SELF-CONCEPT OF HIGH SCHOOL STUDENTS WITH VARIOUS LEVELS OF MATHEMATICAL GIFTEDNESS

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Abstract: The aim of this study was to explore the effect of level of mathematical giftedness and gender on students' self-concept (represented by personal competence perceptions, fear of negative evaluation and self-esteem), while taking into account their general school achievement. Participants in the study were high school students forming three groups: highly gifted (N = 62), moderately gifted (N = 99) and non-gifted students (N = 77). Mathematically gifted students did not differ from their non-gifted peers in their personal competence, fear of negative evaluation and their self-esteem evaluations. The effect of gender was significant only for the fear of negative evaluation, indicating that female students show more intense fear than their male peers. For the measure of self-esteem significant interaction between gender and mathematical giftedness level was found. For male students the highest self-esteem estimates were in the highly gifted students group and the lowest in the moderately gifted students group. Among the girls, moderately gifted girls had the highest self-esteem followed by highly gifted girls and then, with the lowest self-esteem, by non-gifted.

Key words: gifted, self-concept, mathematics

The extraordinary characteristics of cognitive functioning in mathematically gifted students are widely recognized, as well as the positive consequences of their inclusion in various programs for developing mathematical competence (Hoge, Renzulli, 1993; Ma, 2002). But, it has to be emphasized that participating in the challenge of developing their giftedness has consequences not only for future development in the field of giftedness (i.e., on the cognitive level). It could induce changes in the personality domain as well. At the same time, personality structure can influence the expression of giftedness.

The most common ways to identify gifted students are cognitive ability tests, achievement tests, and teacher nominations (Hotulainer, Schofield, 2003). In a number of studies giftedness was defined as a high level of achievement in a particular field (e.g., Luscombe, Riley, 2001; Norman et al., 2000; Plucker, Stocking, 2001; Verna, Campbell, 1999). In high school mathematics, winning at national and international competitions would certainly be the most outstanding achievement (Riley, Karnes, 1998). Academic competitions for secondary school students in the field of mathematics are organized throughout the world to foster development in their field of giftedness and are one of the best methods for identifying talented students and attracting them to mathematics. This kind of challenge for gifted students exists in Croatia also, where competitions in mathematics are organized every year. Numerous students compete every year at gatherings of young mathematicians at school, local and region-

al level. The most successful students, according to results at regional competitions, participate in national competitions. The best students at the national competitions have the opportunity of participating in the International Mathematics Olympiad. Students who participate in mathematical competitions are generally those that come from mathematical high schools. Those students, besides successfully mastering the demanding mathematical curriculum in their schools, have additional interest in widening their knowledge and, as their results prove, are very successful in this.

Still, competitions in mathematics pick up only the most prominent among the mathematically gifted students. The experience of achievement in mathematics of other mathematically gifted students is that of mastering the demanding curriculum of mathematical high school. Although all of these students show excellence in mathematics, research suggests that there might be some differences between them as regards the level of their giftedness (Chan, 2001; Norman et al., 1999, 2000; Solano, 1983). Some studies even suggest that highly gifted students may experience greater adjustment difficulties than less gifted ones (Kwan, 1992; Norman et al., 1999). However, literature that specifically delimits "moderately gifted" from "highly gifted" students is still very limited (Norman et al., 1999).

Aim of Research

Previous notions give rise to the question of whether there are differences in self-concept between mathematically-gifted students regarding the level of their achievement in their field of giftedness. Additionally, we wanted to explore whether there would be differences between young mathematicians and their mathematically non-gifted peers.

Previous research has proved self-concept to be one of the most relevant constructs in research into giftedness. Self-concept may be defined in very general terms as the image we hold of ourselves (Hoge, Renzulli, 1993). A more specific definition refers to our attitudes, feelings and knowledge about our abilities, skills, appearance, and social acceptability. Self-concept is generally accepted as a multi-dimensional phenomenon, in that it includes cognitive, perceptual, affective and evaluative dimensions, as well as being a more general, broadly-based image that one holds of oneself (Hotulainer, Schofield, 2003). It is well known that positive self-concept forms the base for the self-worth and success expectations and, in accordance with this, the basis for the setting of the high goals which makes it a prerequisite for achieving the high results (Bandura, 1990). But, at the same time it can also be the consequence of permanent high achievement. The relationship between self-concept and academic achievement has been very well documented in previous research (see Valentine, DuBois, Cooper, 2004).

Some of the strongest relationships were found between achievement in mathematics and mathematical self-efficacy (Pajares, Miller, 1994) or academic self-esteem (Kelly, Jordan, 1990). Some studies also report the significant impact of the variable of gender when exploring the effect of achievement level on self-concept (Cornell et al., 1990).

Various studies have explored the relationship between the giftedness and self-concept constructs (Hoge, Renzulli, 1993). Gifted students tend to have positive general academic self-concepts, higher than those of non-gifted comparison group

(Hotulainer, Schofield, 2003; Kelly, Jordan, 1990; Plucker, Stocking, 2001), especially when they are placed in mixed ability or heterogeneously grouped classes and/or schools (Hoge, Renzulli, 1993; Hotulainer, Schofield, 2003; Marsh, Yeung, 1997; Wong, Watkins, 2001). Research into gifted students' self-esteem rarely shows large differences in self-esteem between gifted and non-gifted students, except for the academic self-esteem that is regularly higher with gifted students (Hoge, Renzulli, 1993; Lacković-Grgin, 1994). But when significant differences are obtained, they are in favor of gifted students (Hoge, Renzulli, 1993; Kwan, 1992). Some studies also report the significant impact of gender when exploring the effect of achievement level on self-concept. Research findings suggest that gender differences in self-concept hold good across achievement levels (Yun Dai, 2001). Although some studies have found negligible gender differences in general academic self-concept between gifted girls and boys (Chan, 2001; Kelly, Jordan, 1990; Worrell, 1998), a meta-analysis on gifted children conducted by Pyryt and Richwein (2000; cited in Yun Dai, 2001) found that boys tended to rate themselves higher than girls. The studies that did report gender differences tended to find the same pattern of differences that consistently favored males in global, athletic, and physical self-concepts and females in verbal and some areas of social self-concept (Worrell, 1998). Additionally, gifted females may develop more intense fear of failure than gifted males (Luscombe, Riley, 2001).

Hypotheses

From the theoretical viewpoint, there are several bases for hypothesizing that excep-

tional children will have more positive self-concepts than those of more average ability, and, on the other hand, some reasons for hypothesizing that self-concept in the gifted children might be more negative than in less gifted peers (Hoge, Renzulli, 1993).

The first reason for hypothesizing more positive self-concept in the gifted student is that we can expect students' self-esteem to be enhanced to the extent that high levels of ability are translated into actual accomplishments. A second basis for hypothesizing this is that labelling a child as gifted may normally be expected to communicate a positive image, and this might have a positive impact on the child's self-esteem. But the possibility that the high expectations communicated through the labelling process would contribute to feelings of failure provides the first reason to hypothesize more negative self-concept in gifted children. A second basis for predicting lowered self-esteem in the gifted follows from speculations that the gifted child, being cognitively advanced, may be more sensitive to social cues and more analytic about them, which might result in a more critical attitude toward performance. A third basis for predicting more negative self-concept in the gifted child derives from social comparison theory which predicts that, with the transition from regular class to special program, the gifted pupils' self-esteem should decrease, because comparisons will then be made with a group with generally higher ability levels.

In our study we tried to find out if the effects of achievement on self-concept will be present even when self-concept is considered at a more global level, so when choosing self-concept variables for this study we decided to choose global constructs. Accordingly we used in our re-

search the variable of personal competence based on Bandura's theory of self-efficacy, which is considered to be a subset of the construct of self-concept (Kao, Kellegrew, 2000), and the variable of self-esteem which, according to Rosenberg (1979), represents the general attitude we have towards ourselves. Since large numbers of mathematically gifted students experience a series of extreme evaluative situations during competitions, the fear of negative evaluation variable was also included in order to demonstrate possible consequences in the social evaluation domain.

According to Bandura's social-cognitive theory (Bandura, 1990) which assumes that self-efficacy has a great influence on choices people make, effort they put in and perseverance in an activity when faced with a challenge, we expected that gifted students will show higher personal competence in comparison with non-gifted students and that highly gifted students will have higher ratings of competence than moderately gifted students.

Rosenberg based his theory on the assumption that every individual has a general sense of worth that goes beyond self-evaluations in specific life domains, but is nevertheless formed by combining them. Self-esteem is, among other things, developed on the basis of sense of competence, power, and ability. Therefore, we assumed that highly gifted students would have the highest ratings on the self-esteem scale, followed by moderately gifted students, and then by non-gifted students.

Combined results from various studies of anxiety are consistent that anxiety and stress reactions are low when people are facing demands in their perceived scope of self-efficacy (Bandura, 1990). According to this, fear of negative evaluation, as one of the measures of social anxiety, should be somewhat lower in students with a high

level of manifest competence - the gifted students. At the same time, there could be the negative effect of highly gifted students' participation in competitions in this way, that they, because of being exposed to a higher degree of evaluation compared with other students, develop evaluation stress and generalize it to the social domain.

The aim of this study was to explore the effect of level of mathematical giftedness and gender on students' self-concept (represented by personal competence perceptions, fear of negative evaluation and self-esteem), while taking account of their general school achievement.

METHOD

Participants

Participants in the study were high school students (grades 1-3) forming three groups: highly gifted (N = 62), moderately gifted (N = 99) and non-gifted students (N = 77). The data from 17 more participants (non-gifted) were discarded because 2 of them did not follow instructions and another 15 did not provide their grade point average (GPA).

The group of highly gifted students was formed of students that were participants in a national competition in mathematics while the participants in the group of moderately gifted were students enrolled in the mathematical high school who showed excellent achievement in mathematics. The non-gifted group consisted of students who were enrolled in high schools of the general type and did not show exceptional achievement in mathematics.

Students' age ranged from 14 to 19 years (M = 16.07), age means did not differ between groups. Of the 62 highly-gifted participants, 38 were male and 24 were

female. The group of moderately gifted participants consisted of 37 males and 62 females and the non-gifted group consisted of 18 males and 56 females.

Procedure

Students completed the questionnaire that consisted of the Personal Competence Scale (Bezinović, 1988) and Croatian adaptations of Fear of Negative Evaluation Scale (Leary, 1983) and Rosenberg's Self-Esteem Scale (Rosenberg, 1979). Data about students' age, gender and grade point average (GPA) were also collected.

Measures

Personal Competence Scale. Bezinović (1988) developed this scale guided by the Bandura theory of self-efficacy. He tried to generalize Bandura's assumptions to the more global level of individual functioning. Therefore, the contents of items are related to global evaluation of personal competence. The scale consisted of 10 items, and, while responding, students had to show the agreement on the five-point scale of the Likert type. The person who scores high on this scale shows confidence in his personal competence, is confident, and feels up to his tasks. Bezinović (1988) found adequate internal consistency for this scale (α = 0.85 - 0.90), as well as the test-retest reliability (r_{t-r} = 0.70). The same study confirmed one factor structure of the scale.

Self-Esteem Scale. Rosenberg's self-esteem scale was originally developed for the estimation of global self-worth and self-acceptance in high school students and is the most widely used measure of global self-esteem (Whiteside-Mansell, Corwyn, 2003). The participant directly reports the agreement with 10 items on the Likert type

five-point scale (Robinson, Shaver, Wrightsman, 1991). Those authors report Cronbach's α reliability coefficients from 0.77 to 0.98 and test-retest coefficient of reliability around 0.80. Bezinović (1988) demonstrated good internal consistency for the Croatian version of the scale (α = 0.81 - 0.84).

Fear of Negative Evaluation Scale. Watson and Friend (1969) developed this scale with the aim of detecting the degree of anxiety that people feel when they perceive the possibility of negative evaluation. It is usually treated as a measure of social anxiety. Originally, the scale was formed of 30 items. In this research the Croatian adaptation of Leary's shortened 12-item version of the scale was used (Bezinović, 1988). Every item was followed by the five-point Likert scale. Bezinović (1988) showed that reliability coefficients for the Croatian version are satisfactory (α = 0.84 - 0.90; r_{t-r} = 0.75) and he also confirmed the one-factor structure of the scale.

Reliability coefficients (Cronbach's alpha) gathered in the current study are shown in Table 1.

RESULTS

The means and standard deviations of the Personal Competence, Fear of Negative Evaluation and Self-Esteem scales by level of giftedness are presented in Table 1.

Analysis of covariance with level of giftedness and gender as independent variables and GPA as a covariate was performed for each of the dependent variables (personal competence, fear of negative evaluation and self-esteem). As can be seen in Table 2, the results show that mathematically gifted students do not differ from their non-gifted peers in their personal competence, fear of negative

evaluation and their self-esteem evalu-ations. The effect of gender was sig-nificant only for the fear of negative evaluation, indicating that female students show more intense fear than their male peers do.

Table 1. Descriptive statistics and Cronbach's reliability coefficients for Personal Competence, Fear of Negative Evaluation and Self-Esteem scale scores

	N	Personal Competence		Fear of Negative Evaluation		Self-Esteem	
		M	SD	M	SD	M	SD
Highly gifted							
Male students	38	43.3	4.86	32.6	7.54	42.6	4.93
Female students	24	41.6	5.47	37.2	8.9	41.3	5.95
Total	62	42.6	5.12	34.5	8.39	42.1	5.34
Moderately gifted							
Male students	37	41.8	5.48	35.4	9.69	40	5.66
Female students	62	42.6	4.92	36	8.65	42.1	5.55
Total	99	42.3	5.13	35.8	9.01	41.4	5.65
Non-gifted							
Male students	18	41.7	6.29	34.1	8.64	41.4	5.7
Female students	56	39.3	6.3	36.3	7.33	38.5	6.29
Total	77	39.8	6.34	35.8	8.36	39.2	6.25
Cronbach's reliability coefficients		0.84		0.86		0.80	

Table 2. Summary of ANCOVAs for Personal Competence, Fear of Negative Evaluation and Self-Esteem scales

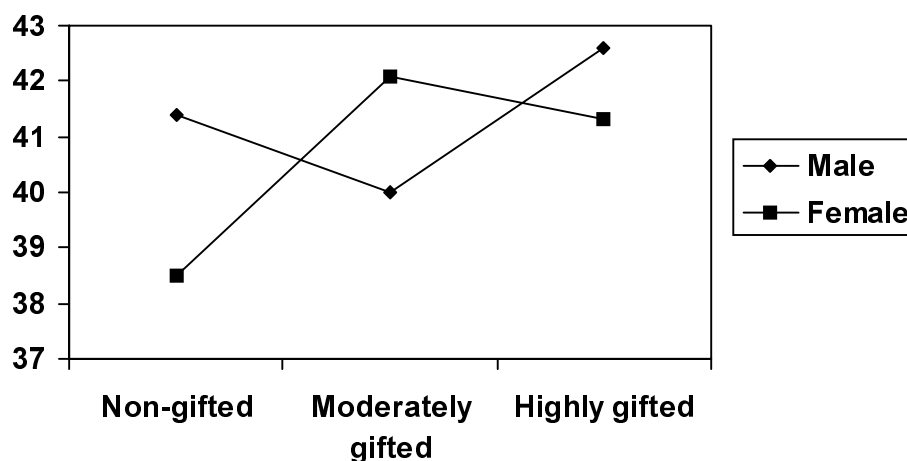| Variable	Personal Competence			Fear of Negative Evaluation			Self-Esteem		
	F	df	p	F	df	p	F	df	p
Level of Gifted-ness	0.91	2/231	0.40	0.16	2/231	0.85	0.61	2/231	0.55
Gender	2.08	1/231	0.15	**4.29**	**1/231**	**0.04**	0.98	1/231	0.32
Level of Gifted-ness x Gender	1.55	2/231	0.21	1.25	2/231	0.29	**3.34**	**2/231**	**0.04**
GPA Covariate	1.19	1/231	0.28	0.55	1/231	0.46	1.41	1/231	0.24

Figure 1. Interaction between level of giftedness and gender for the Self-Esteem Scale scores

The most interesting result is the interaction between gender and mathematical giftedness level for the measure of self-esteem (see Figure 1). For the male students the highest self-esteem estimates were in the group of highly-gifted students and the lowest in the group of moderately gifted students. With the girls, moderately gifted girls have the highest self-esteem, followed by highly gifted girls and then by non-gifted, with the lowest self-esteem.

DISCUSSION

The finding that analysis of covariance for the Personal Competence variable has failed to show significant effects for the level of giftedness and gender variables was only partly consistent with our hypothesis. The absence of significant differences between male and female students was expected, drawing on previous research (e.g., Cornell et al., 1990), but the absence of differences between gifted and non-gifted students was not in accordance with our hypothesis. Two reasons can be suggested to explain this result. First, in our research we used the global measure of competence, which is supposedly less under the influence of achievement level than the measure of specific competence (e.g., mathematical self-efficacy). Second, it is possible that gifted students of both levels set higher goals for themselves, which demand a higher level of competence. They might, therefore, have a different framework for their estimates. These possible explanations should be confirmed in future research, especially since results of previous research are ambiguous and did not give clear answers about the relationship between giftedness and competence beliefs (Windecker-Nelson et al., 1997).

Results obtained for the Fear of Negative Evaluation variable yielded only one significant effect. It showed that girls generally have higher fear of negative evaluation. Since this difference exists for all groups of students, we can presume that female students may be more prone to developing fear of negative evaluation and subsequent social anxiety in the educational context.

Our results are consistent with previous research (Norman et al., 1999) that did not support the hypotheses that highly gifted students would be more likely to display more adjustment problems, including higher anxiety, than the moderately gifted group. When comparing gifted and non-gifted students, Kwan (1992) suggests that more recent studies of gifted children yield a pattern of inconclusive findings. Some have shown the gifted, as a group, to have a high level of personal and social maturity. Other studies of gifted children report more adjustment difficulties than were found among children not identified as gifted. When looking at all students Norman et al. (1999) found that girls displayed more anxiety than boys, which is consistent with previous general student studies (Lewinsohn et al., 1998; Rouxel, 2000).

We have already said that we could not expect large differences in self-esteem between gifted and non-gifted students (Hoge, Renzulli, 1993; Kwan 1992; Lacković-Grgin, 1994) and, since our analysis did not yield significant main effects, our results mainly support these previous findings. Although we hypothesized significant differences in self-esteem between moderately and highly gifted students, with highly gifted students displaying higher self-esteem, our analysis showed no group differences between highly gifted and moderately gifted students, which is consistent with some previous research (Norman et al., 1999).

Analysis of our results, however, revealed significant interaction of level of giftedness and gender. The fact that differences between non-gifted and gifted boys are only moderate, whereas those between non-gifted and gifted girls are quite distinct, may show us that girls may be more prone to base their self-esteem on demonstration of achievement. These results are similar to results of Solano (1983), who showed that mathematically gifted and able girls had higher self-esteem than average girls, while there are no differences between the different groups of boys.

If we limit comparisons to the moderately gifted and non-gifted groups, our results are coherent with Loeb and Jay (1987), who showed that gifted females have more positive self-concepts than gifted males and non-gifted females. But, some previous research also showed that academically gifted males obtained significantly higher scores than females on global-self-esteem (Kwan, 1992; Worrell et al., 1998). Potential contributors to these seemingly contradictory findings regarding the relation between giftedness and level of self-esteem are the different criteria used to identify gifted students in different studies. For this reason we believe that it is really important to specifically delimit moderately gifted from highly gifted students.

The fact that global self-esteem and specific self-esteem may have strikingly different consequences (Rosenberg et al., 1995) gives additional weight to our results. Global self-esteem is more relevant to psychological well-being and specific (academic) self-esteem is more relevant to behavior (e.g., school performance). These findings can suggest that not all gifted adolescents are as well adjusted psychosocially as they are in academic tasks.

The results obtained provide us with a better understanding of the non-cognitive

factors relevant to the field of giftedness. Although further research is needed to extensively address the influence of these factors, we can conclude that there are indications that level of achievement can have some role in forming general self-esteem. But, controversy regarding the conceptualization and measurement of self-concept limit the extent to which the findings could be generalized to other contexts (Hoge, Renzulli, 1993). Despite the results of research comparing self-concept and self-esteem of intellectually gifted and non-gifted students which generally report that gifted students tend to be at least as well adjusted as ordinary students, adjustment problems for some gifted students have been documented in autobiographies, case studies, and research studies of highly gifted or talented individuals (Norman et al., 1999) and in clinical practice (Hoge, Renzulli, 1993). When planning programs for gifted youth, educational authorities should consider relevant social and personal factors in addition to educational development issues.

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SELF-KONCEPT STREDOŠKOLÁKOV S RÔZNOU ÚROVŇOU MATEMATICKÉHO NADANIA

D. R o v a n, V. V l a h o v i ć - Š t e t i ć

Súhrn: Cieľom štúdie bolo zistiť, aký vplyv má matematické nadanie a rod na self-koncept študentov (reprezentovaný vnímaním osobnej spôsobilosti, strachom z negatívneho hodnotenia a sebahodnotením), pričom sa sledovala ich všeobecná školská úspešnosť. Účastníkmi výskumu boli stredoškoláci, ktorých sme zaradili do 3 skupín: vysoko nadaní (N = 62), stredne nadaní (N = 99) a študenti bez nadania (N = 77). Študenti s matematickým nadaním sa od svojich nenadaných rovesníkov nelíšili vo vnímaní osobnej spôsobilosti, v strachu z negatívneho hodnotenia a ani v sebahodnotení. Vplyv rodu bol signifikantný len vo vzťahu k strachu z negatívneho hodnotenia - študentky intenzívnejšie prežívali strach z negatívneho hodnotenia v porovnaní so študentmi. Pri miere sebahodnotenia sme zistili signifikantnú interakciu medzi rodom a úrovňou matematického nadania. U študentov sme najvyššie sebahodnotenie zistili v skupine vysoko nadaných študentov a najnižšie v skupine stredne nadaných študentov. U študentiek sme najvyššie sebahodnotenie zistili u stredne nadaných dievčat, nasledovali vysoko nadané dievčatá a najnižšie sebahodnotenie mali dievčatá bez nadania.