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Ten-Year Longitudinal Follow-Up of Ability-Matched Accelerated and Unaccelerated Gifted Students

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Gifted students identified by the Study of Mathematically Precocious Youth who underwent academic acceleration in their education were longitudinally compared across several domains with a group of equally gifted students who were never accelerated. The groups were matched for gender and for ability and were studied for 10 years. At age 23 few significant differences were found between the groups for the individual academic and psychosocial variables studied. Both the accelerates and the nonaccelerates reported impressive academic achievements, as well as high personal satisfaction with school and self. When academic variables are considered as a group, the performance of accelerates is slightly higher than that of nonaccelerates. In both accelerated and unaccelerated groups, male students pursued mathematics/science more vigorously than did female students, but there was no differential response to acceleration on the basis of gender. The findings do not support the common concern that gifted students may be harmed by accelerative experiences.

The appropriateness of academic acceleration for meeting the needs of gifted students is a controversial topic in education. A great deal of empirical research indicates that acceleration provides academic settings that are well suited to the needs of high-ability students (Benbow, 1991; Terman, 1954; VanTassel-Baska, 1989). Nevertheless, many educators and administrators resist its implementation in their schools (Feldhusen, 1989; Southern, Jones, & Fiscus, 1989). Daurio (1979) suggested that the continuing controversy is due, in part, to preconceived notions and irrational grounds rather than to an examination of the evidence. Perhaps, however, the controversy is sustained by a lack of data from experimental or quasi-experimental designs comparing accelerates and equally able nonaccelerates on academic and psychosocial/attitudinal variables. This study was designed to address such concerns with data obtained from a 10-year longitudinal investigation.

Acceleration can take many forms. Paulus (1984), however, provided a useful overall definition: "[academic] flexibility based on individual abilities without regard for age." Some common forms of acceleration are early entrance to school; grade skipping; advanced placement in certain subject areas; college course enrollment while in high school; and special, fast-paced classes (Copley, 1961; Gold, 1982). Regardless of the type of acceleration used, positive benefits have been noted for students (Benbow, 1991).

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Nevertheless, two primary academic concerns regarding the use of acceleration are expressed by some professionals: (a) Students may burn out if they are placed in classes that are advanced for their chronological age (Compton, 1982) and (b) acceleration may lead to gaps in the knowledge of participants or poor retention of material learned at an accelerated pace (see Hildreth, 1966; VanTassel-Baska, 1989). An example of a general policy on acceleration that reflects these objections to acceleration is the one currently in effect in the National Council of Teachers of Mathematics (see Belcastro, 1990). These concerns about acceleration may not be well founded, however.

Dealing with the question of burnout is rather cumbersome; it involves integrating a variety of points of view. A number of researchers, for example, have concluded that the risk of burnout is offset by an even higher risk of underachievement due to boredom if a gifted student is forced to remain in regular classes (Compton, 1982; Copley, 1961; Freeman 1983; Manaster & Powell, 1983; Paulus, 1984).

Underachievement, in turn, is seen as a sign of maladjustment among students (Schauer, 1976). Furthermore, in the case of the gifted, it has been noted that boredom in the classroom may lead to other adjustment difficulties, such as social withdrawal (Compton, 1982) or lack of self-discipline (Compton, 1982; Paulus, 1984).

The possibility of gaps in knowledge due to grade skipping has been acknowledged as a valid concern by supporters of acceleration (Hildreth, 1966; VanTassel-Baska, 1989). However, Feldhusen, Proctor, and Black (1986) noted that this difficulty can be avoided through the careful evaluation of a student to ensure that he or she is well prepared for advanced grade placement. Moreover, no studies have yielded evidence that students who have been accelerated exhibit deficits in knowledge or achievement (e.g., Feldhusen et al., 1986; Janos, 1987; Mercurio, 1980; Proctor, Black, & Feldhusen, 1988; Proctor, Feldhusen, & Black, 1988; Robinson & Janos, 1986; Stanley & Benbow, 1983; Swiatek & Benbow, 1991). Litera-

ture reviews (e.g., Feldhusen, 1989; Paulus, 1984) and a sophisticated meta-analysis (Kulik & Kulik, 1984) have yielded similar conclusions: When acceleration is properly used, it works academically.

The psychosocial reasons for hesitation in implementing accelerative programs are more numerous than are the academic reasons. The psychosocial concerns have a common foundation with academic concerns, however, in the belief that gifted students who are placed in classes with older students will be unable to adjust to the new setting (Copley, 1961). Specific among these concerns are the following: (a) Gifted students have deficient or retarded psychosocial development and, therefore, will not fit in with more mature classmates (Jung, 1954; Miller, 1980); (b) gifted students who are enrolled in special classes will lose the ability to function in the larger world of average people (Jung, 1954; Miller, 1980; Smith, 1984); (c) accelerative programs emphasize the differences between gifted and average students, thereby jeopardizing the social acceptance of the gifted student (Smith, 1984); (d) special educational opportunities lead gifted students to become conceited and self-centered (Jung, 1954; Miller, 1980); and (e) the self-concepts of gifted students will suffer if such students are set apart from their average counterparts (see Coleman & Fults, 1985).

Research into the psychosocial characteristics of gifted children has failed to support the first four of these concerns. Rather, the research has amply demonstrated that most gifted children are psychosocially mature (Delp & Martinson, 1977; Hildreth, 1966; Hollingworth, 1942; Schneider, Clegg, Byrne, Ledingham, & Crombie, 1989; Terman & Oden, 1947; Tidwell, 1980), perhaps even surpassing average children in this regard (Janos & Robinson, 1985). Also, gifted students have been shown to be popular with other students (Delp & Martinson, 1977; Schneider et al., 1989) and highly involved in extracurricular activities (Janos, 1987; Napolski, 1989; Terman & Oden, 1947; Tidwell, 1980). These findings suggest that gifted students are able to accept and be accepted by their average-ability peers. Gifted students appear to be well adjusted, especially during the preadolescent years; acceleration does not seem to affect that adjustment (Benbow, 1991).

The fifth concern, on which hesitation to use acceleration is often based, concerns the possibility that the self-esteem of gifted students may decline as a result of accelerative experiences. Decreases in self-esteem are indeed frequently found on enrollment in acceleration as well as enrichment programs. Some researchers (e.g., Richardson & Benbow, 1990; Swiatek & Benbow, 1991), however, have noted that these decreases can be interpreted as indications of greater realism in students' self-concepts rather than as indications of a dangerous decline. Also, slight decreases might be explained by Festinger's (1954) theory of social comparison (i.e., self-concepts are the result of comparisons of self with peers). These interpretations are reasonable but not universal. The state of empirical research as it relates to self-esteem cannot, at the present time, be said to strongly support either the use or the avoidance of acceleration.

In addition to studies that have focused on specific measures of psychosocial adjustment such as self-esteem, studies have been conducted using multiple variables to explore psychosocial outcomes of acceleration. One study compared radically accelerated male students with equally gifted unaccelerated male students and found no significant differences on variables associated with personality, career interests and aspirations, and values (Pollins, 1983). Another study compared early entrants to college with average-age students and found no differences in the general areas of social and psychological adjustment (Robinson & Janos, 1986). The results least favorable to accelerates in the area of psychosocial comparisons were reported by Kulik and Kulik (1984), who described their results regarding the question of psychosocial adjustment as "sketchy and inconclusive" (p. 88). The predominance of findings that are either neutral or in favor of accelerates suggests that most gifted students have strong personal resources and are unlikely to experience psychosocial harm from acceleration.

Thus, the majority of existing empirical research suggests that acceleration is an appropriate method of educating gifted students (Benbow, 1991). Nevertheless, because the use of acceleration continues to be viewed with caution, and because information on some issues is ambiguous, research is needed that addresses two basic topics.

The first of these topics concerns global relationships between acceleration and various aspects of the lives of participants. Most past research has addressed primarily either the achievement (e.g., Benbow, 1983; Compton, 1982; Feldhusen et al., 1986; Janos, 1987; Mercurio, 1980; Robinson & Janos, 1986; Stanley & Benbow, 1983) or the psychosocial adjustment (e.g., Brody & Benbow, 1986; Coleman & Cross, 1988; Coleman & Fults, 1985; Janos, Fung, & Robinson, 1985; Kelly & Colangelo, 1984; Lehman & Erdwins, 1981; Richardson & Benbow, 1990; Schneider et al., 1989; Tidwell, 1980) of accelerated students but not both. Therefore, conclusions regarding more general relationships, encompassing both academic and psychosocial domains, have been forced into the realm of inference. This article compares students' self-reports on both academic and psychosocial/attitudinal variables and, thereby, provides direct evidence for the assessment of more global effects of acceleration on gifted students' lives.

The second topic that must be addressed concerns the attributions made for differences between accelerated and unaccelerated students. Much of the existing research has involved comparisons of gifted students who are enrolled in special programs with average students, gifted students not matched for ability, or national norms (e.g., Coleman & Fults, 1985; Kelly & Colangelo, 1984; Lehman & Erdwins, 1981; Richardson & Benbow, 1990; Tidwell, 1980; Werner & Bachtold, 1969). Such research has confounded the effects of special programs with the effects of giftedness itself (c.f. Brody & Benbow, 1986). It is important for research on acceleration to avoid this confound by comparing gifted accelerates with equally gifted nonaccelerates. For this purpose, ideal research designs would require the random assignment of gifted students to accelerated and unaccelerated groups. Such designs are impractical, however, because students cannot ethically be forced into different educational groups for the convenience of an experimenter. Moreover, Benbow (1991) has

recommended that only students who want to accelerate should do so (Benbow, 1991). The best ethical design, therefore, appears to be quasi-experimental (Campbell & Stanley, 1963; Cook & Campbell, 1979). Students who, for reasons of their own, either have or have not accelerated should be matched for ability and then compared. This procedure was followed in the present study.

An additional important feature of the present research is its longitudinal nature. The majority of the existing matching studies have considered only the short-term effects of acceleration on gifted students. The longitudinal data used in the this study, however, allowed for the assessment of acceleration 10 years after the students were identified as gifted and at least 5 years after they were accelerated.

In sum, we compared students who chose to accelerate their education before college with equally able students who did not choose this route. These groups were compared on both academic and psychosocial/attitudinal variables.

Method

Subjects

Subjects were drawn from Cohorts 1 and 2 of the Study of Mathematically Precocious Youth (SMPY). All subjects had participated in an SMPY talent search and, therefore, had taken the Scholastic Aptitude Test (SAT) at the age of 12 or 13 years. Qualification for inclusion in the longitudinal study was based on scores on the SAT Mathematics subtest (SAT-M), the SAT Verbal subtest (SAT-V), the Test of Standard Written English (TSWE), or a combination of the three tests, which were designed for above-average high school students (not seventh or eighth graders).

Members of Cohort 1 participated in a talent search in 1972, 1973, or 1974. Minimum qualifying scores for this cohort, obtained when students were in 7th or 8th grade, were 390 on the SAT-M or 370 on the SAT-V. These scores corresponded to those of the average 11th- or 12th-grade female student (Admissions Testing Program, 1979). We estimated that the ability of these students is in the top 1.0% of American students their age.

Members of Cohort 2 were 7th graders at the time of their participation in a talent search in 1976, 1978, or 1979. Their minimum qualifying scores varied according to the year of their participation. In 1976, the total of twice the SAT-M score plus the SAT-V score was required to meet or exceed 1330 (Cohn, 1977):

$$2(\text{SAT-M}) + 1(\text{SAT-V}) \geq 1330.$$

In 1978, there were a number of ways in which a student could qualify for participation in the SMPY longitudinal study (Benbow, 1978): (a) SAT-M $\geq$ 500 and SAT-V $>$ 430, (b) SAT-M $\geq$ 550 (no SAT-V requirement), (c) SAT-V $\geq$ 580 (no SAT-M requirement), or (d) TSWE $\geq$ 58 (no SAT-V or SAT-M requirement). In 1979, qualification for the longitudinal study was a minimum score of 500 on the SAT-M and a minimum composite score (SAT-M + SAT-V) of 1000 (Bartkovich & Mezynski, 1981). Nationally, the scores of Cohort 2 participants placed them in the top 0.5% of students their age with regard to mathematical ability.

At the time of this study, subjects from both cohorts had reached a minimum age of 23 years. Two groups of subjects were formed for this study. One group comprised *accelerates*, defined in this study as students who enrolled in college at least 1 year early. The other group comprised *nonaccelerates*, those students who pursued a traditional educational route, as reflected by enrollment in college at the typical age. Members of these two groups were matched for gender. To match for ability across the groups, SAT scores at time of talent search were used. SAT-M scores were matched within 10 points; SAT-V scores were matched within 20 points. The resulting two groups were each composed of 107 students, 69 of whom were male and 38 of whom were female. The mean 7th-grade/8th-grade SAT-M score in each group was approximately 560; the mean 7th-grade/8th-grade SAT-V score was approximately 460. These scores were not significantly different between the groups.

Procedure

When subjects were approximately 23 years of age, the longitudinal after-college questionnaire was mailed to them. Those who did not respond initially were reminded, first by mail and then by telephone if necessary, to complete the survey. Those who did not respond after telephone reminders were telephoned again and requested to verbally answer the survey questions. This procedure resulted in a response rate of approximately 75% for Cohort 1 (n = 1,247). Data collection is currently in progress for Cohort 2. At the time when subjects for this study were selected and matched, the response rate for this group was 33% (n = 207). The final subject group of 107 pairs of students, matched in terms of ability and gender, was drawn from the total pool (N = 1,454) of Cohort 1 and Cohort 2 students who had returned an after-college questionnaire. (The approximate age range of the subjects, on completion of the survey, was 23 to 25 years.) Cohort 2 students were included to maximize the number of pairs available for study. In neither cohort did after-college respondents differ from nonrespondents in ability, socioeconomic status, or college attendance.

Data pertaining to the dependent variables were obtained from a subset of items included on the SMPY after-college questionnaire, which addressed many issues in the subjects' academic and psychosocial lives. The academic variables of particular interest for the present research were the following: educational level completed, educational aspirations, undergraduate grade point average, undergraduate awards and honors earned, graduate school attendance, quality of schools (both undergraduate and, if applicable, graduate), academic or creative accomplishments, publications, and research participation. The majority of these items were formatted as multiple-choice or free-response questions. We obtained variables reflecting the quality of schools attended by using national rankings of institutional quality. At the undergraduate level, Astin's (1977) rank ordering of United States colleges and universities was used. At the graduate level, departments were ranked according to Gourman's (1983) listing of graduate and professional programs. In both of these systems, lower numbers indicate higher status.

The psychosocial and attitudinal variables studied included two 6-item scales, one assessing self-esteem and one assessing locus of control. The items from these scales are listed in Table 1. Both scales were rated with a 5-point response format and were taken from the national longitudinal study (NLS) questionnaire (Conger, Peng, & Dunteman, 1976; Peng, Fetters, & Kolstad, 1981). For our subject group, the values of Cronbach's alpha were .74 for the self-esteem scale and .59 for the locus of control scale. We also analyzed original individual items assessing participation in undergraduate extracurricular activities, attitudes toward college, and attitudes toward mathematics and science. These variables were assessed on 5-point scales, with two exceptions: (a) Participation in extracurricular activities was measured by the number of activity areas in which students reported involvement, and (b) usefulness of mathematics and science to students' planned careers was rated on a 4-point scale. In addition to considering the individual variables regarding attitudes toward mathematics and science, we standardized and combined these variables to form two scales: one reflecting attitudes toward mathematics and

Table 1
Items on the Self-Esteem and Locus of Control Scales

Scale	Item
Self-esteem	I take a positive attitude toward myself.
	I feel I am a person of worth, on an equal plane with others.
	I am able to do things as well as most other people.
	On the whole, I'm satisfied with myself.
	At times I think I am no good at all.
	I feel I do not have much to be proud of.
Locus of control	Good luck is more important than hard work for success.
	Every time I try to get ahead, something or somebody stops me.
	Planning only makes a person unhappy, since plans hardly ever work out.
	People who accept their condition in life are happier than those who try to change things.
	What happens to me is my own doing.
	When I make plans, I am almost certain I can make them work.

Note. The items on these scales were adapted from the national longitudinal study questionnaire.

one reflecting attitudes toward science. The resulting scales were reliable for the students in our sample ($\alpha = .77$ for attitudes toward mathematics; $\alpha = .83$ for attitudes toward science).

We compared the two groups on the academic and psychosocial/attitudinal variables described above. In addition, we made comparisons between male and female students and between those students who had entered college only 1 year early and those who had entered college 2 or more years early. First, we examined the variables separately with t tests (median tests for college and graduate school rankings). Because of the large number of individual comparisons involved in this design, we modified the alpha levels indicating statistical significance by the Bonferroni method. The resulting alpha levels were .002 for academic variables and .004 for psychosocial/attitudinal variables.

Second, we examined the variables in the two groups (i.e., academic and psychosocial/attitudinal), with stepwise discriminant function analyses. The discriminant function analyses focusing on academic variables included most of the variables listed in Table 2. Excluded from these analyses were (a) college and graduate school rankings, because they are expressed in medians rather than means; (b) educational aspirations, because several subjects were missing data for this item; and (c) age attending graduate school, because the inclusion of this item would have limited the analysis to only those students who had attended graduate school; this variable was replaced by the graduate school attendance variable (see Table 3). SAT–M score at age 13 years also was included in these analyses; SAT–V score at age 13 years was excluded because of missing data. The sample size necessitated limitation of the number of academic variables included in the discriminant function analyses. We chose to exclude the majority of variables from Table 3 because there was little variance with which to work; few students had achieved the distinctions represented. The analyses focusing on psychosocial/attitudinal variables included variables that are listed in Table 4: liking for college, extracurricular activity areas, locus of control, self-esteem, and attitudes toward mathematics and science (as measured by scales, not by the individual items).

Results

Academic Variables and Acceleration

Means and standard deviations of both in-class academic variables (e.g., college ranking, area of study, and grade point average) and out-of-class achievement variables (e.g., publications and presentations) are presented in Table 2; proportions are presented in Table 3. Level of achievement in college had been high for both accelerates and nonaccelerates. Students who entered college at least 1 year early and those who entered at the typical age had attended prestigious colleges, had earned grade point averages between the levels of B+ and A−, and aspired to obtain further education. A majority of students in each group (59% of accelerates and 61% of nonaccelerates) had majored in mathematics or science as undergraduates. Many students in each group had taken several mathematics and science courses that were not required for graduation. A majority of students from each group (75% of the accelerates and 63% of the nonaccelerates) attended graduate school. In both groups, the graduate schools attended were highly ranked. Also, many students in both groups had taken advantage of out-of-class academic opportunities, such as working on a research project.

For all comparisons between accelerates and nonaccelerates on individual academic variables, there were only two statistically significant differences, both of which occurred with variables presented in Table 2. First, the accelerates reported a higher average level of educational attainment at the time of the survey than did nonaccelerates, $t(211) = 3.90$, $p < .001$. Second, the accelerated students who attended graduate school began their graduate studies at a younger age than did the unaccelerated students who attended graduate school, $t(134) = 7.73$, $p < .001$. Thus, at age 23 years, as at age 18 years, the accelerates had gained at least 1 year in their educational development.

We conducted a stepwise discriminant function analysis to predict membership in the accelerated and unaccelerated groups by academic variables. Although the groups were very similar across the variables (Wilks's $\lambda = .91$), there were significant differences between them ($p < .0005$). The variables that contributed most to the prediction of acceleration group membership were the following (in order of entry): educational level, number of unrequired mathematics courses taken, and undergraduate grade point average. With the exception of grade point average (for which the mean difference

Table 2
Means and Standard Deviations for Academic Variables, According to Group

Variable	Accelerates		Nonaccelerates	
	M	*SD*	*M*	*SD*
Educational level[a]	3.36	0.75	2.95	0.77
Educational aspirations	4.63	0.54	4.52	0.64
Undergraduate GPA	3.50	0.52	3.51	0.44
Number of undergraduate mathematics courses taken	4.31	4.41	3.93	3.92
Number of undergraduate physical science courses taken	5.84	7.50	4.77	6.46
Number of undergraduate natural science courses taken	2.15	3.59	2.51	5.45
Number of undergraduate computer science courses taken	1.67	3.20	1.18	1.93
Number of unrequired mathematics courses taken	1.62	2.30	0.89	1.42
Number of unrequired science courses taken	2.09	2.96	1.53	2.20
Age attending graduate school[a]	21.13	1.10	22.36	0.76
Astin college rank (*Mdn*)	46.00		95.00	
Gourman graduate department rank (*Mdn*)	13.00		17.00	

Note. GPA = grade point average.
[a] The differences between the two groups on these measures were significant at $p \leq .001$.

of less than .02 favored the nonaccelerates), these variables favored accelerates. The canonical correlation of the function was small ($r = .31$); the discriminant function correctly classified approximately 64% of the students (as opposed to the 50% that would be expected by chance).

Psychosocial/Attitudinal Variables and Acceleration

We also compared accelerates with nonaccelerates with regard to their liking for college, participation in extracurricular activities, attitudes toward mathematics and science,

Table 3
Proportions of Students Involved in Academic Activities, According to Group

Activity	% responding	
	Accelerates	Nonaccelerates
Attending college	99	98
Majoring in mathematics/science as undergraduate	59	61
Earning honors as undergraduate	28	28
Attending graduate school	75	63
Majoring in mathematics/science as graduate student	51	52
Creating original invention or process	13	8
Editing a publication	23	22
Presenting a paper; participating in a colloquium	32	20
Publishing a book	1	1
Publishing a journal article	20	13
Publishing a magazine article	9	4
Publishing a newspaper article	10	7
Having probable publications in preparation	34	18
Contributing to a research project	48	30

Note. No individual item yielded statistically significantly different proportions for the two groups at $p \leq .002$.

locus of control, and self-esteem (Table 4). On the average, students in both groups liked college, were active in extracurricular areas, and expressed positive attitudes toward mathematics and science. Locus of control for both groups was internal; mean self-esteem scores for both groups were high. No significant differences between the two groups were found for any of these individual attitudes or aspects of psychosocial life. Furthermore, the differences between the groups across the psychosocial/attitudinal variables were not sufficient for a discriminant function to be calculated.

Subgroup Comparisons

Gender differences. Tables 5, 6, and 7 summarize the results of gender-separate comparisons of all academic and psychosocial/attitudinal variables. We conducted two types of comparisons with these individual variables. First, we explored within-group gender differences. Among the accelerates only, male students reported having taken more college mathematics courses that were not required for graduation than did female students, $t(104) = 3.17$, $p < .005$. Among nonaccelerates only, male students rated science as being more important to their planned careers than did female students, $t(102) = 4.17$, $p < .001$. In both the accelerated and the unaccelerated groups, talent search SAT–M scores were higher among male students than among female students: $t(105) = 5.29$, $p < .001$, for accelerates, and $t(105) = 5.16$, $p < .001$ for nonaccelerates. Also in both groups, male students reported that they felt more confident about working out science problems than did female students: $t(102) = 3.00$, $p < .005$, for accelerates, and $t(104) = 4.14$, $p < .001$, for nonaccelerates. Additionally, in both groups male students reported that they found science to be easier than did female students: $t(101) = 3.86$, $p < .001$, for accelerates, and $t(102) = 4.13$, $p < .001$, for nonaccelerates. In fact, gender comparisons in both acceleration groups indicated that general attitudes toward science (i.e., scores on the standardized attitudes toward science scale) were more positive among male students than among female students, $t(100) = 3.12$, $p < .005$, among accelerates, and $t(60) = 3.96$, $p < .001$, among nonaccelerates.

Second, between-groups comparisons were made separately for male and female students to explore possible differential responses to acceleration by gender. For both male and female students, accelerated students began attending graduate school at a younger age than did unaccelerated students, $t(93) = 5.31$, $p < .001$, for male students, and $t(36) = 6.07$, $p < .001$ for female students. For male students only, accelerates reported having obtained a higher level of education at the time of the survey than did nonaccelerates, $t(136) = 3.37$, $p \leq .001$. No other statistically significant differences between acceleration groups were found for either gender.

We conducted stepwise discriminant function analyses to predict gender group membership on the basis of academic and psychosocial/attitudinal variables. In these analyses we included the entire subject pool to maximize power. The differences between the groups were statistically significant (Wilks's lambda =. 72, $p < .0001$, for the academic variables and Wilks's lambda = .88, $p < .0001$, for the psychosocial/attitudinal variables).

The academic variables that contributed most to the prediction of gender group membership were the following (in order of entry): talent search SAT–M score, the number of

Table 4
Means and Standard Deviations of Psychosocial Variables, According to Group

Variable	Accelerates		Nonaccelerates	
	M	*SD*	*M*	*SD*
Liking for college	1.62	0.84	1.71	0.84
Number of extracurricular activity areas	2.30	1.32	2.24	1.40
Confidence in mathematics[a]	4.18	0.95	4.07	1.12
Confidence in science[b]	3.95	1.00	3.77	1.07
Perceived ease of mathematics[a]	3.87	1.12	3.81	1.07
Perceived ease of science[b]	3.61	0.97	3.59	1.08
Interest in mathematics[a]	3.97	1.02	3.79	1.29
Interest in science[b]	4.40	0.86	4.36	0.99
Usefulness of mathematics for planned career[a]	2.98	1.00	2.89	1.04
Usefulness of science for planned career[b]	2.93	1.06	2.87	1.15
Attitudes toward math scale (*z* score)	0.06	0.71	−0.06	0.82
Attitudes toward science scale (*z* score)	0.04	0.77	−0.05	0.86
Locus of control scale	4.01	0.57	4.12	0.45
Self-esteem scale	4.19	0.59	4.16	0.64

[a] Responses were converted to standard scores and used in the attitudes toward math scale.
[b] Responses were converted to standard scores and used in the attitudes toward science scale.

Table 5
Means and Standard Deviations for Academic Variables, According to Acceleration Status and Gender

Variable	Accelerated students				Unaccelerated students			
	Male		Female		Male		Female	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
SAT-M score at age 12 or 13	580	55.8	520	53.9	580	55.1	520	53.9
SAT-V score at age 12 or 13	450	70.7	460	71.7	450	72.4	460	70.2
Educational level	3.38	0.73	3.32	0.78	2.96	0.74	2.95	0.84
Educational aspirations	4.75	0.44	4.38	0.65	4.55	0.63	4.46	0.65
Undergraduate GPA	3.50	0.61	3.48	0.30	3.51	0.44	3.50	0.45
Number of undergraduate mathematics courses taken	4.67	4.74	3.66	3.69	4.09	3.96	3.63	3.89
Number of undergraduate physical science courses taken	6.39	7.30	4.84	7.84	5.48	7.08	3.47	4.99
Number of undergraduate natural science courses taken	2.19	3.95	2.08	2.87	2.74	6.42	2.11	3.03
Number of undergraduate computer science courses taken	1.93	3.60	1.21	2.28	1.17	1.66	1.18	2.36
Number of unrequired mathematics courses taken	2.06	2.59	0.84	1.37	1.07	1.45	0.55	1.33
Number of unrequired science courses taken	2.65	3.26	1.08	2.01	1.73	2.39	1.18	1.77
Age attending graduate school	21.20	1.08	20.96	1.15	22.20	0.76	22.68	0.67
Astin college rank (*Mdn*)	23.0		180.5		46.0		299.0	
Gourman graduate department rank (*Mdn*)	10		14		22		16	

Note. SAT-M = Scholastic Aptitude Test-Mathematics; SAT-V = Scholastic Aptitude Test-Verbal; GPA = grade point average.

Table 6
Proportions of Students Involved in Academic Activities, According to Acceleration Status and Gender

Activity	% responding			
	Accelerated students		Nonaccelerated students	
	Male	Female	Male	Female
Attending college	99	100	99	97
Majoring in mathematics/science as undergraduate	68	42	68	49
Earning honors as undergraduate	30	24	32	21
Attending graduate school	80	66	67	55
Majoring in mathematics/science as graduate student	60	32	62	29
Creating original invention or process	17	5	10	5
Editing a publication	22	26	23	21
Presenting a paper; participating in a colloquium	35	26	22	16
Publishing a book	2	0	1	0
Publishing a journal article	26	8	16	8
Publishing a magazine article	12	5	6	0
Publishing a newspaper article	9	13	7	5
Having probable publications in preparation	38	26	22	11
Contributing to a research project	51	42	36	18

Table 7
Means and Standard Deviations of Psychosocial Variables, According to Acceleration Status and Gender

Variable	Accelerated students				Unaccelerated students			
	Male		Female		Male		Female	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Liking for college	1.75	0.85	1.40	0.79	1.68	0.85	1.78	0.82
Number of extracurricular activity areas	2.19	1.33	2.50	1.29	2.23	1.36	2.29	1.49
Confidence in mathematics[a]	4.33	0.79	3.92	1.15	4.25	0.95	3.74	1.33
Confidence in science[b]	4.17	0.89	3.58	1.08	4.07	0.92	3.24	1.13
Perceived ease of mathematics[a]	4.08	1.03	3.51	1.19	3.94	0.98	3.58	1.20
Perceived ease of science[b]	3.88	0.84	3.16	1.03	3.89	0.91	3.05	1.14
Interest in mathematics[a]	4.00	0.95	3.92	1.15	3.94	1.24	3.53	1.35
Interest in science[b]	4.45	0.84	4.32	0.90	4.49	0.75	4.13	1.30
Usefulness of mathematics for planned career[a]	3.15	0.88	2.68	1.13	3.00	1.06	2.71	1.01
Usefulness of science for planned career[b]	3.09	0.95	2.65	1.21	3.20	1.03	2.29	1.14
Attitudes toward math scale	0.19	0.59	−0.17	0.83	0.07	0.73	−0.28	0.92
Attitudes toward science scale	0.21	0.70	−0.26	0.80	0.21	0.69	−0.49	0.95
Locus of control scale	4.00	0.60	4.02	0.53	4.07	0.46	4.21	0.43
Self-esteem scale	4.31	0.48	4.00	0.71	4.12	0.61	4.23	0.69

[a] Responses converted to standard scores and used in the attitudes toward math scale.
[b] Responses converted to standard scores and used in attitudes toward science scale.

unrequired undergraduate mathematics courses taken, the number of physical science courses taken as an undergraduate, undergraduate grade point average, graduate school attendance, the number of unrequired undergraduate science courses taken, the number of computer science courses taken as an undergraduate, and the overall number of mathematics courses taken as an undergraduate. Male students scored higher on all of the variables in the discriminant function. The canonical correlation resulting from the analysis was rather substantial ($r = .53$); the function classified approximately 70% of the students into the correct gender group.

The psychosocial/attitudinal variables that contributed most to the prediction of gender group membership were, in order of entry, attitudes toward science and liking for college. Male students expressed more positive attitudes toward science; female students expressed greater liking for college. The canonical correlation resulting from this analysis was small ($r = .35$); the discriminant function correctly classified approximately 70% of the students into gender groups.

Differences according to extent of acceleration. In addition, we conducted individual *t* tests and chi-square analyses to compare students who accelerated only 1 year ($n = 84$) with students who accelerated their education by more than 1 year ($n = 23$; accelerated by 2 to 5 years; modal acceleration = 2 years). Only one statistically significant difference was found between these two groups: Responses of students who had accelerated more than 1 year reflected more internal locus of control than did those of students who entered college only 1 year earlier than is typical, $t(55) = 3.04$, $p = .004$. Discriminant function analyses could not be conducted for these groups because of limitations in power.

Discussion

We investigated the relationship between acceleration and both academic achievement and psychosocial development at least 5 years after acceleration had occurred. Academically, both the students who entered college at least 1 year early and those who were matched for ability, but enrolled at an older age, demonstrated high achievement. Also, the students in both groups appeared to be satisfied with their educational experiences and psychosocially well adjusted.

We considered exploring the relationship between academic achievement and psychosocial adjustment among the gifted students in our sample. Because of the lack of variability in both academic and psychosocial/attitudinal areas, however, this analysis proved to be impossible. Therefore, we separately discuss our findings for academic and psychosocial/attitudinal variables.

Academic Variables and Acceleration

Few significant differences between accelerated and unaccelerated students were found in the academic domain when individual variables were considered. When the academic variables were aggregated, however, the results tended to favor the accelerates. This pattern of results appears to refute many common concerns about the effects of acceleration.

On neither the undergraduate level nor the graduate level were there differences between accelerates and nonaccelerates in the quality of schools attended. This finding indicates that the accelerates in this subject group were able to compete successfully for admission to schools with good reputations

despite the difficulties that young students frequently encounter in this area (Brody & Stanley, 1991). Furthermore, the lack of significant differences with regard to the various undergraduate academic variables indicates that, once enrolled in college, the accelerates were able to perform as successfully as the nonaccelerates, even though the accelerates were at least 1 year younger. These findings are inconsistent with the claim that acceleration leads to gaps in the knowledge of participants or poor retention of material learned at an accelerated pace (see Hildreth, 1966; VanTassel-Baska, 1989).

There was no difference between the two groups in the level of education to which students aspired, but the accelerates had attained a higher educational level at the time of the survey and had entered graduate school at a younger age than had the nonaccelerates. Because the students in the accelerated group had been accelerated prior to beginning their undergraduate education, it is noteworthy that they were still advanced approximately 5 years later. The accelerates did not appear to slow their college educations, take time off before pursuing graduate studies, or plan to curtail their educational pursuits. These findings mitigate the concern that accelerated students may be more likely than unaccelerated students to experience burnout (Compton, 1982). If accelerated students were burnt out on academics, they would not equal their unaccelerated counterparts in either graduate school attendance or extent of educational planning, as they did in our evaluation.

Overall, few differences between the acceleration groups were noted for individual variables. Nevertheless, when academic variables as a whole were considered, the performance of the accelerates appeared to be slightly stronger than that of the nonaccelerates.

Psychosocial/Attitudinal Variables and Acceleration

The lack of significant differences between accelerated and unaccelerated students across multiple psychosocial and attitudinal variables suggests that the accelerated students in our sample are as well adjusted as the unaccelerated students. It is possible that some studies may find gifted students to score lower in some of these areas than average students. Although it is beyond the scope of this article to examine this relationship, the results obtained in this study indicate that any such differences that may be found are unlikely to be due to acceleration among members of the gifted group.

Subgroup Comparisons

When scores on individual variables were compared by gender within each acceleration group, we noted several differences. In addition, there are several within-group gender differences that did not achieve statistical significance but appear to be large enough to contribute to an interpretation of the pattern of results by gender (e.g., differences in undergraduate college rankings and in mathematics/science majors both at the undergraduate and graduate levels). Generally, these differences (both those that were statistically significant and those that were not) suggest that male students may pursue mathematics and science more vigorously than do female students. The results of the discriminant function analysis with academic variables also support this interpretation. Nevertheless, the results of between-groups comparisons for individual variables, conducted separately by gender, indicate that accelerative experiences did not have differential impact on the male and female students in our sample. Although we have noted gender differences, analysis of such differences did not constitute the primary focus of this article. Gender differences in achievement are discussed in greater detail by Sanders, Benbow, and Albright (1991).

In addition to gender, we explored extent of acceleration as a possible factor in academic and psychosocial/attitudinal outcomes. The only difference between students who accelerated only 1 year and those who accelerated more than 1 year was that students who accelerated to a greater extent scored higher than did 1-year accelerates on our scale of locus of control. Because both groups reported internal locus of control and because there were no other differences between the groups, the appropriate conclusion appears to be that students who desire to accelerate their educations by several years are affected no differently by their educational experiences than are students who choose to accelerate by only 1 year.

Conclusion

This study is limited in three ways. First, self-reported follow-up data were used. Second, the students studied were highly gifted and, therefore, may not be representative of the total population of students who are identified as gifted in American school systems. It is important to note, however, that acceleration is not recommended for all gifted students but only for those who are highly gifted and who desire acceleration. Third, the groups in this study were matched only for ability, as measured by a single test (i.e., the SAT). Therefore, there may be characteristics not investigated in this study (e.g., motivation) that distinguish the accelerates from the nonaccelerates.

Although the self-selection of students into their respective groups can be considered a limitation of the study, it has important implications for the interpretation of the results as well. As has been recommended previously, students who do not wish to accelerate should not be accelerated (Benbow, 1991). The converse may also be true, that is, that students who wish to accelerate should not be denied the opportunity. Some individuals might argue that the results of this study indicate that acceleration is useless because there are few significant differences, over time, that favor the accelerates. Perhaps, however, the students who wished to accelerate would have suffered if they had been denied the opportunity to do so. Ethical considerations prevent the direct empirical investigation of this possibility.

This study is unique in that both academic and psychosocial/attitudinal aspects of gifted students' lives were explored. This approach enabled consideration of gifted students in a more global way than is permitted by the designs used in most research, and matching of students on the basis of ability avoided the confounding of ability and acceleration. Furthermore, the longitudinal design of this study allowed for the

empirical investigation of long-term achievement and adjustment among gifted students who have used different methods of education.

The results of this study suggest that the common beliefs that acceleration puts bright students at a disadvantage academically (Compton, 1982; see Hildreth, 1966; VanTassel-Baska, 1989) or psychosocially (see Coleman & Fults, 1985; Copley, 1961; Jung, 1954; Miller, 1980; Smith, 1984) should be reconsidered. Avoidance of the implementation of acceleration in the education of gifted students, whether male or female, does not appear to be supported by the present study or by earlier empirical research. Rather, accelerated students appear to benefit by gaining at least 1 year that they can devote to their own interests, such as professional or advanced educational development. We conclude that highly gifted students who desire to accelerate may benefit from being permitted to advance in their academics as far as they are willing and able to go.

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Zahn-Waxler Appointed New Editor, 1993–1998

The Publications and Communications Board of the American Psychological Association announces the appointment of Carolyn Zahn-Waxler as editor of *Developmental Psychology.* Zahn-Waxler is associated with the National Institute of Mental Health. As of January 1, 1992, manuscripts should be directed to

Carolyn Zahn-Waxler
4305 Dresden Street
Kensington, Maryland 20895

Manuscript submission patterns make the precise date of completion of the 1992 volume uncertain. The current editor will receive and consider manuscripts through December 1991. Should the 1992 volume be completed before that date, manuscripts will be redirected to the incoming editor for consideration in the 1993 volume.