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The Influence of Self-Perception of Abilities and Attribution Styles on Academic Choices: Implications for Gifted Education

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This article shows how important self-perception is for the development of academic talent and encourages researchers and educators to acknowledge this dimension more. Our emphasis is on mathematical talent; most of the empirical findings include Finnish Olympians or Pre-Olympians. Research shows a positive correlation between perceived ability and achievement. Gifted girls tend to underestimate their abilities in mathematics and perceive their abilities higher in language arts even when they perform equally in both domains. The findings from Finnish Olympians reveal similar stereotypes in parental attitudes. They prefer ability as an explanation for their success rather than effort. However, our studies show that females tend to attribute success to effort more than males.

Keywords: Academic Olympians, attribution styles, failure, gender stereotypes, self-perception, success

Earlier studies on gender differences among gifted students indicate that males outperform females in mathematics and science (Reis, 1998). According to Reis, the main reason that some girls do not succeed in mathematics is not lack of ability or effort; it is simply that girls are not expected to succeed in these areas. A great deal of stereotyping and prejudice affect girls and boys in their studies. According to Siegle and Reis (1998), adolescent gifted female students indicated that they had higher ability than males only in language arts, whereas gifted male students indicated they had higher ability than females in mathematics, science, and social studies. Eccles' research (1984) has demonstrated that even when girls and boys were both earning the highest grades in mathematics and English, girls were considered by their parents to be better in English and boys to be better in mathematics. Even when girls had higher grades, higher standardized test scores, and higher teacher ratings in mathematics, parents believed that mathematics was harder for girls than for boys.

These gender stereotypes are universal and similar findings of parental attitudes have been reported within Finnish samples as well (Tirri, 2002). Research results have also shown a positive correlation between perceived ability and achievement (Multon, Brown, & Lent, 1991). Therefore, students' self-perceptions of their own abilities become a key factor in educating high-ability students.

In this article, we review research on students' self-perceptions of their abilities and attribution styles. Our emphasis is on mathematical talent and most of the empirical findings include Finnish Olympians or Pre-Olympians. We also discuss the influence of self-perception on the academic choices of students and pay attention to gender differences. Our aim is to show the importance of self-perception in regards to the development of academic talent and encourage researchers and educators to acknowledge this dimension more.

LITERATURE REVIEW

Attributions are the reasons individuals give for a certain outcome, such as success or failure in a task (Heider, 1958). Factors involved in attributional thinking, such as specific reasons for success and failure, have shown to be related in achievement settings (Weiner, 1974, 1980, 1986, 1994, 2000). Weiner's studies showed that the four most frequent reasons for success or failure are ability, effort, task difficulty, and luck.

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Dai, Moon, and Feldhusen (1998) classified attribution constructs into three groups. First, attribution *appraisals* are online explanations assessed following actual or manipulated success or failure in performing a specific task. Second, attribution *beliefs* are domain-specific or domain-general beliefs about the causes of success or failure. Third, attribution *styles* are generalized, stereotypical patterns of attributions and dispositional beliefs. Attribution styles are assessed in a similar way to attribution beliefs, except that a certain typology is imposed on the data using predetermined criteria.

In this article, attribution styles are examined using Weiner's (1992) classification of reasons for success and failure: (a) *origin*: internal and external attributions, referring to within or outside individual causes; (b) *stability*: stable and unstable attributions, referring to consistent or inconsistent causes over time; and (c) *degree of control*: controllable and uncontrollable attributions, referring to the extent an individual believes that he or she has control over the cause of an outcome.

According to a social cognitive view of self-regulation, expertise develops from both external support and self-directed practice sessions (Zimmerman, 2006). The importance of both of these factors for exceptional talent development was clearly shown in Bloom's (1985) classical study. Self-regulatory competence has three elements: self-regulation of covert personal processes, behavioral performance, and environmental setting (Bandura, 1986). Research has shown that successful learners have an ability to monitor and regulate these triadic elements (e.g., Kitsantas & Zimmerman, 2002; Zimmerman, 1989). Zimmerman (1998) stated that self-reflection begins with self-judgment, which is the process where an individual compares information attained through self-monitoring to extrinsic standards or goals. The goal is to have fast and accurate feedback on his or her performance compared to others. Self-judgment leads to attribution interpretations where an individual interprets the reasons for success or failure. The most widely applied theoretical viewpoint for attribution interpretations is Weiner's (1974) attribution theory, which is based on the principle that an individual is in constant search for understanding why an event has occurred.

Attribution interpretations can lead to both positive and negative self-reactions. The individual might interpret the failure of a strategy as the result of too little effort and then increase his or her efforts, but if he or she interprets the reason for failure as lack of ability, the reaction is most likely to be a negative one. Attribution interpretations reveal the possible reasons for learning mistakes and help the learner to find the learning strategies that best suit the given situation. They also develop or promote the adaptation process; self-regulated individuals are more adaptive and evaluate their performance appropriately (Bandura, 1997). Positive reactions (e.g., self-satisfaction) reinforce positive interpretations of oneself as an individual and enhance intrinsic interest in the task.

Self-efficacy refers to the belief that one has the resources and confidence to do the acquired tasks in different settings (Bandura, 1997). According to Bonney and her colleagues (2005), *self-efficacy* is not a synonym for *self-esteem*, which refers to an undifferentiated affective evaluation of the self. Research has shown that males typically rate their self-efficacy beliefs higher than females in traditionally male-dominated fields (e.g., athletics and mathematics), and females display higher ratings for reading, English, and social studies (Eccles, Wigfield, & Schiefele, 1998). These findings are related to gender-role stereotyping and gender socialization, because men and women are socialized early in life to follow different occupational paths. On the other hand, it has been argued that males typically overestimate how well they think they will perform on future tasks, whereas females generally underestimate their abilities (Eccles et al.). Indeed, Eisenberg, Martin, and Fabes (1996) noted that there is very little evidence showing that males actually outperform females academically.

The Role of Abilities and Attributions in Talent Development

Gagné (2004) developed a differentiated model of giftedness and talent (DMGT) that distinguishes the two usually intertwined concepts of giftedness and talent. His view of talent development is summarized with the *C.GIPE* acronym (Figure 1). The chance (*C*) is seen in a predominant role in the DMGT because it includes both genetic and parental endowment that affect natural abilities (*G*, gifts) and intrapersonal catalysts (*I*). It represents the degree of control over talent emergence in a similar way that attributions of success and failure are classified within previously discussed three-dimensional system (origin, stability, degree of control) in attribution theory (Weiner, 1986).

Natural abilities *G* precede intrapersonal catalysts *I*, such as motivational constructs in Figure 1. The reason is drawn from the existing research body that shows IQ scores explaining on average five times or more achievement variance than measures of motivation (Gagné, 2004). Further, *I* precedes *P* components, because practice is based on the existence of self-regulatory *I* components, such as motivation, volition, and self-reflection (including attributions). Gagné's argumentation for the *P* component's position in the *C.GIPE* causal chain is that in order to excel, we really need more than pure practice, namely, both gifts and ability to keep things under control; that is, self-regulation. This leads to a conclusion that intrapersonal catalysts *I* causally precede practice *P*. Environmental influences (*E*) have been placed in the last position because their differences in normal environments will not explain the difference between average and outstanding achievements.

Ericsson, Krampe, and Tesch-Römer (1993) stressed the role of deliberate practice in talent development, stating that in most fields it takes 10 years to become an expert. Later

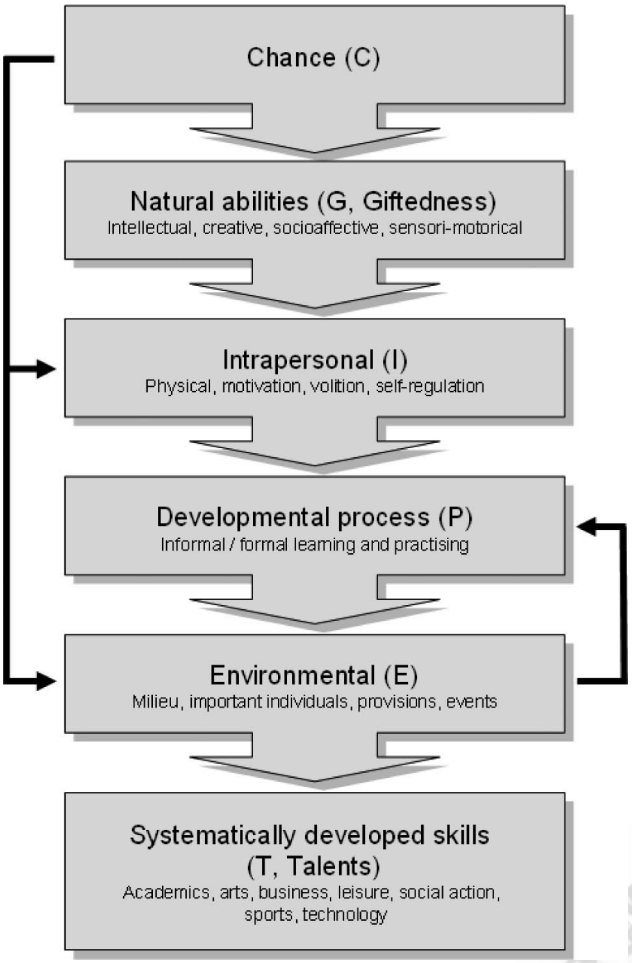

FIGURE 1 Causal order of components in Gagné's (2004) differentiated model of giftedness and talent.

research has shown that the 10-year rule is not absolute: in some fields (e.g., chess, sports) total mastery of the skill takes about 6 years, and in some fields (e.g., music, science) to reach the top level it takes 20–30 years of deliberate practice (Ericsson, 2006). His *relative* approach to the study of experts' characteristics assumes that the fundamental capacities and domain-general reasoning abilities of experts and nonexperts are almost identical (Chi, 2006). The major difference between experts and novices is that the former are more knowledgeable, through deliberate practice, than the latter.

However, Gagné's (2004) DMGT is based on a different approach to the study of experts' characteristics: the goal of *absolute* approach is to understand how truly exceptional people perform in their domain of expertise (Chi, 2006). Because the role of natural abilities in talent development is stressed in DMGT, it is viable to call for one of the most well-known categorizations for individual giftedness, Gardner's theory of multiple intelligences (MI; 1983, 1993).

Sternberg (1991) identified MI theory as a systems approach similar to his own triarchic theory. MI theory was first introduced in 1983 with seven dimensions: (a) linguistic, (b) logical–mathematical, (c) musical, (d) spatial, (e) bodily–kinesthetic, (f) interpersonal, and (g) intrapersonal intelligence. Later, Gardner discussed adding more dimensions to the model; for example, naturalist, spiritual, and existential intelligences (Gardner, 1999).

In a recent study, Tirri and Nokelainen (2008) reported that males in the preadolescent sample rated their logical–mathematical intelligence higher than females on the basis of correlation analysis between the gender, age, and self-rated MI intelligence. This finding is in accord with earlier studies concerning gender differences among gifted students. A study by Siegle and Reis (1998) found that adolescent gifted male students indicated that they had higher ability than females in mathematics, science, and social studies. Females tended to rate their linguistic abilities higher than the males. Similar results have been reported with studies with gifted preadolescents (Tirri & Ubani, 2007).

Research on gender differences in mathematical achievement has shown that gifted girls tend to underestimate their abilities in this area, and this trend could have influenced the self-rated behavior of the girls in our sample as well (Tirri & Nokelainen, 2008). Kerr (1994) and Reis (1998) have identified the external barriers that may prevent gifted women from excelling: the attitudes of parents and school, environmental options, and possible discrimination or harassment at school or at work. The possible internal barriers among gifted females included self-doubt, self-criticism, and too low expectations. According to Siegle and Reis (1998), gifted girls tend to underestimate their abilities, especially in mathematics, social studies, and science.

EMPIRICAL FINDINGS RELATED TO FINNISH OLYMPIANS' SELF-PERCEPTIONS OF THEIR ABILITIES AND ATTRIBUTION STYLES

Finland has participated in Olympian programs for several years. Separate programs exist for the Mathematics, Physics, and Chemistry Olympiads. In recent years programs have been created for Biology and Computer Science as well. Distinct studies have been undertaken in each of these academic areas. In Mathematics, Physics, and Chemistry Olympiad programs, a series of increasingly difficult tests are administrated. The end result of this testing concludes with the identification of the top national finalists (6–20 Olympians). These individuals are trained to compete in the International Olympiad programs. The title, International Mathematical Olympiad (IMO), was first used in January 1959 when the then Mathematical and Physical Society of Romania sent invitations to the first IMO. Since 1965, the teachers' association has arranged a competition to select members of the Finnish IMO team; but, with limited financial and manpower resources, that association has not met with great success. Earlier, the attitudes in education in

Finland stressed equality in learning and in the name of democracy disapproved all competitions, which may place some people before others (Turner, 1978). The more recent educational trend to encourage individuality and freedom of choice has created better conditions for the Academic Olympiad programs in Finland (Tirri, 1997).

Considering the degrees earned and the publications produced, the Finnish Olympians have been very successful in their careers. The majority of them are researchers in academia or engineers in technical fields with many published articles, books, or patents (Tirri, 2001). Is academic success due to giftedness alone or to hard work that leads to high talent? Tirri and Campbell (2002) asked the Finnish Olympians ($N = 168$) to rate their perceptions on the attributions of ability and effort regarding their academic success. The Self-Confidence Attribute Attitude Scale (SaaS) instrument (Campbell, 1996) used a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The SaaScale included 29 items measuring the Olympians' attributions. The four-factor solution with its principal components analysis grouped the variables as follows. Factor 1, success due to ability, included statements like: "I do poorly only when I do not work hard enough," "The smart kids tried the hardest," and "Why work in an area where your ability is low?" Factor 2, failure due to a lack of ability, included statements like: "There are some things you can't do no matter how hard you try," "You have to have the ability in order to succeed in most things," and "When I did poorly in school it was because I did not have the needed ability." Factor 3, success due to effort, included statements like: "You can be successful in anything if you work hard at it," "Self-discipline is the key to school success," and "Poor study habits are the main cause of low grades." Factor 4, failure due to a lack of effort, included statements like: "I worked harder if I liked the teacher," "Being smart is more important than working hard," and "When I scored low on a test, it was because I didn't study hard enough" (Tirri & Campbell).

The Finnish Olympians considered both ability and effort important to their academic success. The differences were very small, but effort was considered slightly more important (26.1%) than ability (24.2%). None of the Olympians denied effort completely regarding their success and only 13.4% disagreed strongly on the importance of effort. Only 3 Olympians (1.9%) denied ability totally and only 15.3% of them disagreed strongly on the importance of ability (Tirri & Campbell, 2002).

The Finnish Olympians tended to attribute success and failure to both ability and effort. The German participants have been reported to attribute success and failure more to ability than to effort (Heller & Lengfelder, 2000). On the other hand, the American and the Taiwanese participants have attributed success and failure more to effort than to ability (Feng, Campbell, & Verna, 2001; Wu & Chen, 2001). In an American study, a small significant difference between males and females was found with regard to ability. Female American Chemistry Olympians considered ability to be a more important factor for success than did males. However, no difference was found for the effort factor (Verna & Campbell, 2000).

The Finnish Olympians considered their failures to be due more to ability than a lack of effort. Sixty-three (40.1%) Olympians evaluated their failures as being due more to lack of ability, and 51 (32.4%) Olympians ranked the failures due more to a lack of effort (Tirri & Campbell, 2002).

Nokelainen, Tirri, and Merenti-Välimäki (2007) examined the influence of attribution styles on the development of mathematical talent with a sample of 203 Finnish mathematically highly (Olympians), moderately (Pre-Olympians), and mildly (polytechnic institute of higher education mathematics students) gifted adolescents and adults. The study employed the SaaS questionnaire (Campbell, 1996), which measures ability and effort attributions (Weiner, 1974). The results of Bayesian classification modeling showed that items attributing success to effort and failure to lack of effort were the best predictors for the level of mild mathematical giftedness and gender (females). The results of multivariate analysis of variance showed that mathematically highly and moderately gifted (mostly males) reported ability to be a more important reason for success than effort, as opposed to mathematically mildly gifted (mostly females), who tended to believe that their efforts lead to success.

Implications for Gifted Education

The empirical findings indicate that the Finnish Olympians actualize their mathematical talent by choosing a career in science. The majority of them are researchers in academia or engineers in technical fields. The Olympians have been very successful in their graduate studies, and they have published articles and books related to their fields (Tirri, 2001). The Finnish Olympians have been very independent learners, and they attribute their academic success to both ability and effort. Their own interests and efforts have been the key factors in their talent development and career orientations. The Olympiad program had increased their self-confidence and confirmed the career choices they had already made. The Finnish Olympians have been motivated mostly by their own inner drive. A conducive home atmosphere and supportive teachers had been helpful, but the Olympians viewed themselves as being the most influential in developing and actualizing mathematical talent (Tirri & Campbell, 2002). The identification of mathematical talent and encouragement gained from the Olympiad program has once again produced long-term positive consequences for career contributions (Campbell, 1996).

Qualitative interviews with both male ($N = 17$) and female ($N = 13$) Olympians reveal critical events that have helped the Finnish Olympians in actualizing their mathematical talents (Tirri, 2002; Tirri & Koro-Ljungberg, 2002).

The qualitative results also helped us to understand the lack of females among Olympians. According to the study, male Olympians identified early reading and mathematics experiences as more influential than the females did. Furthermore, the males had more science experiments and discussions with their parents than the females (Tirri). According to previous research on gifted children, more boys than girls have been encouraged by their parents to pursue a specific career (Reis, 1998). In early childhood, a child's reading, mathematics, and science experiments are greatly dependent on parents' readiness to provide books and other materials for their child. The case studies of Finnish Olympians reveal that the males had been provided more early encouragement in mathematics and sciences than the females had (Tirri).

During the school years, both male and female Olympians had enjoyed academic competitions and the Olympiad experience. However, the males had taken part in more competitions than the females had. The males had more peer support at school and hobbies that supported their talent development more than the females had. However, the female Olympians reported teachers' encouragement more often as an influential event than their male counterparts. The most successful Olympians had studied abroad during their graduate studies. Both males and females mentioned the choice of the right domain as an influential factor for their academic success. The Finnish Olympians had been very independent students and only three of them reported mentoring as a critical event in their talent development. Those females who had found a good mentor had continued their graduate studies and been successful in their academic career (Tirri & Koro-Ljungberg, 2002).

International cooperation was identified as the most influential factor for academic success. The most well-known researchers in our sample had used international cooperation in their work and published in international journals. Both males and females identified the choice of a supportive partner as a critical event. The females who referred to their husbands reported equal responsibilities with child care and opportunities for both spouses to actualize their talents. The male perspective emphasized the freedom to concentrate on the academic work because of the wife who takes care of the household (Tirri, 2002).

The findings on self-rated intelligence profiles give important information to educators on how gender influences the self-perception of students' abilities (Tirri & Nokelainen, 2008). Educators and counselors should be aware of the main trend of girls to rate themselves lower in logical–mathematical dimensions than in other ones. Girls should be encouraged to see their whole potential in that dimension as well. Furthermore, the similarities in girls' and boys' ratings of their spiritual sensitivity opens new possibilities to holistic education, where both sexes are educated for their whole potential, including spiritual and moral domains.

Research findings suggest that parents should actively and early enough encourage their daughters to engage in science experiments and mathematical problem solving. Furthermore, girls should be guided to intellectual hobbies that support their talent development during their school years. Teachers should acknowledge their important role in encouraging girls to choose mathematics and science in their studies. Furthermore, girls need help in finding the peer support at school for their talent development. Eccles (2007) suggested that educators need to help females to evaluate and pursue now male-dominated occupational areas, such as physical science and engineering, by providing them information about the importance of these fields. Educators and mentors should guide gifted females in choosing the right domain and encourage them to study abroad. According to empirical results, the most successful scientists in academia need international cooperation to gain eminence in their fields. Furthermore, the importance of partner choice in the lives of gifted scientists should be addressed and discussed with gifted girls. The life histories and critical events experienced by gifted people can guide our efforts in providing equal opportunities for both females and males to actualize their talents (Tirri, 2002; Tirri & Koro-Ljungberg, 2002).

Finally, according to the previously discussed study by Nokelainen et al. (2007), it is essential that educators and parents understand the influence of different attribution styles on the development of mathematical talent. The study addressed the issue of how mathematically highly, moderately, and mildly gifted adolescents and adults differ in their specific reasons for success and failure. Differences in attribution styles between the three groups of mathematically gifted indicate that it is important to know whether the attributions for success or failure are stable or unstable, external or internal. The highly mathematically gifted prefer ability over effort as an explanation for success or failure. This indicates that their perceived ability levels are so high that they are able to meet the most demanding challenges by adjusting their efforts. According to the *attribution asymmetry* phenomenon (Dai et al., 1998), high-ability students tend to attribute their success to both ability and effort. According to high-ability students, attributing success to ability represents self-awareness of high potentialities that constitute a necessary but not sufficient condition for success. Attributing success to effort has a self-enhancing and motivating effect because one feels in control of one's own development.

It is not our primary purpose to compare ability and effort only with questions that ask which is a better explanation for success but rather to continue with further questions such as "What are the best developmental practices for those individuals who mostly prefer effort over ability as an explanation for success in a given task?" As Campbell stated, "Achievers need four qualities: ability, discipline, confidence, and good working habits" (1995, p. 186). Thus, high effort level as a cause for success may indicate that tasks are too demanding and thus individuals feel that too much effort is needed to accomplish the task. Further, this might indicate that an individual needs more support to be convinced that he or

she has the ability to succeed. Research has shown that ability is often viewed as a stable and uncontrollable attribution. The worst scenario for a mathematician according to some of the self-attribution theorists (e.g., Dweck, 1999) is to blame personal ability for failure, because it is believed to be something that you either do or do not have, an internal and stable attribution. Interestingly, the most highly mathematically gifted in this study scored highest in this respect when compared to those who were moderately and mildly gifted. This finding makes sense if we agree that Olympians represent the highest mathematical talent level and, thus, have probably faced a lot more challenging mathematical tasks during their lifetime than most of the other mathematically gifted individuals.

Alderman (2004) suggested that it is up to the teacher or trainer to convince a learner or trainee that mathematical thinking ability as a skill or knowledge is a learnable, unstable quality. Thus, knowledge of how learners or trainees use attributions to account for success and failure can help teachers or trainers predict their expectancies and plan intervention strategies when needed. Further, knowledge of how learners or trainees use attributions to account for success and failure can help educators and parents to gain a deeper awareness of the mathematically gifted and, thus, predict their expectancies and plan intervention strategies when needed. The information is also applicable to courses concerning the needs of the gifted. According to Tirri and Nokelainen (2008), the information can be presented directly to the mathematically gifted in order to help them develop more insight into their own behaviors.

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