow to Cope).

Proposition 3: Highly able students have an advantage in expanding their personal horizons and building their personal visions and life ambitions (i.e., more inner resources to work with, more potential for Grow), but they also have to cope with issues related to their personal ambitions, such as high expectations, more performance pressure, and negative affects, such as alienation from others and discontent with the world, and self-doubts and dissatisfaction with oneself (more issues to Cope with).

Corollary: The focus of an affective curriculum for talent development should be on cultivating personal strengths and promoting personal visions (Grow) as well as addressing their extra burdens of coping: (a) living up to one's high personal standards and goals, (b) ward off social pressure of varied sorts, and (c) dealing with the fundamental instability (negative affect) of inner life (Cope).

In short, an affective curriculum is meant to optimize personal dynamics for talent development through *enhanced growing experiences* and *supported coping experiences.* Thus, an affective curriculum is by nature growth-oriented, rather than deficit-oriented (cf. Peterson, 2009).

As the Model (figure 2) shows, successful coping leads to resilience (will, confidence, commitment, and perseverance) as well as growth experiences; for example, overcoming fear and anxiety (Cope) is necessary for developing a strong interest in an activity (Grow). On the other hand, growing experiences lead to personal vision (agency, life themes, identity, and vision) as well as more power and resources available to cope with new challenges; for example, once a person's personal horizon is broadened, overcoming temporary setbacks becomes easier. We call the former Cope to Grow and the latter Grow to Cope (see table 1).

In the context of talent development, coping is more situational and current: one is dealing with a problem or obstacle that seems to exhaust or exceed one's personal resources and further reflects negatively on oneself. In comparison, growing is a more gradual and less situation-bound process (actively pursuing an interest or reflecting on one's strengths and possible selves). In light of the differences, we specify a curricular focus on Grow as "promotional" and a focus on Cope as "interventional." The former is more proactive, nurturing positive qualities, while the latter is more reactive, dealing with current problems students have encountered.

As noted in figure 2, both coping and growing have two dimensions: enactive and reflective. This formulation is based on the distinction William James made between two aspects of self (see Dai, 2002): the enactive self as an agent capable of effecting changes (the "I" self, such as "can I do it?" "how do I feel about the situation and what action should I take?"), and the reflective self as an object of reflection (the "me" self, such as "whom am I?" and "why do I feel the way I do?"). The latter is akin to meta-affect in Olenchak's (2009) model. Growing can be enactive, directed toward the outside world (e.g., developing intrinsic interests and life passions through transactions with a particular environment); it can also be reflective, directed inward, for instance, searching for a better understanding of self. Likewise, coping can be *enactive*, focusing on solving problems of the academic,

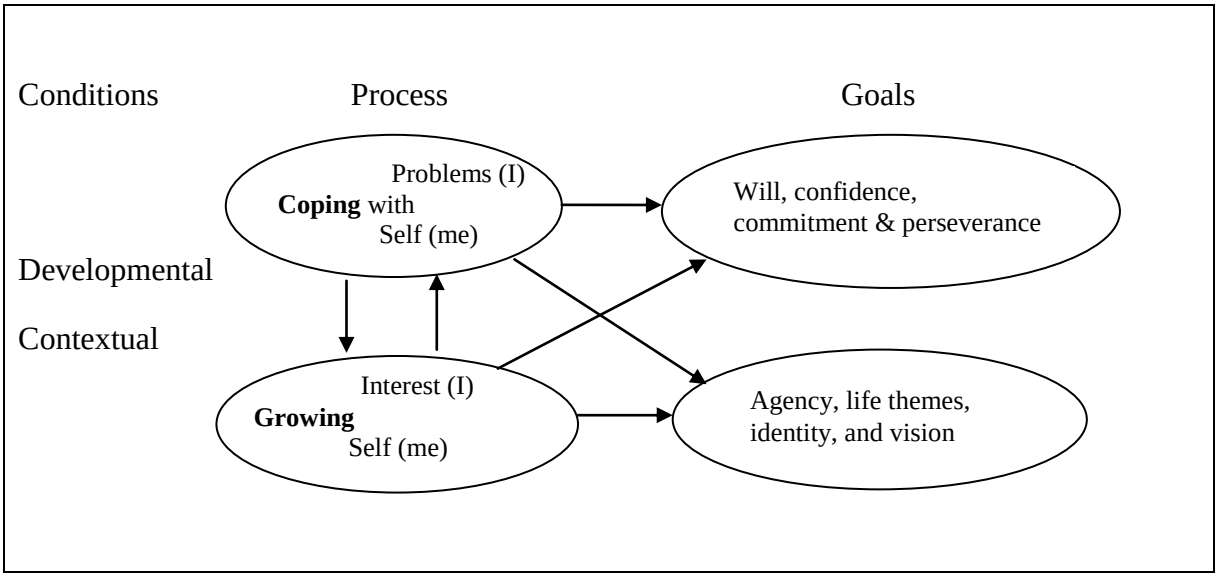

Figure 2. A schematic representation of the Cope-and-Grow Model.

Table 1. Topics and Goals of Cope-and-Grow by Four Stages

Stage	Grow to Cope	Cope to Grow
Foundational Stage: Developing Foundational capabilities and sensibilities **Emergent Agencies /Excitabilities**	**Enactive Growing** Experiences: • Five forms of human agency • Intrinsic motivation to expand self • Intellectual playfulness, intellectual risk taking **Reflective Growing** Experiences: • A sense of agency and direction • Spontaneous interests and life themes	**Enactive Coping** Experiences: • With adversity, isolation, deprivation, etc. • With novel and complex tasks **Reflective Coping** Experiences: • With frustration, anxiety • With fear of novelty or failure
Transitional Stage: Transitioning from other-direction to self-direction (taking more responsibility); a pattern of strengths and interests gradually becoming clear **Developing Interest/Self-Direction and Self-Efficacy**	**Enactive Growing** Experiences: • Enrichment and extracurricular activities (selective affinity) • Taking personal initiatives and more active self-initiated explorations **Reflective Growing** • Interests and self-efficacy appraisals at a new level of reflectivity	**Enactive Coping** Experiences: • With increasing demands • With increasing risks • With peer pressure and role expectations and other life stressors **Reflective Coping** • with uncertainties about self • with negative emotions • with perfectionism
Crystallizing Stage: With more intimate engagement in talent areas, a clearer sense of self **Personal Meaning/Identity**	**Enactive Growing** Experiences: • Mentorship/apprenticeship • Deep understanding of the nature and significance of work **Reflective Growing** Experiences: • A clear sense of personal meaningfulness of an endeavor • More deliberate self-direction • Making commitments	**Enactive Coping** Experiences: • With multi-potentialities • With increasing challenges **Reflective Coping** Experience • With big-fish-little-pond • With procrastinations • With lack of direction
Advanced Stage: Highly dedicated efforts in a particular line of development **Vision/Commitment**	**Enactive Growing** Experiences: • Maximal grip • Intrinsic value of the task • At the edge of chaos **Reflective Growing** Experiences: • Personal meaning of one's work • Personal niche in a large social context	**Enactive Coping** Experiences: • With performance pressure • With setbacks and plateau • With competing priorities **Reflective Coping** Experiences: • With identity • With Internal and external barriers

social, or, developmental nature, or *reflective*, dealing with negative emotions and self-affect engendered by taxing conditions. The main pedagogical implication is that both successful coping and growing experiences can be *enactively engendered* as well as *reflectively enhanced*.

In an affective education, the enactive self (I-Self) is engendered through guided personal actions, such as guided self-explorations, interest development, through which a sense of agency will be gained, life themes will emerge, cross-validation of ideals and ambitions will take place, and a sense of purpose will be crystallized. Developmentally, the enactive self is initially more spontaneous (e.g., sustaining an interest for a prolonged period of time) and then becomes increasingly deliberate (e.g., executing and keeping track of a plan for a science or art project). In contrast, the reflective self (Me-Self) is enhanced through guided self-reflections, problem-based versus emotion-based coping with setbacks and negative emotions, and through the evolution of self-identity from simple self-perceptions to deeper self-understandings of feelings and emotions about the world and self.

Four Stages of Affective Development in the Cope-and-Grow Model

Ultimately, the developmental appropriateness and developmental process considerations can be formulated as the issue of stages of talent development. That is, an affective curriculum should be responsive to where the child is with respect to (a) stages of talent development, (b) what the child's educational conditions look like, and (c) what is the child's affective condition. The way the Cope-and-Grow Model is reflected in a talent development curriculum will depend on the talent developmental stage of students in question and social-ecological contexts in which they are situated. Four stages of talent development and their major psychosocial themes are identified for the Model (see figure 3).

Cope-and-Grow in the Foundational Stage (Stage I)

For *the Foundational Stage*, which roughly covers preschool and most elementary school years, during which children still develop their basic mental instruments (e.g., 4Rs: reading, writing, arithmetic, and reasoning), their behavioral patterns are still relatively spontaneous rather than deliberate, and they are emotionally still developing. During this stage, we emphasize the enactive aspect (I-self) of affective growth. Specifically, the focus for this stage is *Agency and Will* ("I can," "I will"). A sense of agency is promoted through a variety of meaningful activities (Grow), and children's will power is fostered by helping children cope with and overcome *internal barriers* such as fear and anxiety, instant gratification and lack of persistence (Kuhl, 1985; Mischel et al., 1989), as well as *external barriers* such as peer pressure, lack of stimulation and support (Reis, 2006).

"Grow" in the Foundational Stage. The main purpose in this stage is to promote a strong sense of *Agency*. Personal agency here is defined as a self-engendered action that effects changes in oneself as well as one's environment. There are five basic forms of personal agency. *Expressive* (writing, drawing, acting, imaginative play), *technical-inventive* (making and building tools and artifacts), *intellectual* (reasoning, understanding, explaining, theorizing; two major modes: metaphorical or mathematical), *social* (communicating, negotiating, collaborating, and leading), and *psychomotor* (coordinating body movements to accomplish complex tasks) agency. These forms of agency bear some resemblance to the notion of multiple intelligences (Gardner, 1983), but it should be noted that agency so defined is not capacity but a form of effectiveness in the person-environment transaction. Agency so expressed reveals a functional relationship with the world as much as internal capacity. It is affective as much as cognitive (e.g., in the form of over-excitabilities; Ackerman, 2008). Development of any real-world talent entails a combination of these basic elements of human agency in achieving complex tasks featured in a domain. The emphasis on enactive activities is aimed at both developing students' basic competencies and providing opportunities to experience personal agency enactively and positive self-affect reflectively. Learning and training activities in this stage carry both cognitive and affective goals (e.g., writing on a favorite topic).

Levels of Development	*Nature of Affect and Motivation*
Advanced Stage	**Vision/Perseverance**
Crystallizing Stage	**Identity/Commitment**
Transitional Stage	**Life Themes/Confidence**
Foundational Stage	**Agency/Will Power**

Figure 3. Developmental stages and major psychosocial themes in affective development.

"Cope" in the Foundational Stage: Building "Will Power". The term "will" is used to denote two things, the volition to pursue goals and the ability to overcome adversities and overcome negative emotions. A case in point is delayed gratification (Mischel et al., 1998). Sources of obstacles and challenges can be internal or external or the interaction of both. Coping issues such as lack of confidence, performance anxiety, or perfectionism point to internal barriers, and issues such as lack of inspiration or educational opportunities and resources in a disadvantaged condition point to social-contextual barriers (Ambrose, 2003). Here the Cope-to-Grow approach works in an interventional mode. When the sources of obstacles are mainly internal, the task is to help students cope with task-related fear and anxiety (breathing technique, self-talk, encouraging risk-taking to overcome fear, etc.), with setbacks and frustrations (attribution training, etc.). In the Cope-to-Grow mode, gifted children particularly need challenges and experiences of setbacks to develop coping skills (e.g., normalization of "failures;" developing an incremental mindset; Dweck, 2006). When the sources of obstacles are mainly external, how to instigate aspirations and a sense of personal agency through empowering experiences becomes essential (Olenchak, 2009).

Cope and Grow in the Transitional Stage (Stage II)

In the *Transitional Stage*, roughly starting in late elementary school and middle school years, children are making important transitions from other-direction to self-direction, with increasing autonomy and responsibility. Students take on more self-directed activities, beginning to develop and follow their own interests. The period is also marked by the onset of puberty, heightened reflectivity, more social comparison and self-categorization (Harris, 1995), and increasing uncertainties about oneself, and more affective vulnerability. The emphasis of an affective curriculum in this stage is to enhance the development of *Life Themes* (Grow) and *Confidence* (Cope).

"Grow" in the Transitional Stage: Developing Life Themes (Culture). Life themes are enduring life interests that have pervasive influences on one's choice of activities, such as books one reads, activities one participates in, and even friends one makes. The main affective goal is to induct students into varied cultural ways of meaning making, represented in most school subjects, and enrichment classes and beyond, so that students will develop enduring interests, typically in areas of their personal strength (Lubinski & Benbow, 2006). Self-directed explorations will be encouraged and supported given that (a) students in this stage are more capable of taking initiatives, and (b) learning activities take on a new level of reflectivity and affective valence to the self. Enactively, structured productive activities that promote self-direction and self-initiative (Larson, 2000) will help to strengthen a sense of agency and self-efficacy surrounding these experiences and interests. Reflectively, post-activity discussions can be organized given the new level of reflectivity and self-understanding during early adolescence. It is particularly fruitful to help students develop life themes by connecting their talents and interests to the 21st century themes such as globalization, technology, environment, and health (Partnership for the 21st Century Skills, 2009), and by helping them envision their possible contributions to the world in their own ways.

"Cope" in the Transitional Stage: Building Confidence. Confidence refers to self-perceptions (self-concepts) or appraisals (self-efficacy) regarding one's competence and potential in specific areas or domains. Confidence takes on added importance during this stage because of the increased cognitive capability during this stage for self-evaluation, heightened reflectivity and uncertainties about self, and expanded social scope of one's life (peer group formation, self-socialization, and social comparison). For example, given the gender differences in academic interests (Kerr & Kupius, 2004; Stake & Nickens, 2005) and coping strategies (Masse & Gagné, 2002; Plucker, 1998), peer group discussion on the topic can help female students develop coping strategies for social pressures and role expectations and foster confidence, specific interventions such as attribution retraining (Ziegler & Heller, 2000) can be designed for this purpose.

Cope and Grow in the Crystallizing Stage (Stage III)

In the *Crystallizing Stage*, roughly encompassing high school years and possibly part of college years, students develop more advanced knowledge and skills specific to their interests. With the increased freedom and choices, there is also more intense search for identity or niche. Accordingly, the goal of the Cope-and-Grow is to foster the development of *Identity* and *Commitment*. Related back to the foundational stage, identity is built on a clear sense of agency and purpose, and commitment involves will and sheer determination. Identity and commitment have a reciprocal relationship: Identity achievement takes unwavering commitment and determination, and firm commitment to a career and life path also relies on a clear sense of purpose and destiny.

"Grow" in the Crystallizing Stage: Developing Identity or a Clear Sense of Purpose. Developmentally, any enduring life themes and commitments undergo a process from identification to identity (i.e., from situational to personal). The focus of affective curriculum in this stage is to fostering *crystallizing experiences* (Walters & Gardner, 1986). With emergent talents and the adulthood at the corner, it is necessary for talented students to crystallize some feelings about what they are and what they can be (career and college major options). Intel Talent Search, Johns Hopkins Talent Search are some of the programs to facilitate the process, but an affective curriculum should do more to foster identity development (Csikszentmihalyi et al., 1993). Valuable enactive experiences to promote growth during this stage may include internships, mentorships, projects with local organizations, networking within their field, etc. Having an applied field experience can yield important crystallizing experiences for developing purpose and finding one's personal niche in the midst of a multitude of options and opportunities (Olenchak, 2009).

"Cope" in the Crystallizing Stage: Facilitating Commitment. Erickson (1968) characterized adolescence as a stage of identity moratorium. Coping with indetermination and procrastination and its sources is the main goal of a coping curriculum in this stage. Potential let-downs can accompany greater challenges, which can serve as an opportunity to develop effective coping strategies in a professional setting. Activities for reflective Cope-to-Grow can be incorporated as well. For example, in the homogeneous situation (e.g., a gifted school), the big-fish-little-pond effect can be a salient issue (Marsh & Hau, 2003; Zeidner & Schleyer, 1998). Openly discussing this issue can help students reframe the situation in a more positive way (e.g., highlighting its inspiring and motivating aspect). For talented teenagers who are marginalized from mainstream, interventional measures can be taken to help them cope with feelings of alienation and frustration, and restore a sense of personal destiny (Cross & Burney, 2005; Hébert, 1995, 2009).

Cope and Grow in the Advanced Stage (Stage IV)

By advanced stage, we mean students having already made their choice on a particular career path, and invested their energy and time in a professional endeavor (e.g., starting a company, or pursuing a college degree and beyond). Although there are exceptions, typically students will not enter this stage until college, even graduate studies. Concerns in this stage are about successful completion of advanced training and the ability to make creative contributions to a domain in which individuals chose to work. The goal of affective curriculum in this stage goes beyond identity and commitment: it is to develop a personal vision of how one can make professional contributions in a domain (*Vision)* and to develop effective ways to cope with setbacks and failures, frustrations and self-doubts (*Perseverance*).

"Grow" in the Advanced Stage: Developing a Personal Vision. Unlike building basic skills and knowledge, professional life means transforming knowledge and skills into a personal enterprise, what Gruber (1986) called "organization of purpose." Ericsson (2006) focuses on deliberate practice as characterizing the style of working during this stage. Dai and Renzulli (2008) characterized adaptations in this stage as involving *maximal grip*,

getting a firm conceptual and technical handle on a topic or domain, and *staying at the edge of chaos*, being innovative in one's thinking and approach. The goal of an affective curriculum is to develop a personal vision of how one can make a difference in an area of one's choosing. For this purpose, mentorship and in-depth experiences are crucial for building such a vision (Bloom, 1985).

Cope in the Advanced Stage: Developing Perseverance and Mental Toughness. Development at the advanced level is a prolonged process; setbacks, plateaus, and bottlenecks will almost be inevitably encountered in the process. In performance domains, competition could be fierce (e.g., Juilliard; see Subotnik & Jarvin, 2005). In scientific and academic fields, competition can also be present. Big-fish-little-pond effect (Marsh & Hau, 2003; Dai & Rinn, 2008) can impact one's decisions; restoration of confidence and re-affirmation of one's commitment can be a salient issue (authors, under review). The goal is to develop perseverance through active coping with setbacks and adversity, with social pressure and expectations, and perfectionism. Some form of counseling and psychological training would be desirable (Subotnik et al., 2011).

Social-Ecological Considerations: Intersections with Developmental Stages

Developmental stages represent progressions of life that have their distinct contents and contexts. These contents and contexts are not uniform across individuals. Therefore, it is important that an affective curriculum is sensitive to the current educational and social situations in which students find themselves. For a simplified taxonomy, we identify three typical conditions in which gifted students will find themselves.

Cope and Grow in Homogeneous Conditions

Homogeneous conditions refer to self-contained gifted schools or programs where most of the educational activities are shared by a group of similarly gifted and talented students. At younger ages these may be self-contained gifted programs, special schools for the gifted or summer programs (e.g., those offered by the Center for Talented Youth at Johns Hopkins), and in later years they may be honors programs, specialized schools, and special college programs. These homogeneous settings can be perceived by students to have both advantages and disadvantages academically (challenging curriculum at a fast pace) and affectively (conversing with like-minded peers, but also suffering a lowered self-esteem) compared with heterogeneous settings (Adams-Byers, Whitsell, & Moon, 2004). In these homogeneous settings, children often compare themselves to their equally able peers, and may experience the "big-fish-little-pond effect," in which students have to cope with moving from the top of the class to middle or even bottom of the class (Dai & Rinn, 2008).

For early college entrants, however, it is a unique setting and often these experiences reflect the advanced stage in that students are able to pursue their interests and hone their skills in self-selected areas of expertise in greater depth than before possible. They, too, are faced with unique concerns affectively. A study of 180 early entrance college students found that differences in adjustment to college could be predicted by a combination of the students' family environment factors and self-concept (Caplan, Henderson, Henderson, & Fleming, 2002). Caplan et al. suggest that programs with an affective component could help early entrance students to better adjust to college. Students at this stage are confronted with new expectations both academically and socially. The authors' recent study of an early college entrance program lends support to this argument. As a matter of fact, the Cope-and-Grow model was initially developed to account for the lived experiences of early college entrants in a prestigious science program (authors, under review). Again, learning to cope with these challenges can ultimately help students to grow and facilitate their ability to fully delve into their field of study.

Peer comparisons, common in homogenous settings, may also lead to forms of perfectionism (Dweck, 1999). While perfectionism is often viewed as a negative and harmful trait, some evidence suggests that it is a multi-dimensional trait that can result in negative outcomes such as low self-esteem, or possibly more often, result in positive results such as a raised conscientiousness (Parker, 2000). Under the Cope-and-Grow Model, the aim is to be mindful of issues surrounding self-esteem, while recognizing the potential opportunity presented, which in this case may be to develop what Parker calls "healthy perfectionism." These challenges may serve as opportunity to strengthen students' coping skills, allowing them to become more humble and feel more relaxed and accepted after adjusting to the new setting (Cross & Swiatek, 2009).

Providing supports for students to cope with the academic and social challenges that are specific to these homogeneous settings can help students strengthen their academic and collaborative skills while also strengthening their self-concepts and self-efficacy. Evaluation of such supports suggests that to be successful, specific program goals and structure should be made clear to students. Successful implementation of an affective curriculum can help students to grow personally and academically.

Cope and Grow in Mixed Conditions

Mixed conditions refer to mixed experiences gifted and talented students have, with some educational experiences (e.g., a pull-out program, an on-line course) with similarly competent peers and some in regular heterogeneous classrooms. Under this condition, peer acceptance and stigmatization (Coleman & Cross, 2005; Swiatek, 2002), and achievement-affiliation conflicts (Gross, 1998; Clasen & Clasen, 1995) can be acute. Gifted students may feel ostracized by their peers or experience limited social leverage amongst their peers. Additionally, gifted students may face elevated expectations from both peers and teachers. Particularly younger students, just forming their self-concept, may be concerned with peer acceptance and stigmatization. Additionally at this age, students are often being separated from their peers based on abilities for the first time, which may have an impact on their social interactions with peers.

At different developmental stages, the affective influences vary. In a study that includes students in the foundational stage, 26 gifted students from a heterogeneous class in a public school were compared with gifted peers in a homogeneous classroom in a private school for the gifted (grade 5). Those in heterogeneous settings were less likely to spontaneously contribute to discussions and to reflect on their own cognitive processes (Sheppard & Kanevsky, 1999). These authors suggest differences in social peer interactions to have had an impact. Understanding that peer involvement in discussion can impact students' own participation, the classroom climate and encouragement of high-level contributions may support student's involvement even in these mixed classroom settings.

An Israeli study comparing students (grade 4 through 9) in regular and gifted classrooms found that test anxiety increased for students in the gifted classrooms (Zeidner & Schleyer, 1999). More recent investigation of this data revealed that within groups, individual achievement is negatively associated with test anxiety, while class achievement was positively correlated with test anxiety (Goetz, Prackel, Zeidner, & Shleyer, 2008). This effect echoes the fish-big-little-pond effect and raises similar concerns as discussed for students attending special gifted schools. A major difference for those attending gifted classes from those attending gifted schools is the reference of the larger school context. Supporting students to develop strong coping skills for academic anxiety, while simultaneously supporting positive self-concepts and confidence can provide students with the tools to succeed with the recursive relationship between Cope to Grow and Grow to Cope.

During the crystallizing stage, students are often choosing their own paths and are able to explore their interests with greater depths. In many regular schools, this is in the form of

advanced placement (AP) classes or international baccalaureate (IB) programs. Foust, Hertberg-Davis, and Callahan (2009) found that students in both of these settings had to balance social and academic time commitments and often sacrificed sleep to do so. Students reported positive affective and academic benefits such as pride from high accomplishment, strong bonds with peers, and high-level content. The concerns students expressed were stigmatization of gifted students and expectation-related stress.

Another existing condition represents in some ways issues associated with heterogeneous and mixed settings, and in other ways reflects issues common in homogeneous gifted settings. Early college entrance and acceleration programs allow students to surround themselves with peers of dissimilar age, but more comparable cognitive skills or achievement, creating a unique situation. For K-12 students in advanced grade placements, it is quite similar to gifted settings in mixed schools because their regular education peers are still within the school. Often these experiences also place students in the crystallizing stage, providing them with opportunities to explore self-initiated interests and developing themes throughout their work. At this stage, identity formation will be important and students are beginning to commit to areas of study and deciding what their efforts will ultimately work toward. This may also be a cause of stress, but ultimately can provide an opportunity to strengthen their sense of identity and purpose.

Cope and Grow in Marginalized Conditions

Marginalized conditions refer to marginalized experiences typically encountered by those students who are socially and educationally disadvantaged and lacking in opportunities to develop their talent potential and be recognized as gifted and talented. These students may not have access to an appropriate curriculum and may not have peers of comparable ability. In addition to these basic problems, these marginalized students may face criticism from peers for reasons quite different from those for the stigmatization mentioned earlier.

There are a few ways to define the underserved, marginalized gifted and talented students. They may be twice-exceptional students, females in math and science, ethnic minority students traditionally underrepresented in gifted and talented programs, and economically disadvantaged, to name the most commonly identified categories. The focus here will be less on the issues concerning under-identification and modifying identifycation methods and more on the common concerns for designing curricula for gifted students, who experience limitations in available resources.

VanTassel-Baska, Feng, Swanson, Quek, and Chandler (2009) considered five prototypes while tracking students' academic and affective success over four years of gifted programming, including low-income Caucasian students, low-income African American students, low-income other minority students, high non-verbal and low verbal students, and twice-exceptional students. Some group differences were evident. For example, low-income African American learners particularly struggle with the loss of their former peer groups, while low-income Caucasian students embraced their new peers in the gifted program. However, similarities were found across subgroups, suggesting that these gifted learners gained skills, improved academically, and had improved confidence and self-esteem when given opportunity to develop their talent.

A closer look at one child considered both gifted and at-risk (attending a low-income multiage curriculum school) led to some valuable insights about what may have contributed to his success (Barone & Schneider, 2003). Primarily success was attributed to a strong relationship between the mother, school, teacher, and student. Additionally, students in the classroom were allowed many opportunities to choose their own reading and writing topics, encouraged to learn with other students of varying abilities, reflect on their learning, and engage in open-ended work. These considerations emphasize an affective component of gifted education by valuing family-school communication, self-reflecting students, strong peer support, while encouraging individualized pace and

instruction.

Project Aspire provides enriched experiences to gifted, poor, rural students and has identified some common issues to consider (Cross & Burney, 2005; Burney & Cross, 2006). Students in this program may suffer from insufficient study environments, lack of the appropriate modeling of organizational skills, inconsistent attendance for reasons beyond their control, and inconsistent or contradictory social expectations. High-ability low-income students are unique in that they are intellectually different from their low-income peers and economically different from their high-ability peers, which may present concerns for acceptance, peer relationships, and self-concept.

At the foundational and transitional stages, these younger students may experience separation into either gifted classrooms or schools, and leaving behind former classmates and friends. Identity formation may be an important concern. During the crystallizing and advanced stages, older students may be faced with conflicting cultures and possibly conflicting physical settings. At these older ages, self-concept will also be an issue, but additionally students may lack family support to attend college for ideological and/or financial reasons. Another developmental concern for the underserved gifted and talented, is that early foundational and crystallizing experiences such as opportunities to explore high-level self-chosen content areas, may come at later ages than for other students. Gifted students in this position may realize their own abilities and find a purposeful endeavor later. Providing early opportunities for students to develop their personal interests will help to avoid this discrepancy. Other supports in later years such as mentoring and in-depth experiences such as internships can also provide both the affective support and academic opportunity to develop strengths for college and career planning.

Programs such as Project STREAM have sought to provide early college preparation for underserved youth (Clasen, 2006). A longitudinal study assessing the program found that level of involvement with program activities was a significant predictor of later academic outcomes such as high school graduation and enrollment in a higher education institution, and college completion.

Considering these common issues within the Cope-and-Grow framework, schools should link with other organizations that may also interact with the same population to provide the models and supports that may be missing in students' life, while trying to instill a sense of community and acceptance for gifted students. Earlier mentioned issues regarding homogeneous and heterogeneous settings will still be relevant to this population, but their distinct features should also be considered. Providing a range of experiences, mentors, and strong family-school-community supports can again enable educators to create opportunities that empower students, enhancing their sense of agency and raising their aspirations.

Pedagogical Considerations of Implementing the Model

How can the Cope-and-Grow Model of affective curriculum be delivered in a way that is feasible in current school conditions and effective in facilitating the kind of affective experiences and changes intended by the curriculum? The pedagogy of an affective curriculum involves model specification, strategies for effectively promoting positive development as specified by the model, and the ease of use by specifying procedures as well as tools and resources needed to turn the model into teaching practices in school (VanTassel-Baska & Brown, 2007).

The Cope-and-Grow Model specifies two modes of curriculum: enactive or reflective; the former is experiential and the latter uses personal experiences as an object for reflection or "processing" (Peterson, 2009). Both are non-didactic, using strategies to induce affect, meta-affect, and self-understandings rather than teach students what they should do and how they should feel (see Moon, 2009 for a distinction between indirect and direct teaching). We specify three main tools and resources to support the curriculum delivery:

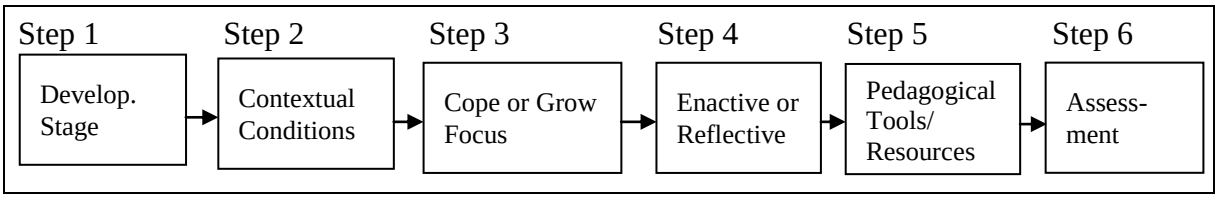

Figure 4. Decision flow in designing a Cope-and-Grow unit or infusing an affective component.

(a) Engage students in structured activities for *experiential* gains, (b) organize *social* group activities for cross-validation and perspective taking, and (c) use *media* (books, videos, internet sources) to help build a broad vision of the world and life.

We suggest that a curriculum unit can be designed by specifying three components: (a) goals, (b) methods of implementation, and (c) assessment of the process and outcomes. Designing a unit flexibly tailored to local situations and needs takes six decision points (figure 4):

(1) What is the class's developmental stage based on the four-stage scheme? (2) What is the educational condition based on three types of contextual conditions delineated in the model? (3) Given the developmental and contextual conditions, and identified problems (defined goals), will a Cope or Grow focus be more appropriate (i.e., is the focus interventional or promotional)? (4) Will the affective development mainly take an enactive or reflective experience, or a combination of both (defining methods)? (5) What pedagogical tools and resources (experiential, social, and media) are available and appropriate for the desired outcomes? And (6) how does the effectiveness of an interventional or promotional activity vis-à-vis its desired objectives can be evaluated? The following are two examples of using these decision points in designing a unit of affective curriculum:

Example 1: Designing a "Cope" unit for combating gender stereotype threat for adolescent girls.

1) Developmental condition: Crystallizing stage
2) Contextual condition: Mixed groups
3) Goals: Cope to Grow – Raising awareness of gender stereotypes regarding women's occupations in a society.
4) Methods: Reflective, related to self-efficacy and self-concept, and identity
5) Pedagogical tools/resources: social, in the form of focus group discussion
6) Assessment: Career interests survey

Example 2: Designing a "Grow" unit for developing life themes and interests

1) Developmental condition: Transitional stage
2) Contextual condition: Self-contained program
3) Goals: Grow – Life theme of environmental protection
4) Methods: Enactive; Project-based learning on "ecological footprints"
5) Pedagogical tools/resources: Experiential in the form of field work
6) Assessment: A presentation to a local community of audience

Significance of the Cope-and-Grow Model

The Cope-and-Grow Model of affective curriculum deals with the central affective aspect of talent development as we know of. The model can facilitate integration of cognitive and affective goals, talent development and personal growth by incorporating a more explicit affective component in gifted education; it can help educators better identify a Cope-and-Grow agenda for a particular group or individual students; it is flexible enough to be used in a variety of situations and can be easily adopted by classroom teachers to infuse an

affective curriculum in a talent development agenda, and flexibly used by school counselors to promote positive growth (Grow) and deal with emergent problems (Cope). Admittedly, the model is a work in progress, and systematic research is needed to support and refine the Cope-and-Grow Model while implementing it in practical settings. It is our hope the model proposed in this article can serve as a first step toward a more integrated talent development approach in gifted education.

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The Authors

David Yun Dai is an associate professor of Educational Psychology and Methodology at University at Albany, State University of New York. He currently also serves as a Zhijiang Lecture Professor of Psychology and Education at East China Normal University. Dr. Dai was the recipient of the Early Scholar Award in 2006 conferred by the National Association for Gifted Children in USA, and he was a Fulbright Scholar to China during 2008–2009. He has published seven books and over 70 journal articles, book chapters, encyclopedia entries, and book reviews in general psychology, educational psychology, and gifted education.

Kim Speerschneider is a Research Analyst in Institutional Research at Excelsior College and a doctoral student in Educational Psychology and Methodology at the University at Albany, State University of New York. She is interested in early intervention programming for at-risk youth, gifted education, and online higher education.

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