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ABSTRACT

Mathematically precocious adolescents were studied in order to identify sex differences in self-concept/self-esteem which exist at a stage when intellectual differences are emerging. Subjects were 166 males and 68 females, ages 12-15 years, enrolled in a summer residential program for talented youth. Mean SATM scores for the experimental population were 605 (males) and 575 (females). Students completed a battery of self-report personality tests, including the Myers-Briggs Type Indicator (MBTI), which ascertains a person's preference for thinking or feeling and for introverted or extroverted activity; the Adjective Check List (ACL); the Self-Esteem Checklist; and the Bem Sex Role Inventory (BSRI). A large number of these math-gifted boys and girls had significantly different preferences for taking in, evaluating, and using information. A connection between thinking preferences and math ability and between social activities and math ability was indicated for girls. High math ability girls tended to be socially introverted and "thinking" types when compared to normal ability girls of the same age. The question is raised of whether these social tendencies may widen the gap between males and females in the use of their abilities, i.e., whether the tendencies may affect the decision to pursue math careers. Tables provide information on several of the tests performed. (LP)

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Sex Differences in Self-Concept and Self-Esteem for Mathematically Precocious Adolescents

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Sex Differences in Self-Concept and Self-Esteem for Mathematically Precocious Adolescents

Small but reliable sex differences in mathematical reasoning ability have been consistently noted from adolescence onwards, particularly in groups exhibiting high levels of mathematical ability (Benbow & Stanley, 1980). With the recent suggestion that sex differences in mathematical ability may be biologically based (Benbow & Stanley, 1981), it is especially important to carefully document the personality differences that may exist between the sexes at the time that such ability differences are noted. Although it will be a long and difficult process to sort out the causal connections between biological and environmental factors since there is undoubtedly a complex, life-long reciprocal relationship between the two, the task will remain impossible until existing differences between the sexes in both spheres are empirically and reliably established. Only then can we begin to understand the unfolding interaction between the intellectual and personality patterns of the young adolescent as he/she begins to make educational and career decisions. Is it possible that personality differences between the sexes interfere with the full development or use of one's intellectual abilities? How does self-concept/self-esteem affect these important decisions?

The present investigation is a modest step in the process of identifying sex differences in the self-concept/self-esteem of adol[illegible] time when intellectual differences are emerging. [illegible]tudy the same po[illegible]n which established sex differences have been documente[illegible]athematically precocious. Although a descriptive study at this point, it is hoped that the

results will help in the continuing investigation of what factors contribute to the development, nurturance, and full use of high-level intellectual ability.

Subjects included 166 male and 68 female adolescents between the ages of 12 and 15 who were enrolled in The Johns Hopkins University Center for Talented Youth 1983 summer residential courses held at Franklin and Marshall College. All subjects had SATM scores of 450 or higher. SAT mathematical reasoning scores ranged from 460 to 780 for males and 500 to 710 for females. Mean score for the boys was 605, for the girls 575, a significant difference ($t = 2.61$, $p < .01$).

Instruments

A battery of self-report, personality tests were completed by the students in order to gather a broad picture of each student's self-concept and self-esteem. Included was the Myers-Briggs Type Indicator (MBTI) (Myers, 1962): a self-report, forced-choice inventory of preferences in regard to perceiving and judging the world around us. The purpose of the Indicator is to implement Jung's Theory of Type by ascertaining a person's basic preference for: either extraversion (preference for the outer world of people and things) or introversion (preference for the inner world of ideas); either sensing (preference for facts) or intuiting (preference for possibilities and relationships); either thinking (impersonal analysis and logic) or feeling (consideration of personal values and implications); either judging (preference for a planned, orderly, decided way of life) or perceiving (preference for a flexible, spontaneous way of life). The MBTI was scored for

preference along each of the four dimensions just listed, the strength of each preference, as well as the personality type that emerges from the combination of the four preferences.

The Adjective Check List (ACL) (Gough & Heilbrun, 1965) is a set of 300 self-descriptive adjectives each of which a person can check off or leave blank. From this set of adjectives, a number of different scales can be scored to present a picture of an individual's self-concept. For this study 13 scales were scored including such things as Self-confidence, Personal Adjustment, and Achievement motivation.

The Self-Esteem Checklist includes questions on four subtypes of self-esteem: intellectual, social, personal, and global. Questions for social self-esteem were taken from the Texas Social Behavior Inventory (TSBI) (Helmreich & Stapp, 1974); questions for global self-esteem were taken from the Rosenberg Self-Esteem Inventory (Rosenberg, 1965); the rest of the questions were written by myself for the present form of the inventory.

The Bem Sex Role Inventory (BSRI) (Bem, 1974) contains 60 adjectives, 20 labeled "masculine," 20 labeled "feminine," and 20 labeled "neutral." A person rates him/herself on each trait using a scale from 1 (never like me) to 7 (always like me). In addition to a separate masculinity and femininity score, individuals can be classified as masculine sex-typed, feminine sex-typed, androgynous (high endorsement for both masculine and feminine traits), or undifferentiated (low endorsement of both).

Results and Discussion

First of all, there were no significant correlations between SATM score and ACL Self-Concept scores, BSRI Masculinity or Femininity scores, the MBTI Preference scores, or the Self-Esteem Scale scores for either males or females. This is understandable since everyone in the sample had exceptionally high SATM scores for their age (they were all above the mean score for students five to six years older than themselves). Second, there were no significant differences between the sexes for scores on the ACL Self-Concept scales or the Self-Esteem Scale.

There were significant sex differences on the BSRI Masculinity and Femininity scales (typical of adolescent populations). The boys were significantly higher on masculinity scores (M = 504) than the girls (M = 479) ($\underline{t}$ = 2.34, $p < .02$). The reverse was true for femininity scores with girls higher (M = 484) than boys (M = 419) ($\underline{t}$ = 7.20, $p < .001$). Interestingly, the boys had significantly higher masculinity than femininity scores ($\underline{t}$ = 8.89, $p < .001$), while the girls showed no difference between their two scores. This pattern has been found in other gifted groups and particularly with mathematically precocious adolescents (Hall & Haberstadt, 1980; Mills, 1981).

Table 1 shows the percentages for preferences on the four dimensions of the MBTI. The percentages are reported separately for the boys and girls. In addition, I have included some general population, age-appropriate norms and percentages for the verbally precocious adolescents who were enrolled in the same summer program as the high math group reported here.

The striking sex differences for the Sensing-Intuiting and the Thinking-Feeling dimensions raise some interesting questions concerning the male vs. female students' approach to mathematical reasoning, learning styles, problem-solving styles, and cognitive styles. Could such differences ultimately lead to an overall difference in the sexes for high-level mathematical reasoning ability? Is it possible that brain lateralization differences between the sexes, combined with some yet undefined biological predispositions (intellectual or otherwise), are exaggerated by existing socialization differences for the sexes? Is it possible that these differences result in this preferential divergence between mathematically gifted boys and girls for taking in, and making decisions about, information? Since a preference for Intuition is related to creativity, and indicates a preference for seeing possibilities and relationships within a set of information rather than seeking "pure" facts and only facts, is it possible that these girls will ultimately make better theoretical mathematicians? Are they at a disadvantage given the item content for the SATM? We have a partial answer to this question. Within the present group, Sensing versus Intuiting individuals did not differ on SATM scores, although only 10 girls expressed a preference for Sensing. On the other hand, since a preference for Thinking is related to a logical, analytical approach to problems, is it possible that the girls with a preference for Feeling are less able to effectively utilize their mathematical ability than the large majority of boys who are Thinkers? To score above 600 on the SATM at 12 years of age, must one have a preference for, and thus a more highly-developed ability to seek out facts

(ignoring the distraction of alternative possibilities) and analyze them in a logical fashion? Could this be a reason that fewer girls score at the higher levels on the SATM? The SATM scores for the Thinking girls were significantly higher (M = 596) than for the Feeling girls (M = 546). Interestingly, for boys, the large number of Thinkers did not differ from the few boys who expressed a preference for a Feeling mode.

What can we make of these differences? A large number of these mathematically gifted boys and girls have significantly different preferences for taking in information, evaluating, and using it. The Sensing/Intuiting difference should be related to qualitative differences in approach to mathematics, particularly high-level, theoretical mathematics. Although quantitative differences in mathematical ability are not related to this Sensing/Intuiting dimension, the qualitative difference is what Sherry Turkle in her book The Second Self (1984)calls "hard and soft mastery" in reference to computer programming. Not exclusive to one sex or the other, "soft mastery" is more typical of females -- an interactive, creative, evolving, even "sensuous" process, rather than a unilateral imposition of will and purpose created out of rules and logic.

The Thinking-Feeling dimension, on the other hand, appears to have some important implications for SATM scores for girls, and perhaps, ultimately, for the futher development and use of their mathematical ability. Is it the case that the Thinking-Feeling difference for boys matters less in terms of the development and use of mathematical ability? Since the Thinking-Feeling dimension parallels the typical socialization pattern for boys and girls,

and mathematics is often considered a "masculine" field, is it possible that males (regardless of preference) are socialized to be "Thinkers" rather than "feelers," slip into the objective, impersonal, analytical mode more easily, regard it as more appropriate for their sex, and are more "at home" within the field of mathematics (even the few boys who prefer the "feeling" mode)? Girls, on the other hand, who are feelers are socialized to be that way, must not only fight their natural preference, but also social pressures to slip into the "thinking" mode, and are less comfortable than the "thinking" girls, thinking boys, or even "feeling" boys within the field of mathematics.

Table 2 shows the 16 "types" on the MBTI. Age appropriate normative percentages for males and females are shown along the top of each box. Percentages for our math gifted boys and girls ar shown in the bottom of the boxes. The mathematically gifted girls were most frequently classified as INFP, ENFP, or ENTJ's -- percentages in all three types were significantly higher than percentages found for girls in the comparison population. The high math boys were most frequently classified as INTP or ENTP's (significantly more than for boys in the comparison population). The Thinking-Feeling dimension clearly differentiates between the sexes in this gifted group, as noted above. Quite an unusual number of the girls in our sample (as compared to a "normal" population of girls) were classified as INTJ (8.5%) INTP (10.6%), and ENTJ (12.8%) - all three of these types are extremely underrepresented in the normative population of girls. Our girls were classified from 4 to 8 times as often as their female peers in these "thinking" types.

I am convinced of a connection between "thinking" preferences and mathematical ability for these girls. It is also the case that the majority of the "thinking" girls are also introverts - loners, less sociable, less concerned with people and things than with the internal world of ideas -- the quietly logical, analytical thinker that is perhaps less influenced by the vagaries of stereotypic socialization pressures and adolescent social norms. What is disturbing to me, however, is the low frequency of females in the extraverted, thinking types. Twenty-two percent of the mathematically gifted boys were extraverted and thinking (ENTP's) - outspoken, may argue for fun on either side of a question, resourceful in solving new and challenging problems, skillful in finding logical reasons for what they want. Did these boys "naturally" develop this type or set of preferences? Did they develop this way because of social pressures and, more importantly, opportunities and expectations to develop these "skills?" Will these differences widen the gap between males and females in the use of their ability, for example in the decision to major in mathematics or pursue a career in this area? It will be interesting to examine in more depth the 13% of the girls who are ENTJ or the very few (4.8%) ENTP's. In the end, it may be just as informative to study the intraindividual differences among groups of girls as the interindividual differences between the sexes. These girls clearly do not fit the typical pattern found for the normative population of girls. The way in which they differ may help us to understand the development and utilization of high mathematical ability in females. And, the

Thinking-Feeling dimension for the sexes may ultimately help us to understand the sex differences in mathematical ability.

MYERS BRIGGS TYPE INDICATOR

based on Carl Jung's Theory of Psychological Types

Extraversion means you relate more easily to the outer world of people and things than to the inner world of ideas

Introversion means you relate more easily to inner world of ideas than the outer world of people and things

Sensing means you probably would rather work with known facts than look for possibilities and relationships

N for Intuition means you would probably rather look for possibilities and relationships than work with known facts

Thinking means you would probably base your judgments/decisions on impersonal analysis and logic than on personal values

Feeling means you would probably base your judgments more on personal values than on impersonal analysis and logic

Judging means you probably like a planned, decided, orderly way of life better than a flexible, spontaneous way

Perceptive attitude means you would probably like a flexible, spontaneous way of life better than a planned, decided, orderly way.

16 Personality Types

TABLE 1

Percentages for Preference Scores on the MBTI

	E	I	S	N	T	F	J	P
Males	56	44	45	55	77	23	40	60
(Verbal)	(75)	(25)	(25)	(75)	(75)	(25)	(12)	(88)
Gen'l pop. Age Norms	(60	(40)	(70)	(30)	(60)	(40)	(50)	(50)
Females	47	53	19	81	53	47	47	53
(Verbal)	(47)	(53)	(16)	(84)	(38)	(62)	(13)	(87)
Gen'l pop. Age Norms	(65)	(35)	(70)	(30)	(40)	(60)	(50)	(50)

Note: Strength of Preference was significantly different for the two sexes on the Judging dimension only ($t = 2.41$, $p < .01$)
(Male judgers - stronger preference)

Mathematically Gifted Males: N = 166
Mathematically Gifted Females: N = 64
Verbally Gifted Males with low SATM scores: N = 18
Verbally Gifted Females with low SATM scores: N = 19

Table 2. CHARACTERISTICS FREQUENTLY ASSOCIATED WITH EACH TYPE

	SENSING TYPES		INTUITIVE TYPES	
Norm group male, female	ISTJ 8% 6% Serious, quiet, earn success by concentration and thoroughness. Practical, orderly, matter-of-fact, logical, realistic and dependable. See to it that everything is well organized. Take responsibility. Make up their own minds as to what should be accomplished and work toward it steadily, regardless of protests or distractions.	ISFJ 4% 10% Quiet, friendly, responsible and conscientious. Work devotedly to meet their obligations and serve their friends and school. Thorough, painstaking, accurate. May need time to master technical subjects, as their interests are usually not technical. Patient with detail and routine. Loyal, considerate, concerned with how other people feel.	INFJ 2% 2% Succeed by perseverance, originality and desire to do whatever is needed or wanted. Put their best efforts into their work. Quietly forceful, conscientious, concerned for others. Respected for their firm principles. Likely to be honored and followed for their clear convictions as to how best to serve the common good.	INTJ 5% 2% Usually have original minds and great drive for their own ideas and purposes. In fields that appeal to them, they have a fine power to organize a job and carry it through with or without help. Skeptical, critical, independent, determined, often stubborn. Must learn to yield less important points in order to win the most important.
Gifted: male, female	10% 4%	-- --	2% 2%	6% 9%
INTROVERTS	ISTP 5% 4% Cool onlookers—quiet, reserved, observing and analyzing life with detached curiosity and unexpected flashes of original humor. Usually interested in impersonal principles, cause and effect, how and why mechanical things work. Exert themselves no more than they think necessary, because any waste of energy would be inefficient.	ISFP 4% 6% Retiring, quietly friendly, sensitive, kind, modest about their abilities. Shun disagreements, do not force their opinions or values on others. Usually do not care to lead but are often loyal followers. Often relaxed about getting things done, because they enjoy the present moment and do not want to spoil it by undue haste or exertion.	INFP 4% 4% Full of enthusiasms and loyalties, but seldom talk of these until they know you well. Care about learning, ideas, language, and independent projects of their own. Tend to undertake too much, then somehow get it done. Friendly, but often too absorbed in what they are doing to be sociable. Little concerned with possessions or physical surroundings.	INTP 6% 3% Quiet, reserved, brilliant in exams, especially in theoretical or scientific subjects. Logical to the point of hair-splitting. Usually interested mainly in ideas, with little liking for parties or small talk. Tend to have sharply defined interests. Need to choose careers where some strong interest can be used and useful.
	5% 2%	1% 4%	6% 20%	18% 11%
EXTRAVERTS	ESTP 8% 5% Matter-of-fact, do not worry or hurry, enjoy whatever comes along. Tend to like mechanical things and sports, with friends on the side. May be a bit blunt or insensitive. Can do math or science when they see the need. Dislike long explanations. Are best with real things that can be worked, handled, taken apart or put together.	ESFP 6% 16% Outgoing, easygoing, accepting, friendly, enjoy everything and make things more fun for others by their enjoyment. Like sports and making things. Know what's going on and join in eagerly. Find remembering facts easier than mastering theories. Are best in situations that need sound common sense and practical ability with people as well as with things.	ENFP 7% 6% Warmly enthusiastic, high-spirited, ingenious, imaginative. Able to do almost anything that interests them. Quick with a solution for any difficulty and ready to help anyone with a problem. Often rely on their ability to improvise instead of preparing in advance. Can usually find compelling reasons for whatever they want.	ENTP 8% 1% Quick, ingenious, good at many things. Stimulating company, alert and outspoken. May argue for fun on either side of a question. Resourceful in solving new and challenging problems, but may neglect routine assignments. Apt to turn to one new interest after another. Skillful in finding logical reasons for what they want.
	6% --	1% 4%	4% 17%	22% 4%
	ESTJ 16% 14% Practical, realistic, matter-of-fact, with a natural head for business or mechanics. Not interested in subjects they see no use for, but can apply themselves when necessary. Like to organize and run activities. May make good administrators, especially if they remember to consider others' feelings and points of view.	ESFJ 7% 18% Warm-hearted, talkative, popular, conscientious, born cooperators, active committee members. Need harmony and may be good at creating it. Always doing something nice for someone. Work best with encouragement and praise. Little interest in abstract thinking or technical subjects. Main interest is in things that directly and visibly affect people's lives.	ENFJ 4% 4% Responsive and responsible. Generally feel real concern for what others think or want, and try to handle things with due regard for other people's feelings. Can present a proposal or lead a group discussion with ease and tact. Sociable, popular, active in school affairs, but put time enough on their studies to do good work.	ENTJ 7% 2% Hearty, frank, able in studies, leaders in activities. Usually good in anything that requires reasoning and intelligent talk, such as public speaking. Are usually well-informed and enjoy adding to their fund of knowledge. May sometimes be more positive and confident than their experience in an area warrants.
	6% 2%	2% 4%	2% 2%	9% 13%

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