From Noncompetence to Exceptional Talent: Exploring the Range of Academic Achievement Within and Between Grade Levels

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ABSTRACT
This article analyzes the magnitude of individual differences in academic achievement and their growth over the first 9 years of schooling. The author anchors the widening-gap phenomenon on the theoretical recognition of large individual differences in learning pace, which logically leads over time to an increasing gap in knowledge and skills between the fastest and slowest learners. The achievement data used as evidence were borrowed from the developmental standard score (SS) norms of the Iowa Tests of Basic Skills (ITBS; Hoover, Dunbar, & Frisbie, 2001). These norms reveal, among other things, that within most grade levels the range between the lowest and highest achievers exceeds the 8-year gap in knowledge between average 1st- and 9th-grade students. Moreover, the achievement gap widens by about 250% between grades 1 and 9. Parallel evidence suggests that standardized achievement test data probably underestimate the true differences. Because it ensues from stable individual differences in learning aptitude, educators should not perceive that widening achievement gap as a failure of the educational system, but should recognize it instead as a proof that all learners are given the opportunity to progress at their own learning pace.

After reading an early draft of this text, a colleague in the field of gifted education told me the following anecdote. A 4th-grade teacher she knew well decided to implement a continuous progress scheme for the math curriculum, which was subdivided into many short modules. She first tested each of her 32 students on end-of-module achievement tests, having decided that they could skip any module if their mastery level reached at least 85%. Students were thus assigned different modules as their starting point. They could then progress at their own pace, advancing to the next module as soon as their mastery level reached the 85% criterion. At the beginning of that experiment, early in the school year, she observed a 16-module span between the most and least advanced students. At the end of that school year, the distance had grown to 33 modules, an increase of about

PUTTING THE RESEARCH TO USE
This demonstration of a huge gap in academic achievement between the fastest and slowest learners constitutes a powerful argument in favor of curriculum differentiation, ability grouping, and academic acceleration. It is hoped that readers will find the results impressive enough to discuss them, using Figures 1 and 2, with friends and colleagues. Readers are invited to target school professionals, administrators, and school board members as those most likely to benefit from this information. They could highlight with these educators the fact that the gap in academic knowledge within most grade levels is huge, even exceeding the knowledge span between average 1st- and 9th-grade students. Secondly, they could introduce the talent search data, whose results suggest an even larger span than what the ITBS data reveal. Thirdly, they should stress that the growth of the achievement gap over time—the fan spread effect—is a logical outcome when all students are given the opportunity to progress at their own learning pace. Fourthly, they should point out that these results constitute a powerful argument in favor of curriculum differentiation, ability grouping, and academic acceleration. Finally, it is hoped that many school principals will make the contents of this article an object of discussion at a faculty meeting.
100% in the knowledge gap between the fastest and slowest learners. Moreover, she noticed that the fastest learners needed little help in their learning beyond a few minutes of presentation for new concepts, whereas the slower learners required most of her time for repeated explanations and constant guidance during most problem-solving situations. Only continued support for the slow learners and lack of special stimulation for the fast ones prevented an even greater spread in academic progress.

This anecdote will surprise few teachers who work with heterogeneous groups. Moving beyond that informal level of observation, can we more precisely measure individual differences in learning ease and speed? Stated differently, how far ahead are academically talented students compared to average peers or slow learners in terms of their knowledge and skill mastery?

**Problem Statement**

The idea of individual differences in learning rate is certainly not new. Educators and psychologists have always recognized that some students learn much more easily and rapidly than others, and every teacher could give numerous examples of such differences in ease, and thus speed, of academic learning. Most definitions of intelligence include the idea of individual differences in learning facility and speed. For instance, more than 50 years ago, Stroud (1946) wrote,

The ability to learn is one of the principal things meant by “intelligence.” When we speak of bright seven-year-old children, for example, we usually have in mind those who learn quickly or those who can achieve at a level not attainable by others at their age. Conversely, dull children are those who progress slowly in academic subjects. (p. 250)

More recently, Gottfredson (1997) stated, “Although researchers disagree on how they define intelligence, there is virtual unanimity that it reflects the ability to reason, solve problems, think abstractly, and acquire knowledge” (p. 93). Carroll (1997) similarly claimed, “Experts have largely neglected what seems to be an obvious conclusion to be drawn from the evidence from IQ tests: that IQ represents the degree to which, and the rate at which, people are able to learn” (p. 44). In his Differentiated Model of Giftedness and Talent, Gagné (2003) identified ease/speed of learning as a major behavioral marker of giftedness:

High aptitudes or gifts can be observed more easily and directly in young children because environmental influences and systematic learning have exerted their moderating influence in a limited way. However, gifts still manifest themselves in older children, even in adults, through the facility and speed with which some individuals acquire new skills in any given field of human activity. (p. 62)

Statements that associate intelligence with ease/speed of academic learning automatically suggest two corollaries, one of them static and the other dynamic.

**Static Corollary**

The static corollary can be stated as follows: Within any representative population of students from any grade level, we should observe a large gap in academic knowledge and skills between slow and fast learners. What evidence does the scientific literature offer concerning the size of these differences in academic achievement? Although a computer search produced thousands of references, none offered detailed descriptions of their magnitude. A similar search in well-known handbooks of educational psychology (e.g., Ormrod, 2000; Slavin, 2000; Sternberg & Williams, 2002), major compendia of educational information (e.g., Berliner & Calfee, 1996; Keesee, 1988; Mitzel, 1982; Wittrock, 1986), and even books or chapters specifically addressing individual differences in educational achievement (e.g., Ackerman, Kyllonen, & Roberts, 1999; Fennema & Goodlad, 1983; Wang & Walberg, 1985) revealed no detailed discussion of range differences between the slowest and fastest learners. These writers seem to consider their readers well aware of the amplitude of individual differences in achievement. One scholar, Biemiller (1993), did bring up the subject in a short section of his article devoted to “the magnitude of diversity in educational skill acquisition” (p. 7). But, his presentation surveyed the question only briefly and was based on the norms of a single math test (from the Wide Range Achievement Test; Jastak & Wilkinson, 1984). Interestingly, Biemiller mentioned his own frustration concerning the lack of quantitative data:

Much of the information presented in this section is not “new.” However, although diversity
is a pervasive fact in nonstreamed classrooms, texts directed at teacher education candidates do not always reflect this reality. For example, in the excellent and widely used Looking in Classrooms (Good & Brophy, 1987), four chapters (4, 9, 10, and 11) address issues intimately related to diversity. However, no quantitative information on ability ranges is provided. . . . The same can be said of widely used texts in educational psychology (e.g., Gage & Berliner, 1988). (p. 11, Note 1)

**Dynamic Corollary**

The second corollary concerns the longitudinal and cumulative academic impact of individual differences in learning ability. Essentially, these aptitude differences should produce with time a widening gap in performance between the slowest and fastest learners. This phenomenon is coarsely analogous to the physical law D = S x T, which states that the distance traveled is the product of speed by time; as time increases, the faster objects move progressively farther away from the slower ones. That corollary should apply to any field of skill learning, from traditional school subjects, to crafts, arts, technology, games, sports, and so forth.

The widening-gap phenomenon has been mentioned regularly in the educational literature. Kenny (1974, as cited by Lohman, 1999) dubbed it the “fan spread effect.” Jensen (1991) perceived it as a ubiquitous phenomenon: “So consistently has [it] been found that it could almost be called The First Law of Individual Differences, to wit: In achievements that do not have a low performance ceiling, instruction that succeeds in raising the group mean also increases the variance among individuals” (p. 178). And Eisner (2002) recently restated the widening-gap phenomenon as a desired goal in his vision of what the best schools should look like:

*The kind of schools we need* would not hold as an ideal that all students get to the same destinations at the same time. They would embrace the idea that good schools increase the variance in student performance and at the same time escalate the mean. . . . Individuals come into the world with different aptitudes, and, over the course of their lives, they develop different interests and proclivities. In an ideal approach to educational practice . . . each youngster would learn at an ideal rate. . . . Over time, the cumulative gap between students would grow. Students would travel at their own optimal rates, and some would go faster than others in different areas of work. (p. 580)

While testimonies recur, detailed quantitative examinations of this widening-gap phenomenon remain elusive. Biemiller (1993) did present a graph where the fan spread was evident, but he did not discuss it in his text. Others (e.g., Petersen, Kolen, & Hoover, 1989) have shown similar graphs, but again without any detailed analysis. Interestingly, this phenomenon has been the focus of a controversy among psychometricians involved in the construction of standardized achievement tests. The debate appears to oppose those who have adopted item-response theory (IRT) models to select items and create systems of norms and test specialists who work within the framework of classical test theory (Hoover, 1984, 1988; Phillips & Clarizio, 1988; Yen, 1988). The debate originated from the observation that IRT-made achievement tests do not show the widening gap so clearly visible with the other types of tests, for instance the Iowa Tests of Basic Skills (ITBS; Hoover, Dunbar, & Frisbie, 2001). In spite of various analytical efforts (e.g., Schulz & Nicewander, 1997; Yen & Burket, 1997), the reasons for such a large discrepancy in measurement results remain unclear.

It is beyond the scope of this article—and the expertise of this author—to discuss the technically sophisticated arguments advanced by both sides in defense of their divergent positions. What seems clear to those who endorse the dynamic corollary stated above is its logical necessity: When left free to express themselves, individual differences in learning pace must generate the fan-spread effect. The dynamic corollary questions theoretical grounds any assessment system that does not produce the widening gap postulated by individual differences in learning aptitudes. Consequently, until further analyses bring forth a satisfactory explanation, I will maintain my conviction that databases showing a fan-spread effect represent more accurately the reality of individual differences in academic achievement, as well as their evolution over time. This is why this empirical analysis of both the static and dynamic corollaries uses the ITBS data, more specifically, the developmental standards scores (SS) created as part of that test’s system of norms (Hoover, Hieronymus, Frisbie, & Dunbar, 1993).
Describing the Database

The ITBS and Its Developmental Standard Scores (SS)

The Iowa Tests of Basic Skills are a series of standardized achievement test batteries designed to assess basic academic learning from kindergarten to 9th grade. Three major types of batteries exist: the Complete Battery, the Core Battery, and the Survey Battery, each one somewhat shorter than the preceding one. The Survey Battery is composed of three 30-minute subtests: Reading, Language (e.g., spelling, punctuation, usage), and Mathematics. Two parallel forms are available (K & L); each has tests ranging over at least eight successive age levels (7 to 14), thus covering students from grades 1 to 8. Norms have been prepared to compare students from the end of grade 1 to the end of grade 9. Different types of norms are offered: percentiles, grade equivalents, stanines, and developmental standard scores (SS). There is a SS scale for each test in the Survey Battery, as well as for the total score. These SS scales appeared very appropriate to examine the magnitude of individual differences both within and between grade levels.

The SS scale was designed to track student progress from grade to grade (Jorgensen & McBee, 2003). It was created through a statistical procedure analogous to the absolute scaling technique developed long ago by L. L. Thurstone (see Anastasi & Urbina, 1997). Petersen et al. (1989) briefly described and discussed developmental standard score scales, pointing out that their construction is based “on a psychometric model that is intended to produce an ‘equal interval’ scale” (p. 236). Basically, the technique consists in administering a subject matter achievement test to a large representative sample of students in two adjacent grades. The difference between the respective average performances of the two groups will indicate the amount of improvement from one grade to the next. The same comparison can be made with different subject matters and different pairs of grade levels. Sophisticated statistical analyses lead to the creation of a new single scale that measures annual improvements in learning, for groups as well as individuals, within a range of grade levels. It is called “developmental” because it allows direct comparisons between students from different grade (or age) levels. The SS scores can be standardized on any system of units that the test authors consider more practical. In the case of the ITBS Survey Battery, the developmental scores were statistically standardized by arbitrarily giving the value 200 to the average performance (raw total score) of end-of-year grade 4 students and the value 250 to the corresponding average score at the end of grade 8 (shown in italics in Table 1). In other words, the authors decided arbitrarily that a 50-unit difference would represent 4 years of average progress in academic learning. All other SS scores are statistically adjusted to these two anchor points.

Petersen et al. (1989) questioned the validity of SS scores, judging them to be based on doubtful assumptions (e.g., the normal distribution of within-grade achievement) and less useful educationally than grade-equivalent scores. Still, their continued presence among the different types of norms offered by most commercial test publishers (e.g., the Stanford Achievement Tests, the Metropolitan Achievement Tests) confirms their perceived usefulness for specific purposes, especially longitudinal comparisons. “SSs can be averaged for making group comparisons and for monitoring the change of grade groups over time” (Iowa Testing Programs, n.d.). Moreover, the comparisons involve SS values computed from large representative samples of thousands of students, which minimizes measurement error.

Presentation of Table 1

Among the tables of norms prepared for the Survey Battery (Hoover et al., 1993), I selected the “Student Norms: Developmental Standard Score to National Percentile Rank Conversions” for grades 1–9, based on the Spring 1992 National Standardization Sample (see pp. 80–102). Consequently, the student performances discussed will correspond to end-of-year achievements. To illustrate the magnitude of individual differences, I chose nine achievement levels for each grade level: the minimum and maximum SS scores observed in the standardization sample; the average SS score, corresponding to a percentile rank of 50; the two SS scores (P25 and P75) that bracket the middle half of the student population; the four SS scores that identify the top 10% and 2% (P90 and P98), as well as their mirror images (P10 and P2) at the bottom of the distribution. The P90 and P98 reference points were chosen to represent both a more generous and a more selective threshold for academic talent (Gagné, 1998). I included their mirror images (P2 and P10) to permit various symmetrical comparisons.

The top section (A) is the heart of Table 1; most examples will be drawn from it. Section A presents the SS scores for each achievement level (rows A.1 to A.9) in each of the nine grade levels (columns 1–9) included in the Spring ITBS norms. Note that the ITBS develop-
Table 1
Developmental Standard Scores (SS) for the ITBS Survey Battery Total Score for Various Achievement Levels in Grades 1 through 9, with Range and Growth Indices between Various Pairs of Values

<table>
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<th>Grade Level</th>
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Section A: Achievement levels

1. Min DS 110 120 130 140 140 140 150 150 150 40  .36
2. P_{25} 127 140 149 159 167 175 184 187 192 65  .51
3. P_{50} 135 149 161 171 181 189 199 204 211 76  .56
4. P_{75} 143 158 172 185 196 206 216 224 232 89  .62
5. P_{90} 150 169 186 200 215 228 240 250 260 110 .73
6. P_{95} 160 180 201 220 237 251 266 277 287 127 .79
7. P_{max} 169 191 213 234 253 271 285 297 306 137 .81
8. P_{98} 179 203 225 249 269 288 302 314 324 145 .81

Section B: Adjacent ranges

1. Min/P_{25} 25 29 31 31 41 49 49 54 61 36 1.44
2. P_{25}/P_{50} 15 20 25 29 34 39 41 46 49 34 2.27
3. P_{50}/P_{90} 19 22 27 34 38 43 45 47 46 27 1.42
4. P_{90}/Max 30 38 46 55 56 58 54 62 63 33 1.10

Section C: Symmetrical ranges

1. P_{25/75} 17 22 29 35 41 45 50 53 55 38 2.24
2. P_{10/90} 34 42 52 63 72 82 86 93 95 61 1.79
3. P_{98} 52 63 76 90 102 113 118 127 132 80 1.54
4. Min/Max 90 110 130 150 170 190 190 210 220 130 1.44

Section D: Ratios from Section C (in %)

1. C.1/C.4 19 20 22 23 24 24 26 25 25 n/a
2. C.2/C.4 38 38 40 42 42 43 45 44 43 n/a
3. C.3/C.4 58 57 58 60 60 60 62 61 60 n/a

Note. Except for the Min/Max and P_{90/Max} ranges, which include both extreme values, all range measures exclude the upper value, while all growth measures exclude the lower value.

mental scale ranges from a minimum of 110 (minimum SS at the end of grade 1) to a maximum of 369 (maximum SS at the end of grade 9). Sections B and C include two sets (adjacent and symmetrical) of within-grade range values; they show in SS scores the achievement range between the two performance levels chosen. The four adjacent ranges in Section B correspond to the following subgroups of students: (a) the bottom 10%; (b) the next 40%; (c) the 40% just above the midpoint SS score; (d) the top 10%. The four symmetrical ranges in Section C bracket (a) the middle 50% (P_{25/75}) of the within-range population, (b) the middle 80% (P_{10/90}), (c) all students but the extreme 2% (P_{98}), and (d) the total range of SS scores (Min/Max).
Section D (ratios) presents the percentage of the total (Min/Max) range covered by the three other symmetrical ranges. For instance, row D.1 shows a value of 19% in grade 1, which represents the proportion of the Min/Max range (90 units) covered by the $P_{25,75}$ symmetrical range of 17 units. In other words, the middle 50% of the grade 1 student population covers only 19% of the total range of SS scores for that particular grade level. Similarly, the value of 60 on row D.3 for grade 5 means that the range of values between $P_2$ and $P_{98}$—96% of the total student population—represents only 60% of the total range. Said differently, the combined range for the top and bottom 2%—just 4% of the student population—covers no less than 40% of the total range of SS scores for that grade level. Finally, the two right-hand columns contain achievement growth values from grades 1 to 9; both raw values (grade 9 SS score minus grade 1 SS score) and growth metrics (raw growth/grade 1 SS score) are shown. For example, row A.5 shows a raw growth of 110 (260 - 150), which represents the increase in academic learning between grades 1 and 9 for average students. That increase corresponds in turn to a growth ratio of 73% (110/150) over these 8 years of schooling. Note that the growth values in Sections B and C must be interpreted as changes in achievement ranges from grades 1 to 9. In other words, they illustrate the growth of the achievement gap within various subgroups of the student population.

**Interpreting SS scores**

The ITBS Survey Battery includes subtests in reading, language, and mathematics, the major subject matters in the elementary and middle school curriculum of most educational systems worldwide. Consequently, any SS total score can be interpreted as a good approximation of the level of basic academic knowledge and skills (BAKS) attained. The better the students’ mastery of the language and math concepts taught in school from grade 1 up (those assessed by the ITBS Survey Battery), the higher their scores will be on the SS scale. For the SS scale to be intrinsically valid, a given SS score must convey approximately the same meaning whatever the grade level of the students who obtain it. That assumption is supported by the ITBS psychometricians themselves when they state: “A student’s score of 230 on ITBS Reading Advanced Skills means the student’s reading level is like that of a student who has just finished sixth grade” (Hoover et al., 1993, p. 12). Whether that 230 belongs to a student in grade 4, 6, or 8, its developmental meaning remains the same. That basic interpretive rule can be stated as follows: *A given SS score represents a similar level of basic academic knowledge and skills (BAKS) whatever the grade level of the student receiving that score.* For instance, we observe in Table 1 a SS score of 199 as the maximum SS score for grade 1 students, a SS score of 200 for average grade 4 students, and a SS score of 199 setting apart the bottom 10% ($P_{10}$) of grade 7 students. These three scores correspond to similar academic knowledge mastery, even though we are comparing the highest achievers in grade 1 with average 4th graders and low achievers in grade 7.

But, there is more. Because the ITBS SS scale was built to approximate an equal interval scale, differences between pairs of scores can be compared. For instance, we observe in row A.5 of Table 1 a 50-point difference between average grade 4 and grade 1 students (200 - 150) and a similar 50-point difference between these same average grade 4 students and average grade 8 students (250 - 200). This can be interpreted as follows: Students learn on average about as much during the 3 years between grades 1 and 4 as they do during the 4 years between grades 4 and 8. In other words, there is a slow decrease in the pace of learning from the beginning of elementary school to the beginning of high school. The ITBS psychometricians gave that exact interpretation to the data when they stated, “The main advantage of the developmental standard score scale is that it mirrors reality better than the grade-equivalent scale. That is, it shows that year-to-year growth is usually not as great at the upper grades as it is at the lower grades” (Hoover, Hieronymus, Frisbie, & Dunbar, 1994, p. 53). When ranges differ in size, the smaller range does indicate a smaller progress in BAKS learning. But, the interpretation of these differences requires caution: Because of the controversy over the equality of intervals in SS scales, few scholars would agree that a 50-unit range means exactly twice as much progress as a 25-unit range. Differences must be looked at as approximations of proportions.

**Observations**

This section first covers the two questions identified in the problem statement, then adds a few peripheral, yet relevant observations. In the presentation of most examples, I allowed myself a small methodological “misdemeanor.” The data in Table 1 are cross-sectional; they were obtained at a given point in time from different students in each grade level. But, I present them “metaphorically” as longitudinal trends, as if they represented the
successive performances of students who had been followed during the 8 years of schooling covered by these norms. For instance, looking at row A.5 (P_{10}), I describe the progress of “average students” as if the SS values on that row came from the same group of individuals. Or, looking at row A.9 (Max SS), I discuss the yearly progress of the “highest achievers.” While such metaphors are technically incorrect, I believe them to be justified by the fact that this large sample includes thousands of individuals whose academic performances over this 8-year period would follow stable patterns above or below average performances.

**The Magnitude of Individual Differences**

I found that the 50-unit range between the two anchor points can serve as a useful and meaningful yardstick when examining the values in Section A of Table 1. Recall that the authors of the SS scale chose as anchor points the average raw scores of grade 4 and grade 8 students. These two means were arbitrarily given the values 200 and 250 respectively when the SS scale was created. All other scores were adjusted to fit these two anchoring points, just like the way artists have to readjust proportions when redrawing a picture on a different scale. For instance, if some students in grade 7 perform on the ITBS at the same level as average 4th graders, they will receive a SS score of 200. As shown in Table 1, grade 7 students at the P_{10} level had a score of 199, almost identical to the grade 4 average; it means that approximately 10% of the lowest achievers in grade 7 performed below average grade 4 students. Said differently, the data in Table 1 show that 10% of grade 7 students are lagging behind by at least 3 full years. Finally, keep in mind that a 50-unit discrepancy on the SS scale represents 4 years of average academic progress, as measured between grades 4 and 8.

Comparisons can be made either within a particular grade level (vertically) or between grade levels (horizontally or diagonally). Since both perspectives cannot be easily isolated, I have mixed them below. Here are just a few observations that stand out when we apply the 50-unit yardstick to the Table 1 data.

1. In grade 1, the top half of the score distribution covers 50 units (150–199). The best achievers in grade 1 are at least 3 years in front of their average peers, since they perform at the level of average grade 4 students. Note also that the total range of SS scores among grade 1 students (110–199) equals the BAKS discrepancy between average grade 1 and grade 7 (150–240) students, which corresponds to 6 years of average academic learning.3

2. In grade 2, there is a 50-unit range just within the top 25% of the student population (180–229). In other words, the very best students are about 3 full years more advanced than those at the 75th percentile, and they are 4 years more advanced than the average 2nd grader, since their SS score of 229 equals that of average grade 6 students.

3. In grade 3, the most academically talented students (SS = 259) have caught up with average grade 9 students (SS = 260); this represents a 6-year academic advance over average 3rd-grade peers.

4. From grade 4 up, the range within the top 10% (253–309) exceeds the 50-unit yardstick. In other words, even within the academically talented population, the range of academic progress varies by many years of regular learning.

5. The achievement gap among 5th graders covers almost two thirds (65%) of the total range of 260 SS units (110 to 369); it signals large achievement overlaps between grades. For example, the slowest 5th graders (SS = 140) achieve below average grade 1 students (SS = 150); by contrast, the best 5th graders (SS = 309) achieve at least as well as the top 10% (P_{10} = 306) of 9th graders. Finally, half of the grade 5 students (SS ≥ 215) outperform at least 10% of the grade 9 population (P_{10} = 211). The range of SS scores among the top 2% of 5th graders (309 – 269 = 40 SS units) is equivalent to almost 3 years of average progress in BAKS. In other words, the very best achievers in grade 5 are 3 years more advanced academically than those who already surpass 98% of their peers. Moreover, at least 5% of grade 5 students (see rows A.7 and A.8) outperform average grade 9 students.

6. In grade 7, the 50-unit yardstick corresponds to the range of performances within the middle 50% of that student population (216–266). Even if we exclude the low (bottom 25%) and high (top 25%) achievers, the range of SS scores covers many years of regular BAKS learning.

7. When we look at the grade 9 data, we observe almost a 50-unit range (324–369) just within the top 2% of that student population.

8. The achievement range within the bottom 10% of 5th graders (41 SS units, row B.1) is larger than the corresponding range among the next 40% of below-average students (P_{10} \times 100 = 34, row B.2). Similarly, the achievement range among the top 10% of grade 5
students (56 SS units, row B.4) is almost 1.5 times larger than the equivalent range among the next 40% of above-average students (P_{50/90} = 38, row B.2). Note that these two observations apply to all grade levels in Table 1. The above observations emphasize the fact that, in a normal distribution of achievement scores, the more extreme zones (e.g., + 1.5 SD) represent at least as high a percentage of the total range as those closer to the mean. This is readily observable in the Section C and D data in Table 1. For instance, a range of 72 SS units (row C.2) covers the academic achievement of 80% (P_{10/90}) of the 5th-grade population. These 72 units represent only 42% (row D.2) of the total grade 5 range. In other words, in order to include just the bottom 10% (41 SS units, row B.1) and top 10% (56 SS units, row B.4) of that cohort, we need almost 60% of the total range (97 units). Similarly, we need 40% (67 SS units) of the total range just to include the bottom 2% (27 SS units) and top 2% (40 SS units) of the 5th-grade population (compare rows C.3 and C.4).

**Evidence for a Widening Gap**

Section C of Table 1 contains the most relevant information concerning the widening-gap hypothesis. Looking first at row C.4, it can be seen that the within-grade achievement range—the distance between the lowest and highest achievers—increases from 90 SS units in grade 1 to 220 SS units in grade 9, an increase of 250% over these 8 years of schooling. Not only does the full range expand, but so do partial ranges, as shown in rows C.1 to C.3. For instance, the range of achievements in SS units for the middle half (P_{25/75}) of the student population grows from a span of 17 units in grade 1 to 55 units in grade 9. That central portion of the score distribution more than triples in width (growth ratio = 2.24) during these 8 years.

In line with the D = S x T physics analogy, there should be regularity in pace of learning differences: As the learning aptitudes increase, which can be approximated through individual differences in grade 1 achievements, so should the learning pace. The growth ratios (rightmost column in Table 1) constitute a good measure of learning pace. The lowest achievers (row A.1) show a pace of .36 (40/110), which means that, in 8 years of schooling, they increase their baseline BAKS by only a third. That same rate increases to .73 (110/150) for average students and to .85 (170/110) for the most academically talented (row A.9), almost twice their already high baseline. Note the strong increase in ratio in spite of the fact that the baseline SS scores (grade 1) almost double (110 to 199) from the bottom level (Min SS) to the top one (Max SS). The 8-year growth of just 40 SS units among the slowest students equals what students at the threshold of the top 25% of students (P_{75} row) will acquire in just 2 years, between grades 1 and 3 (from 160 to 201). As already mentioned, it brings these very slow learners barely to the BAKS level of average 1st graders. In the case of the top achievers (Max SS row), the growth in basic academic knowledge over 8 years is 170 SS units, more than four times that of the slowest students. The widening gap is also evidenced by a regular increase of very talented students—those with at least 2 years of BAKS advance. Their number grows from approximately 1% in 1st grade (SS ≥ 186) to approximately 33% in 7th grade (SS ≥ 260). At the same time, there is a parallel increase in the percentage of very low achievers—those lagging at least 2 full years behind average level; it grows from 2% in 3rd grade (SS ≤ 150) to approximately 35% in 9th grade (SS ≤ 240).

Similar increases can be observed in Section B for various ranges of scores. For example, the achievement gap between P_{10} and P_{90} students (row B.2) is just 16 SS units in grade 1, but triples to 49 SS units by grade 9. Figure 1 illustrates the phenomenon very clearly. The
curves reproduce Section A data for five of the nine achievement levels; spaces between these five curves represent the four adjacent ranges shown in Section B. Finally, we can examine the widening gap through longitudinal range comparisons. The question becomes, “How much of the 260 SS-unit total range is covered by the yearly ranges?” In 1st grade, the 90-unit range equals about 35% of the total range; by 5th grade, the gap has increased to 170 SS units, almost two thirds of the total range. In grade 9, the Min/Max range of 220 SS units covers no less than 85% of the total range. It confirms that the fan-spread effect results from both limited progress by the very slow learners and rapid progress by the very fast ones. The much larger variability is highly visible in Figure 2, which illustrates the SS score distributions for these three grade levels. Because it shows the “bell curve” shape of the SS score distribution, as well as the bottom and top 10% cutoffs, Figure 2 synthesizes very nicely both the magnitude of the individual differences and the widening-gap phenomenon.

Additional Observations

While not directly related to the core questions, the following observations have enough practical implications to justify including them in this text. They concern (a) the slow yearly decline in learning pace, and (b) the “relatively slow” progress of the most talented students.

Yearly Decrease in Learning Pace. Recall our earlier quote from an ITBS manual (Hoover et al., 1994) in which the authors argued that “year-to-year growth is usually not as great at the upper grades as it is at the lower grades” (p. 53). Indeed, Table 1 shows that average students progress by 19 SS units during grade 2, but by only 10 SS units during both grades 8 and 9. Does that longitudinal trend apply to all achievement levels? Table 2 shows, for the Section A data from Table 1, the amount of progress during each half of the 8-year schooling period covered in Table 1, as well as the ratio of the second value over the first. These ratios represent the rate of progress observed during the second 4-year period as a

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Figure 2. Distribution of SS scores in grades 1, 5, and 9

percentage of the corresponding rate during the first half. Except for the two extreme groups, the ratios cluster within the 0.6 zone, with a slight inverted curvilinear trend having its maximum in the middle group (.69) and slowly decreasing toward the extremes. Since the SS scale only approximates an interval scale, we cannot interpret the .69 ratio as meaning that the pace of learning decreases by 31% over the grade 6–9 period as opposed to the grade 2–5 period. But, just as the ITBS psychometricians did in the twice-quoted statement, we can infer that the average learning pace observed between grades 6 and 9 has “decreased significantly” when compared to the previous 4-year period.

Slower Rate of Progress Among the Talented. Observations in the past pages have shown a strong positive relationship between grade 1 achievement and learning pace: The brighter early achievers progress faster during the following years. Stated quantitatively, the first of the two Growth columns in Table 1 (raw differences) reveals that the highest achievers’ progress over 8 years (170 SS units) is 4.5 times faster than that of the lowest ones (40 SS units). But, other data paint a different picture. For example, let us look at the growth ratios in the rightmost column of Table 1. As expected from the widening-gap hypothesis, the values increase regularly from the lowest achievers, who improve their BAKS by only 36%, to the most academically talented, who increase their baseline SS score by 85%. However, these percentages do not increase linearly; they follow a negatively accelerated pattern. Within the bottom half of the student population, the growth rate doubles from .36 to .73; thereafter, it trickles down to .12 (.73 to .85). In other words, whereas there is a significant and regular increase in learning pace from the lowest achievers to the average learners, that increase (the pace of the pace) slows drastically among the brighter students. Because of the large size of the ITBS national standardization sample, these differences can be considered very significant. These changes are better observed in Section B of Table 1. The ratios for the range increases reveal that those who achieve in the top 10% (row B.4) widen their relative spread much less (1.10) than the two preceding groups (2.27 and 1.42, respectively). These differences between the four adjacent pairs can be clearly seen in Figure 1.

The most striking evidence for this selective slowdown appears in Section B of Table 2. The ratios show that the range of achievements within the bottom 10% increases slightly during the second half of the 8-year period (1.25) and that it decreases only slightly (.83) among the large group of below-average students, although it almost stops widening (.40 and .27) within each of the two above-average groups. The Table 1 data show the yearly changes. Note how regular they are within the P_{50/50} subgroup (row B.2) and how different the change is within the P_{50/90} and P_{90/Max} subgroups. In these two cases, the range of scores increases at first rapidly, then almost levels off. In the P_{90/Max} group, the leveling occurs in grade 7, whereas the range levels off at 55–60 SS units as early as grade 4 in the top 10% group of talented students (see Figure 1).

Summary

1. Individual differences in academic achievement are very large. For most grade levels in the K–12 curriculum, the range exceeds the 110 SS-unit span of basic academic knowledge and skills (BAKS) separating average 1st-grade students from their 9th-grade peers. In other words, for any grade above 2nd grade, the within-grade student population differs more in terms

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of academic achievement than the 8-year difference observed between average 1st and 9th graders.

2. Individual differences in academic achievement are already quite large by the end of grade 1 (90 SS units); they equal the 91-unit 7-year gap between average 2nd graders and 9th graders.

3. There is more individual variability within the top 10% (and the bottom 10%) of the school population than among the middle 50%.

4. Over the first 9 years of schooling, the data reveal a significant widening of the gap between the lowest and highest achievers: From the end of grade 1 to the end of grade 9, it widens by about 250%.

5. Students from all achievement levels contribute to the widening process, but high achievers contribute more than low achievers (see growth ratios in Table 1). This trend indicates a strong positive relationship between early academic achievement and the learning pace observed over the following school years.

6. The ITBS norms show evidence of a slow, but steady decrease in the pace of learning from one school year to the next. Represented by the yearly growth in basic academic knowledge and skills acquired by average students, that learning pace decreases by almost 50% from grade 1 to grade 9. That decrease affects students from all achievement levels.

7. Finally, although the most talented students (those in the top 10% of their grade cohort) progress at a faster pace than their less-talented peers, they advance more slowly than expected considering the pace observed at other achievement levels. They also appear more affected than less-talented students by the phenomenon of yearly decrease in learning pace.

Discussion

Because it implicitly covers the question of within-grade individual differences in achievement, the following discussion will focus on the widening-gap phenomenon. The fundamental question raised by the above observations is one of validity, namely the accuracy of the gap’s size and growth as observed through the ITBS norm data. This question will be examined from both intrinsic and extrinsic perspectives.

Intrinsic Validity of SS Scores

I have already mentioned the existence of a theoretical and technical debate over the metrics of development-
most top achievers remain in regular classrooms because so many school districts do not favor ability grouping (Cox, Daniel, & Boston, 1985), the small number of students beyond the P95 level means that the best students in typical classrooms would rarely exceed the P95 SS scores. At the lower end, many of the slowest students are progressively transferred to special classes (no doubt in spite of mainstreaming policies), again reducing the range to some extent. Consequently, the usual range of BAKS within regular classrooms probably varies between the P98 and P000 values on rows C.2 and C.3 of Table 1. What it means concretely is that a typical grade 2 teacher, for instance, probably encounters a range of achievements equivalent to at least 50 SS units (from approximately 145 to 195); it is just half of the total range, but still the equivalent of almost 4 years of average school learning. That typical range grows to approximately 115 SS units in grade 9, still only half of the total range, but the equivalent of the knowledge gap separating average 1st and 9th graders.

The Underestimation Perspective. This counterpart argumentation is based on two distinct pieces of evidence: (a) the lack of academic challenge experienced by talented students, especially in middle schools and high schools, and (b) outstanding achievements by these talented students as shown in various programs of out-of-level testing. Concerning the lack-of-challenge question, various surveys have shown that the large majority of academically talented students receive little support from their school environment to help them develop their abilities to the fullest. On the one hand, one of the most extensive surveys of school district practices (Cox et al., 1985) revealed that ability grouping remained an exceptional administrative provision and, when adopted, was rarely backed by appropriate curricular enrichment to adjust the content and pedagogy to the faster learning pace. On the other hand, teachers in regular classrooms offer little enrichment to accommodate the individual needs of students, including the academically talented (Archambault et al., 1993). Even worse than this lack of enrichment, there is evidence that recent educational reforms have reduced the density of the K–12 curriculum, a phenomenon commonly labeled “the dumbing down” of the school curriculum (Reis et al., 1993). Basically, detailed comparisons of before-and-after curricula indicated that concepts formerly taught in a given grade were “upgraded” by one or two grades, thus producing a slower acquisition of basic academic knowledge. There is no doubt that the desire of teachers and other school professionals to minimize the percentage of failing students played a major role in these curricular transfor-

mations. However, this slower pace creates daily “learning jams” that exacerbate the feeling of boredom for those who can learn much faster. And, because the slower pace has cumulative effects, its impact will be more visible during the middle school and high school years. This “dumbing down” could explain, at least partly, the decreasing learning pace observed in the ITBS data, especially its more specific impact on the brighter students. Recall that the range of achievements among the top 10% of students (row B.4 in Table 1) grows steadily between grades 2 and 4, but then almost flattens out; the learning pace during the second half of the schooling period covered by the ITBS norms is only one fourth that of the first half (see Table 2).

The second piece of evidence comes from talent searches, a nationally implemented program of out-of-level testing. These competitions demonstrate that many very bright students create their own enrichment opportunities and progress well beyond what can be measured by traditional standardized achievement tests. Begun in the early 1970s by Julian Stanley (1977) under the acronym SMPY (Study of Mathematically Precocious Youth), the talent searches now reach tens of thousands of middle school and junior high school students yearly (Lupkowski-Shoplik, Benbow, Assouline, & Brody, 2003). Using achievement tests normally administered to students 3–5 years older (e.g., the College Board’s Scholastic Aptitude Test, or SAT, usually administered to grade 12 students and used for college admission, is offered to the top 5% of 7th- and 8th-grade students), the talent searches reveal that this small top slice of the normal curve hides a complete new bell curve of abilities (see Figure 15.1 in Lupkowski-Shoplik et al., p. 171). For instance, the results of the middle school talent search participants average between 450 and 500 on the Verbal and Math forms of the SAT. The score distributions show that at least a third of these young talented 7th and 8th graders outperform average college-bound high school seniors; a few of them even attain or come close to the maximum score of 800. It must be pointed out that they reach these outstanding performance levels without having yet been exposed to the high school curriculum.

Although both pieces of evidence strongly support the underestimation hypothesis, the talent search data conflict with the observed slowing rate of progress among talented students; their out-of-level achievements in both language and mathematics should increase the observed pace from grade 5 onwards among the top 2% of students (see the top curve in Figure 1), thus widening the gap even more. Indeed, if we maintained the learning pace observed
between grades 1 and 5 for the top two curves (P_{95} and Max) in Figure 2, the revised grade 9 values would be 334 (vs. 306) and 419 (vs. 369), respectively. To explain that apparent contradiction, one needs to look at the purpose and content of standardized achievement tests. These tests are designed to assess the large possible span of academic skills in a given grade with a small sample of items. A majority of the items target the knowledge of average or close-to-average students because they constitute the bulk of the school population. Tests administered in lower grades are available to assess the basic academic knowledge of the lowest achievers in middle school and junior high school. In the case of top achievers in junior high school, an appropriate assessment of their real BAKS would require college-level contents. Since it is not efficient to include a significant number of very difficult items to measure a small percentage of high achievers, these students become victims of a ceiling effect. Does this ceiling effect invalidate the quasi-interval nature of the ITBS SS scale? Not at all. It strictly applies to a very small percentage of top achievers and has no relevance whatsoever for all other students. The basic academic knowledge assessed by the ITBS bat tries—and other similar achievement tests—remains the backbone of that instrument, and it is this backbone that gives the developmental SS scale its relevance and meaning. Moreover, the ITBS bat ries correctly measure the BAKS of all students, including the highest achievers. The problem is that, in the data used for the present study, the tests’ content does not exceed the junior high curriculum.

As a counterpoint to the underestimation hypothesis, it could be argued that the 110-unit gap observed between average 8th or 9th graders and their top-achieving peers can hardly be called a ceiling effect. Recalling that the ITBS psychometricians chose a distance of 50 BAKS units to represent 4 years of average academic progress, namely between grades 4 and 8 (250 - 200), it follows that a 110-unit gap corresponds to almost 9 years of academic advance between these average students and top achievers in grades 8 or 9. Even at the P_{95} level, the threshold for the top 2% of the student population, the 64-unit achievement gap (324 - 260) already exceeds 5 years of average progress.

In summary, whether the true differences in achievement are underestimated, as the relatively slower “pace of the pace” of high-achieving students seems to suggest, or whether they are correctly assessed, as evidenced by the huge achievement gap between average and top achievers in junior high school, remains a debatable question. Hopefully, the present analysis will stimulate further studies to better assess the magnitude of individual differences in academic achievement.

**Conclusion**

The fan-spread or widening-gap phenomenon was introduced as a logical corollary of the recognition of individual differences in learning ability, which Jensen (1991) called “the first law of individual differences.” In other words, if students are left free to learn at their own pace, we will observe a growing gap in basic academic knowledge between the slowest and fastest learners. This widening gap was observed and measured using the ITBS developmental standard scores. Additional evidence strongly suggested that the observed range could underestimate the real learning pace of the fastest learners and, consequently, the size of the fan spread. In view of these facts, I find it very strange, even somewhat disturbing, that some standardized achievement tests do not exhibit a widening range of academic achievement over the K–12 school years.

Because of the strong genetic component of individual differences in learning ability and academic achievement (Thompson & Plomin, 2000), the fan spread should be considered akin to a law of nature, a phenomenon that shows strong resistance to any form of human intervention. But, why should anyone want to reduce it? As Eisner (2002) implied in the statement quoted earlier, educators and school administrators should not interpret the widening gap in academic achievement as a failure of the educational system; rather, they should acknowledge its growth as a confirmation that individual differences in learning ability have been recognized and that appropriate provisions have been implemented to respond to them. In so doing, we would simply be heeding Article 26.2 of UNESCO’s (1948) Universal Bill of Rights, which states that “education shall be directed to the full development of the personality.” Indeed, according to our dynamic corollary, the more educators acknowledge and nurture these individual differences in learning pace, even as they do their best to help the slow learners, the larger the achievement gap will grow between the fastest and slowest learners.

**References**


**Author Note**

The author sincerely thanks François Labelle, graphic artist in the Department of Psychology, for his design of Figure 2.

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**End Notes**

1. When educators mention the concept of “achievement gap,” they usually refer to group disparities associated with socioeconomic, cultural, or ethnic differences. For instance, in his seventh annual State of American Education Address, the U.S. Secretary of Education affirmed: “We must look at the stark reality that a continuing achievement gap persists between the rich and the poor, and between whites and minority students. This gap is a gaping hole in our commitment to fulfilling the American promise” (Riley, 2000). One reviewer complained that the application of that expression to individual differences could create confusion, that the expression had acquired a very specific “group difference” meaning. I would argue that a clear definition permits broadening the more common meaning. In fact, others (e.g., Slavin, 2000, pp. 510–511) have used that expression to describe individual differences in academic achievement.

2. That national sample included 170,000 students in grades K–12. These students, approximately 20,000 per grade level, were chosen to represent the general U.S. school population in terms of type of school system (public, private Catholic, private non-Catholic), SES of parents (five categories, ranging from high to low), size of school district (seven categories, ranging from 50,000+ to <1,200), and geographical region (New England/Mideast, Southeast, Great Lakes/Plains, West/Atlantic). Such a large sample guarantees stable norms, as well as a precise assessment of the size of individual differences. Three sets of norms are available for the ITBS Survey Battery: Fall, Midyear, and Spring. I chose the Spring norms (test administration between March and May) because (a) they give norms for end-of-year grade 1 students, allowing one more grade for comparison purposes, and (b) it is more normal to think of end-of-year achievement than any other period during the school year.

3. One reviewer observed that the Min/Max range (row C.4 in Table 1) was an unreliable measure because of the very small number of students close to either end of the score distribution for each grade level. I would argue that a sample size of 20,000 for each grade level (see above note) translates into a sample size of 400 students just within the top or bottom 2% of the distribution. Such large numbers ensure stability, and that stability can be seen in the regularity of yearly changes in rows A.1 and A.9.
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