Journal of Advanced Academics
jaa
Volume 19 ✣ Number 4 ✣ Summer 2008 ✣ pp. 602–632

A Text Readability Continuum for Postsecondary Readiness

Gary L. Williamson
North Carolina Department of Public Instruction

Over the last 3 decades, a number of authors claimed that too many students were unprepared for the postsecondary world (e.g., Bock & Moore, 1986; Greene & Forster, 2003; Sum, 1999; U.S. Department of Labor, 1991). To support this contention, some reports focused on student behaviors and attainments, such as high school dropout rates and/or graduation rates (e.g., Greene & Forster, 2003; Horn, 1998). Some focused on analogous later events, such as the rates at which college students require remediation or fail to complete their programs of study (Parsad & Lewis, 2003; Rosenbaum, 2004). Others focused on the skill demands of the workplace in contrast to what students have been taught in school (Parker, 2004; Pennsylvania Department of Education, 2004). Still others focused on the literacy demands of citizenship (Kirsch, Jungeblut, Jenkins, & Kolstad, 1993). Traditional indicators of college readiness have included college transcripts, student course completions, and student performance (McCormick, 1999; Sanderson, Dugoni, Rasinski, Taylor, & Carroll, 1996).

However, no one has examined the text demands of high school in contrast to those of college, the workplace, the mili-

Summary

Although high school graduates may be able to successfully navigate high school course content, they may not be prepared to handle the readability of texts they encounter in various postsecondary endeavors. The average readability of high school texts is lower than the average readability of citizenship, workplace, community college, university, and graduate admissions text collections. Previously successful students can appear to be unprepared after high school simply because their reading skills are insufficient for postsecondary texts. Students reading at the highest difficulty levels of high school texts should be able to access the majority of texts in workplace and community college text collections and perhaps as much as 75% of the texts in military and citizenship text collections. However, students reading at the level of the more typical high school texts may be comfortable with only about one fourth of the reading materials in military, citizenship, and workplace text collections and perhaps as little as 5% of postsecondary texts. A graduating high school senior who is confidently reading (with 75% comprehension) at the average level of 11th- and 12th-grade texts may enter a university 3 months later where the average text readability results in less than 50% comprehension for that student because there is a substantial gap in text demand between widely used high school textbooks and typical postsecondary textbooks. High school students should be exposed to more demanding texts in high school, and they should be provided with support for learning the reading skills necessary for reading postsecondary materials. Additionally, educators should strive to achieve better alignment between the reading demands of high school and the postsecondary world.

Williamson, G. L. (2008). A text readability continuum for postsecondary readiness. *Journal of Advanced Academics, 19,* 602–632.

tary, and citizenship to determine if there is a gap in text readability requirements. If such a gap exists, then a lack of student preparedness could be a function of different text demands and preparation for those demands, rather than purely a deficiency in student ability. Put another way, high school graduates may be able to successfully navigate high school course content. However, if there is a gap between the readability of high school texts and the readability of texts encountered in various postsecondary endeavors, then previously successful students could still appear to be unprepared after high school simply because their reading skills are insufficient for postsecondary texts.

To fully ascertain whether there was a reading ability gap, a text readability gap, or both would require that both reader ability and text readability be measured in high school and again in various postsecondary contexts. As will be more evident later, differences between student reading ability in high school and postsecondary contexts are difficult to estimate. On the other hand, differences in text readability were directly addressed in this paper. By analyzing a range of textual material from K–12 education, postsecondary education, the military, the workplace, and citizenship, it was possible to more objectively consider whether there was a gap in text readability between these various domains.

However, this investigation of texts was done without losing sight of the reader. The approach to text will suggest a similar effort with respect to students' reading ability in these various roles in an effort to more systematically address the issue of student readiness for life after the K–12 years.

The paper begins with a brief review of literature related to postsecondary readiness, followed by a description of the theoretical framework for the paper. After describing the methodology used to analyze texts, the results describe text demands near the end of high school, at the beginning of postsecondary education, and in the workplace, the military, and selected activities of citizenship. The paper concludes with a discussion of the results, limitations, implications of the study, and suggested next steps.

Review of Literature on Student Readiness

The following subsections summarize selected literature in the area of student readiness. The review has been organized into the domains of K–12 education, postsecondary (13–16) education, the workplace, the military, and citizenship.

Education (K–12)

Student performance in K–12 has been well documented by such national efforts as the National Assessment of Educational Progress (NAEP) and the National Education Longitudinal Study (NELS). The transition from high school to postsecondary education has been explored through such studies as the NAEP High School Transcript Studies (HSTS), High School and Beyond (HS&B), and the National Longitudinal Study (NLS). There have been numerous reports based on the data collected through these efforts (e.g., Carroll, 1988, 1989; Knepper, 1990; Sanderson et al., 1996).

Researchers have acknowledged that formal schooling is related to adult literacy (Kaestle, Campbell, Finn, Johnson, & Mickulecky, 2001) and that schools have an important role to play in setting, promoting, and raising community achievement standards (Bock & Moore, 1986). However, reports (e.g., Grigg, Daane, Jin, & Campbell, 2003; U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2003) of performance on the NAEP have highlighted the relatively small percentages of students in grades 4, 8, and 12 who performed at or above the NAEP *Proficient* level.

Sanderson et al. (1996) concluded that approximately 62% of the NELS:88 eighth-grade cohort pursued college preparation programs, whereas 38% followed a general or vocational track. Based on a study of 1992 graduates, Horn (1998) concluded that about 44% of at-risk students were "at least minimally prepared academically" to attend a 4-year college. Greene and Forster (2003) were less optimistic, claiming that "only 32% of all stu-

dents leave high school qualified to attend four-year colleges" (Executive Summary, ¶ 3).

During the last three decades of the 20th century, a number of states implemented high school testing requirements for graduation. Some of these evolved into exit exams by the turn of the millennium. However, a report published by Achieve, Inc. (2004) asserted there was a gap between such tests and the requirements of colleges and employers and insinuated that such exams were not demanding enough of high school students. Greene (2000) estimated that a lack of basic skills attained by high school graduates was costing the United States approximately $16.6 billion each year.

Postsecondary Education (13–16)

Relatively few sources have measured the actual reading ability of young adults in the domain of postsecondary education. At the federal level, the Postsecondary Education Descriptive Analysis Reports (PEDAR) focuses primarily on policy issues such as access, financing, persistence, and degree attainment. These findings have been integrated with data from HS&B, HSTS, and NELS—see Horn (1998) and McCormick (1999) for examples. Other reports have focused specifically on the issue of postsecondary readiness (Greene & Forster, 2003; U.S. Department of Labor, 1991; Venezia, Kirst, & Antonio, 2003).

A number of researchers have studied college entrance, persistence, and remedial course-taking patterns among college students. Using HS&B data, Carroll (1988) noted that a little less than half of the 1980 and 1982 high school seniors entered postsecondary institutions directly after graduation. In a subsequent study, Carroll (1989) found that about 57% of graduates who immediately entered 4-year colleges persisted full time for 4 years, and about 75% of that percentage of students actually received their bachelor's degrees. Knepper (1990) found that 22% of the 1980 HS&B cohort who entered postsecondary education directly after high school completed a bachelor's degree in 4.5 years. This was nearly 10 percentage points lower than for the

1972 cohort from the NLS:72. Citing previous research, Venezia et al. (2003) recently reported that 88% of 8th graders expect to attend some form of postsecondary education, and approximately 70% of high school graduates actually attend college within 2 years of receiving their high school diplomas. However, remedial rates (though perhaps improving) have remained above 25% for 3 decades. Rosenbaum (2004) calculated that 44% of the class of 1982 and 25% of the class of 1992 took at least one remedial course. The U.S. Department of Education, Institute of Education Sciences, National Center Education Statistics (2003) reported that 28% of entering freshmen in the fall of 2000 enrolled in at least one remedial reading, writing, or mathematics course.

Venezia et al. (2003) provided an insightful evaluation of the institutional and organizational conditions that characterize the transition from high school to college in their report, *Betraying the College Dream*:

> . . . high school assessments often stress different knowledge and skills than do college entrance and placement requirements. Similarly, the coursework between high school and college is not connected; students graduate from high school under one set of standards and, 3 months later, are required to meet a whole new set of standards in college. Current data systems are not equipped to address students' needs across systems, and no one is held accountable for issues related to student transitions from high school to college. (p. 1)

Workplace

In June 1991, the U.S. Department of Labor issued a report based on the Secretary's Commission on Achieving Necessary Skills (SCANS). Based on an analysis of skills in the workplace and an analysis of what was measured by the 1986 NAEP survey of 21- to 25-year-olds, the Department stated that "more than half of our young people leave school without the knowledge or

foundation required to find and hold a good job" (p. i). NAEP did not assess the SCANS competencies, but from this comparison the Department constructed its estimate. Although the report writers admitted that they could not know exactly how many young people lacked the SCANS identified skills, their estimate persists.

Fortunately, further research has been conducted to investigate the requirements of the workforce. The International Center for Leadership in Education (ICLE) collected samples of reading materials from numerous occupations cutting across 16 career clusters identified by the U.S. Department of Education. They measured the readability of the materials and made the information available to states and educators. These data are described further in the methodology section because they have been incorporated into this research.

In a recent study, the Pennsylvania Department of Education (2004) evaluated its curricular materials against the materials accumulated by ICLE. It found that "society in general and the workplace in particular demand higher levels of reading proficiency than schools" (p. 3). In a news report that same year, Parker (2004) stated, "Many high school sophomores and seniors had difficulty reading above a 1,000 Lexile [denoted 1000L] rating, according to [Florida] state testing" (¶ 19).

Military

The U.S. Department of Defense (1998) found that reading levels were higher in the enlisted military than in the nonmilitary sector. They characterized the mean reading level of active duty personnel without prior military service as typical of an 11th-grade student compared to a mean for civilian youth that was in the range of 10th graders. By comparison, note that typical reader measures were approximately 940L–1210L for 11th to 12th graders and approximately 905L–1195L for 10th graders (MetaMetrics, 2007).

In a study of performance on the Armed Services Vocational Aptitude Battery (ASVAB), Bock and Moore (1986) found

that performance remained near the level of the highest grade completed in school. They concluded, "failure to complete high school argues poorly for meeting vocational test standards at a later time through informal learning and experience" (p. 113).

Citizenship

The 1992 National Adult Literacy Survey (NALS) measured prose, document, and quantitative literacy with a national sample of adults. Kirsch et al. (1993) reported that 21–23% of respondents had skills in the lowest level (Level I) on the three types of literacy. About 25–28% had scores in the next highest level. Sum (1999) noted that those in the labor force had higher scores on the NALS prose, document, and quantitative literacy scales than those who were unemployed; however, more than 40% of those in the labor force had literacy scores in the lowest two levels. Further, less than 5% of the labor force had received any recent training in these skills. Sum concluded dismally, "Together these findings paint a bleak outlook for the future of the United States labor market" (p. xvi).

Research over the last few decades suggests that students are unprepared for postsecondary endeavors, but it has not addressed the issue of whether there is a gap in the text requirements of high school and postsecondary activities.

Theoretical Framework

This paper focuses on whether 11th- and 12th-grade students' exposure to high school texts sufficiently prepares them for textual material they might encounter in their postsecondary endeavors.

The word *readiness* connotes a state of being mentally (or physically) prepared for some experience or action—for example, instruction or reading a book (Ready, n.d.; Readiness, n.d.). For purposes of this article, *reading ability* was conceptualized as a latent cognitive trait that determines an individual's prob-

ability of success in comprehending professionally edited prose text. Although reading comprehension may depend on a variety of factors and conditions (e.g., the purpose for reading, interest level), the assumed primary determinants of reading comprehension were the individual's reading ability and the text's difficulty or *readability*. Thus, reading comprehension was formulated as a mathematical contrast between a person's reading ability and a text's readability (Stenner & Stone, 2004; Wright & Linacre, 1994).

There has been extensive study of text readability since the early part of the 20th century, when readability formulas first appeared (Lively & Pressey, 1923). Accordingly, readability formulas have been the dominant paradigm for measuring text readability; they are typically conceptualized in terms of the semantic and syntactic features of text. Klare (1984) and Zakaluk and Samuels (1988) provided reviews of the literature from this tradition. More recently, other approaches have been developed to characterize text difficulty (Hiebert, 2002, 2005).

For the present work, the Lexile Framework® for Reading was used to determine text readability measures. There were several reasons for this choice. First, readability measures from the Lexile Framework have been shown to correlate highly with measures obtained from traditional readability formulas (Wright & Stenner, 1998; Wright & Stone, 2004). Second, unlike traditional readability formulas, the Lexile Framework measures both reader ability and text readability on a common scale (Stenner, 2003). Third, a conjoint measurement model (Rasch, 1980; Wright & Linacre, 1994) underlies the scale, framing the construct of reading comprehension as a mathematical contrast between reader ability and text readability. Fourth, the text measurement features of the Lexile Framework are integrated with the person measurement features of the Lexile Framework through a construct specification equation (Stenner & Smith, 1982; Stenner, Smith, & Burdick, 1983). Fifth, the Lexile Framework is widely used (Hiebert, 2002).

Lexile measures for students can be obtained from assessments that have been psychometrically linked to the Lexile scale

by means of a formal linking study. Lexile measures for texts can be generated by software that examines an entire text to measure its syntactic (sentence length) and semantic (word frequency) features (Lennon & Burdick, 2004). A Lexile measure expresses the reader's ability, or the text's readability, as a numerical score followed by the letter L. In general, the Lexile scale ranges from about 200L to 1700L although actual Lexile measures can be lower or higher. Additional details about the Lexile Framework for Reading can be found at http://www.Lexile.com.

The sixth reason for using the Lexile Framework in this study was that its use enabled an assessment of student readiness. In the current research, readiness can be quantified by imagining a high school student whose reading ability is well matched to the readability of high school texts and asking, "What is the forecasted comprehension of such a student when he or she encounters a mismatch with text in the postsecondary domains?" Thus, the forecasted comprehension rate provides a numerical characterization of the impact of text mismatch and hence the degree of readiness (or lack thereof).

The seventh and final reason for using the Lexile Framework was that its use lays the foundation for future research related to the issue of readiness. For example, one can envision a time when assessments are linked across the high school and postsecondary spectrum to enable the estimation of an individual trajectory for reading ability that may be compared with the text continuum reported in this paper. In that context, readiness could be quantified by comparing a student's actual reading ability trajectory with the postsecondary text readability continuum (e.g., as suggested by Williamson, 2006). Such a comparison would yield a forecasted comprehension rate on grade-based texts at any point along the individual's trajectory.

Although this paper focuses on describing the postsecondary text continuum, the study was motivated by a concern for students and their readiness for text in the postsecondary world. Because the Lexile Framework for Reading can provide measures for both persons and texts and because both persons and texts are discussed at different points in the paper, the paper's termi-

nology must recognize the distinction between persons and texts in a particular context. To that end, whenever the words *reading ability* are used in this paper, it refers to a person. Measures of reading ability apply to an individual or group of individuals. Whenever the word *readability* is used, it refers to text. Measures of readability apply to a particular text or collection of texts. *Reading demand* connotes the cognitive challenge implied by a text *readability* measure. The words *reading comprehension* refer to the understanding that results when a particular person (or group or persons) reads a particular text (or collection of texts).

Methodology

Identification and Description of Texts

For the secondary education domain, textual sources were drawn from an extensive digital library that has been built and maintained by MetaMetrics, Inc., over the last 20 years. Included in this library were more than 4,400 textbooks used in the K–12 public schools of the United States of America. Each of these texts had been measured on the Lexile scale and possessed a Lexile measure that represented its reading demand or readability.

This paper benefited from a Fall 2005 survey of high school textbooks completed by MetaMetrics, Inc., to improve the representation of high school texts in its textbook database. The survey began with a review of information published by state departments of education in the United States. Based on the similarity of state adoption lists and the relatively small number of textbook publishers used by the states, text collection focused on the adoption titles from five convenient states—North Carolina, Texas, Oregon, Indiana, and Florida. It also was considered beneficial that these five states are dispersed geographically and serve relatively large numbers of public school students. Adopted textbooks were organized into six content categories:

Health, Social Studies, Science, Literature/Reading, Language Arts, and Mathematics.

The major textbook series and their publishers were identified, and all books in a series (i.e., grades 9–12) were included. This list was then matched with the titles in the existing MetaMetrics database to determine which books had already been measured and which would need to be measured. Once the list was established, the most typical books representative of the major publishers and their products were identified, eliminating less common or idiosyncratic books. The selected books that needed to be measured were then acquired and the Lexile measures determined.

Once the textbook database was enhanced with the newly measured high school texts, it contained 175 texts used in the high school grades (9–12); among these, 75 texts were specifically coded as being 11th-grade texts or 12th-grade texts. Those 75 texts were selected for statistical summary for this paper. See Appendix A for a list of selected texts and the corresponding Lexile measures. This paper focuses on texts for the last 2 years of high school and the first 2 years of university or community college to specifically represent the text gap between high school and postsecondary education, if one actually exists.

Questia Media America, Inc., provided the resources for texts used at the beginning of community college and the university (grades 13–14). As a library, Questia primarily included texts used in the humanities and social sciences. For this study, Questia focused on required university courses for the majority, if not all, freshmen and sophomores, and selected 100 titles for analysis. Similarly, they selected 50 titles representing materials that community college students typically encounter.

Texts selected for the beginning (freshman and sophomore years) of university education reflected the content often required in the following courses (among others): American Literature, English Composition, World Literature, U.S. History, World History and Civilization, Psychology and/or Sociology, Philosophy, Understanding Humanities, Music or Theater or

Visual Art Appreciation, Introduction to Business, Introduction to Economics, and Introduction to Education.

For community college, the books selected from the Questia collection represent the variety of materials used in the most popular fields of community college study. The fields of study include: business, social and community service, health, education, design/arts, and technology/science.

Questia assigned Lexile measures to the university and community college texts using software called the Lexile Analyzer, provided by MetaMetrics, Inc. These Lexile measures were provided to the author for inclusion in this study.

In the workplace domain, this study drew upon the previous work of Daggett of the International Center for Leadership in Education (ICLE). Daggett independently analyzed more than 1,400 examples of occupational reading material classified into 16 career clusters identified by the U.S. Department of Education. ICLE used the Lexile Analyzer to determine the Lexile measure for each text and provided the data for inclusion in this study.

For the military domain, reading materials were selected from the U.S. Army Web site. These included: articles from the Army news service and the Professional Writing Collection; a history of the military entitled *225 Years of Service* (Hogan, 2000); the *Soldier's Handbook;* and a selection of field manuals, training circulars, drills, and other documents representing different branches of the armed services. In general, these were official departmental publications available from the General Dennis J. Reimer Training and Doctrine Digital Library. This sample of publications was downloaded from these sites and analyzed to produce Lexile measures, which were statistically summarized for this paper.

Similarly, various materials were examined representing different aspects of citizenship. These included newspapers, the U.S. District Court's *Handbook for Trial Jurors*, material about voting rights and responsibilities from the North Carolina State Board of Elections Web site, the Internal Revenue Service (IRS) 2003 Form 1040 instructions, public online information about state

marriage laws, and the North Carolina Department of Motor Vehicles *Driver's Handbook*. Lexiles calculated by ICLE for 11 similar documents also were included in the analysis. These materials were analyzed to produce descriptive statistics for this paper.

Finally, to add additional perspective, released editions of selected undergraduate admissions tests and the Graduate Record Examination were analyzed for the readability of the text contained on the tests. Representing undergraduate admissions tests were 14 released forms of the SAT I, 4 released versions of the ACT, and 2 released Advanced Placement (AP) English exams. Representing graduate admissions tests were 8 forms of the GRE. The text readability measures obtained from these various admissions tests were analyzed as two text collections: undergraduate admissions tests and graduate admissions tests.

Obviously the choice of materials can have an effect on the results of these analyses. Analyzing all possible materials from the domains of interest would be an unending task. As the study was limited by time, choices had to be made. Available texts were analyzed from the MetaMetrics and Questia databases that conformed to the grade range requirements for the study. All of the workplace materials available from ICLE also were analyzed. Materials from the citizenship realm were chosen to represent typical sources of printed information that most people might encounter in daily life. Materials from the military reflected a variety of sources ranging from the commonplace (e.g., Army post newspapers) to the more technical and tactical. Although not exhaustive, the materials were chosen because they may be representative of the postsecondary domains. To the extent they were not, results should be interpreted with caution.

Application to Text Sources

A Lexile measure was assigned to a text through a two-stage process. First, the entire text was digitized, formatted, and analyzed. All electronic files were formatted according to established guidelines used with the Lexile Analyzer software. Based

Table 1

Analysis of Variance for Text Collections

Source	*df*	*F*	η
Text Collection	7	12.43***	0.22
Within (Error)	1722	(39691.32)	

***Note*. Values enclosed in parentheses represent mean square errors. *** $p < .001$.**

on the lengths of the sentences and the frequencies of the words a Lexile measure was calculated for the text.

The second step in the process was to manually review the Lexile measure for the text in terms of the actual layout of the text and the publisher's reported reading and interest levels (if provided). At this time, a Lexile code was assigned. The Lexile measure and Lexile code of the book were added to the public Lexile Titles Database and reported to the publisher and various trade book distributors (as appropriate).

After Lexile measures were determined for the materials in each text domain, the resulting measures were assembled into a comprehensive database and a series of descriptive and inferential analyses was conducted. The results of text analyses are presented next.

Results

A fixed-effects analysis of variance of the text measures, with text collection as the single factor, showed a significant main effect (see Table 1) that accounts for 4.8% of the variance in the readability measures. Because the interest in this study was in characterizing the text gap between high school and postsecondary text collections, Dunnett's *t* was used for post hoc pair-wise comparisons of average readability, with education (grades 11–12) texts as the reference group. This provided the pair-wise contrasts of interest. That is, each postsecondary text collection was examined to identify the one(s) that had significantly higher

Table 2

Sufficient Statistics, Average Readability Gaps, Effect Sizes, and Forecasted Comprehension Rates Associated with Text Collections

Text Collection	*N*	Mean	*SD*	Readability Gap	Cohen's *d*	Forecasted Comprehension Rate (%)
University	100	1383_a	154	259[b]	1.90	49
GRE	8	1379_a	88	255[b]	2.49	49
Community College	50	1292_a	117	169	1.45	59
Workplace	1401	1248_a	213	125	0.73	63
Citizenship	54	1240_a	92	117	1.12	64
Military	22	1186	118	63	0.54	69
SAT I, ACT, AP	20	1157	94	33[b]	0.32	72
Education (11–12)	75	1123	116	0	—	75

Note. **Subscripted means differ significantly from the mean readability of Education (11–12) texts based on Dunnett's *t* with experiment-wise Type I error rate, α = .05. Means, standard deviations, and readability gaps are expressed in Lexiles. Forecasted comprehension rates are calculated for an individual with reading ability equal to 1123L (the average readability for 11th- and 12th-grade texts). [b]These differences do not match the column of means due to rounding.**

average readability than the 11th- and 12th-grade high school texts. The experiment-wise Type I error rate was controlled at α = .05. Results appear in Table 2.

In Table 2, the text collections were arranged in order of increasing average text readability. The standard deviations indicated about 100L of variability for each text collection except for the workplace materials and the university texts, which showed greater diversity in part because of their larger sample sizes. The column labeled *Readability Gap* displays the difference between the average readability of each postsecondary text collection and the average readability of the 11th- and 12th-grade high school text collection. Five of the gaps are statistically significant—those associated with Citizenship, Workplace, Community College, GRE, and University text measures. The related effect sizes were

considered large according to usual conventions for interpreting Cohen's *d* (Cohen, 1992).

Because the Lexile scale was not an arbitrary psychological metric in the psychometric sense discussed by Blanton and Jaccard (2006) and Embretson (2006), it possessed a general objectivity (Stenner & Burdick, 1997) that made it possible to provide additional practical meaning for the observed results. One such interpretation was provided in the last column of Table 2, which displays the forecasted comprehension rate associated with the average readability measure for each text collection. The forecasts assume an individual whose reading ability is 1123L (that is, an individual whose reading ability was equal to the average text readability of the 11th/12th-grade texts). As text readability increases, the gap between the reader and the text widens and the comprehension rate declines. The table illustrates that an individual who reads the average 11th/12th-grade text with 75% comprehension could expect to have less than 50% comprehension of the average university text.

The distributions of Lexile measures for texts in each domain are shown in Table 3. Figure 1 provides a graphical depiction of the resulting continuum of text readability from high school textbooks to graduate school admissions tests. The text collections were arranged in order of median text measures.

The median readability for texts used near the end of high school (1130L) was lower than the medians for the other text collections. There was a 50L increase up to the readability of undergraduate admissions tests and reading materials for the military. However, there was a larger increase of 100L between the median measures for high school texts and citizenship materials. The gaps between high school texts and workplace materials (130L), community college texts (165L), university texts (265L), and graduate admissions tests (280L) were increasingly larger.

Note in Table 3 and Figure 1 that the GRE text collection had higher median text readability than the university texts. This was in contrast to Table 1, where the average readability of beginning university texts was higher than the average readability of the GRE. This can be attributed to the fact that the

Table 3

Selected Percentiles for Readability Distributions of Different Text Collections

		Lexile Measures Percentiles				
Text Collection	*N*	5th	25th	50th	75th	95th
GRE	8	1248	1323	1410	1440	1466
University	100	1137	1300	1395	1480	1583
Community College	50	1124	1200	1295	1368	1466
Workplace	1401	900	1120	1260	1360	1590
Citizenship	54	1090	1193	1230	1305	1384
Military	22	1013	1105	1180	1235	1388
SAT I, ACT, AP	20	967	1108	1180	1208	1271
Education (11–12)	75	880	1070	1130	1180	1300

small GRE text collection was negatively skewed (-0.83), which affected the mean. The ordering of the medians was more intuitively appealing, as it placed the central tendency of beginning university texts at a lower readability level than the central tendency of GRE text passages.

There was variability within each text collection, and different collections overlapped in their text readability. Upon examination of the various percentiles associated with each distribution, it was encouraging to note that students reading at the highest difficulty levels of high school texts (i.e., the 95th percentile, 1300L) should be able to access the majority of texts in the workplace and community college text collections and perhaps as much as 75% of the texts in the military and citizenship text collections. However, students reading at the level of the more typical high school texts (i.e., the median, 1130L) may be comfortable with only about one fourth of the reading materials in the military, citizenship, and workplace text collections and perhaps as little as 5% of the postsecondary texts.

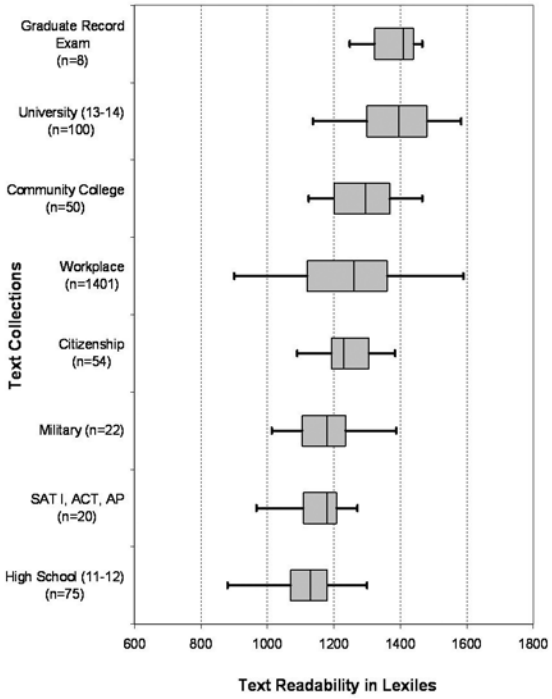

Figure 1. **A continuum of text readability for the transition from high school to postsecondary experiences. The box and whiskers are constructed to display the 5th, 25th, 50th, 75th, and 95th percentiles of the distributions of readability measures.**

Discussion

In terms of their semantic familiarity and syntactic complexity, high school textbooks are less demanding than reading materials likely to be encountered in various postsecondary endeavors typically considered by students. Whether a student aspires to postsecondary education, a job, the military, or merely to be an informed citizen, the reading ability required is likely to be higher than what is typically required in high school (1130L) based on texts that are widely used in this country.

Furthermore, there is a remarkably systematic continuum of increasing text demand that extends from high school texts to

university texts. There are statistically significant increases in text demands from high school texts to citizenship materials, workplace materials, community college texts, and university texts. The overall gap between the readabilities of high school textbooks and university texts is approximately 260L (259L based on averages, 265L based on medians). There are five facts that facilitate an understanding of the magnitude of this difference.

First, Cohen's *d* for the difference in the means is 1.90 (see Table 2). The usual convention for interpreting Cohen's *d* is that 0.8 indicates a large effect (Cohen, 1992). The high school–university text readability gap amply exceeds the requirement to be considered a large effect.

Second, consider the fact that 250L is the difference between 75% comprehension and 50% comprehension of text. This means that a graduating high school student confidently reading (with 75% comprehension) at the average level of 11th- and 12th-grade texts may enter the university 3 months later where the average text readability results in less than 50% comprehension for that student.

Third, consider the observed 260L difference in light of the fact that the range of grade-level median text readabilities across the 4-year span of high school is approximately 100L (Williamson & Koons, 2007). University-bound high school students who have experienced roughly 100L increase in text readability in 4 years of high school can expect to experience a 260L increase in readability demands within approximately 3 months of graduating.

Fourth, the increase in median reading ability of students across grades 9–12 is 100L based on norms for the Scholastic Reading Inventory (E. S. Sanford-Moore, personal communication, September 17, 2007; Scholastic, 1999). Students having improved their reading ability 100L in 4 years may be expected to improve more than that within months of graduating, if they aspire to the workplace, the community college, or the university.

Finally, from another perspective, a 260L difference would likely exceed one standard deviation of a within-grade student

score distribution on a typical standardized test (e.g., the North Carolina End-of-Grade Reading Comprehension Tests). Such a difference would be considered large in terms of effect size. It is larger, for example, than the Black-White score gap that has generated so much attention and concern (Rock & Stenner, 2005).

Limitations of the Study With Respect to Text Readability

It is possible that students supplement their high school academic experiences with ancillary reading material that is systematically higher in its reading demand than is the case for the textbooks typically used in high school. For example, students in Advanced Placement (AP) classes could be exposed to more demanding reading material than that represented by the typical high school text. To the extent that typical high school texts are used for AP classes, some AP texts might have been represented in this study. However, there was no information in the text database to indicate if any of the texts actually were used for AP classes.

Unfortunately, in this study, there is no way to investigate the breadth of reading material actually used by high school students. To the extent that teachers assign or students elect to read more difficult texts than the typically required textbooks examined in this study, the effective size of the text gap may be overestimated in this report.

On the other hand, university texts were chosen predominantly from the humanities and social science disciplines listed earlier. Texts from the areas such as physical sciences, mathematics, and engineering were not systematically examined. To the extent that such texts might require a higher level of reading ability, this paper's quantification of the gap could be an underestimate.

It also should be acknowledged that this study focused primarily on traditional printed textbooks. Although some materials from the Citizenship domain were taken from Internet sources (e.g., the North Carolina State Board of Elections Web site and public online information about state marriage laws),

the vast majority of texts analyzed for this study were traditional printed materials. Online reading materials were not systematically evaluated nor were texts from other multimedia learning contexts. Technology plays an increasingly central role in literacy development (Educational Testing Service, 2002). As students obtain information through digital technology, researchers should consider the implications for the measurement of text readability. Traditional approaches to readability focus on the semantic and syntactic features of the text; other factors could potentially affect readability in online reading contexts. Future research should investigate the readability of texts from nontraditional sources.

In fact, it is impossible to know exactly what the text gap between high school texts and college/university texts is without analyzing all (or a sufficiently large probability sample of) such texts. However, the fact that there appears to be a substantial gap in text demand between widely used high school textbooks and typical postsecondary textbooks examined in this study should be cause enough for concern to those who are interested in educational standards and better alignment between the public school curricula and postsecondary endeavors.

Limitations With Respect to Reading Ability and Postsecondary Readiness

The extant literature on postsecondary readiness and reading ability is filled with concerns about the apparent gap between actual measured student reading ability and the reading requirements of later life. Concluding that there is such a gap and knowing its magnitude is problematic because different studies have used different constructs and metrics to investigate the effect. Yet the uniformity of conclusions that there is a problem is striking, and the calls for higher standards and better alignment between the public schools and other sectors have received more attention in recent times. The importance of students' aspirations to undergraduate education in America (Kirsch, Braun, Yamamoto, & Sum, 2007) makes such considerations all the more urgent.

It is possible that student reading ability continues to improve well beyond the transition from high school to postsecondary endeavors. If that is the case, it could have implications for inferences about student readiness for postsecondary endeavors. Unfortunately, this study could not investigate that possibility because postsecondary measures of student reading ability have not yet been linked to the Lexile Framework for Reading. Thus, it is impossible to construct tables for actual measured reading ability analogous to the tables for text readability that are presented in this paper.

Although it is currently impossible to construct a reader ability continuum analogous to the text readability continuum presented in this paper, the text readability continuum presented here informs the debate about student readiness. We can imagine a reader whose reading ability is well-matched with the readability of 11th- and 12th-grade high school texts and, using the Lexile Framework, we can forecast the effect on reading comprehension of the mismatch with text that such a reader could encounter in the postsecondary world.

Implications for Instruction and Research

Students typically display diversity, and textbooks are written to accommodate a wide range of reading ability as evidenced by the distributional summaries in Table 3 and Figure 1. However, the gaps in central tendency between the various text collections may suggest a need for instructional strategies that address concerns about student readiness. For example, if high school texts display less semantic and syntactic complexity than texts used in later postsecondary endeavors, then perhaps high schools should introduce students to more complex reading materials in the various content areas. In conjunction with exposure to more complex reading materials, students should be provided support for learning and using the reading skills necessary for postsecondary textual material. Alignment between the reading demands of high school and the postsecondary world could facilitate the transition for many students.

Researchers should consider alternative conceptualizations of readiness. For example, rather than contrasting student reading ability on one occasion with text readability requirements at a later occasion, one might study the trend in students' reading ability over time and relate it to the text continuum experienced by the student over time. However, this would require a more systematic study that follows specific students for several years, measures their reading ability on repeated occasions, and also documents and measures the texts that they encounter in each context. This, in turn, would presume the ability to measure both student reading ability and text readability on the same scale.

Such a study would take several years and could be expensive. It would have several advantages over extant investigations, however. It could overcome objections to differences in construct and metric. It could eliminate cohort differences (e.g., demographic or other differences in the groups of students analyzed) as one possible explanation for observed differences in ability. It also could more faithfully represent the actual life courses chosen and events experienced by a nationally representative group of students. It could empower researchers to construct a student reading ability continuum across the postsecondary years and to update the text readability continuum presented in this paper. Having done that, four types of comparisons would be possible:

1. student reading ability during high school versus student reading ability after high school;
2. the readability of high school texts versus the readability of postsecondary reading materials;
3. student reading ability at any point in time versus text requirements at that point in time; and
4. student reading ability at a given point in time versus text requirements at a later point in time.

A study like the one proposed would have higher ecological validity than many studies that now claim to estimate the gap between reading ability and postsecondary reading requirements and would broaden the concept of student readiness into one that might be more useful to students, teachers, and policy-makers.

A by-product of such a strategy might be that educational standards would have a basis for comparability across the nation and throughout an individual's life, a situation that does not now exist. If that were achieved, then policy discussions and actions related to educational standards and accountability would be greatly facilitated. The ultimate benefactors would be the students and all who rely on them for the future of the country.

References

Achieve, Inc. (2004). *Do graduation tests measure up? A closer look at state high school exit exams*. Washington, DC: Author.

Blanton, H., & Jaccard, J. (2006). Arbitrary metrics in psychology. *American Psychologist, 61,* 27–41.

Bock, R. D., & Moore, E. G. J. (1986). *Advantage and disadvantage: A profile of American youth.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Carroll, C. D. (1988). *Enrollment in postsecondary education of 1980 and 1982 high school graduates.* Washington, DC: National Center for Education Statistics.

Carroll, C. D. (1989). *College persistence and degree attainment for 1980 high school graduates: Hazards for transfers, stopouts and part-timers.* Washington, DC: National Center for Education Statistics.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112,* 155–159.

Educational Testing Service. (2002). *Digital transformation: A framework for ICT literacy* (International ICT Literacy Panel Report). Princeton, NJ: Author.

Embretson, S. E. (2006). The continued search for nonarbitrary metrics in psychology. *American Psychologist, 61,* 50–55.

Greene, J. P. (2000). *The cost of remedial education: How much Michigan pays when students fail to learn basic skills*. Midland, MI: Mackinac Center for Public Policy.

Greene, J. P., & Forster, G. (2003). *Public high school graduation and college readiness rates in the United States* (Education Working Paper No. 3). New York: Center for Civic Innovation at The Manhattan Institute.

Grigg, W. S., Daane, M. C., Jin, Y., & Campbell, J. R. (2003). *The nation's report card: Reading 2002* (NCES 2003-521). Washington,

DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics.

Hiebert, E. H. (2002). Standards, assessments and text difficulty. In A. E. Farstrup & S. J. Samuels (Eds.), *What research has to say about reading instruction* (3rd ed., pp. 337–369). Newark, DE: International Reading Association.

Hiebert, E. H. (2005). State reform policies and the task textbooks pose for first-grade readers. *The Elementary School Journal, 105,* 245–266.

Hogan, D. W., Jr. (2000). *225 years of service: The U.S. Army, 1775–2000.* Washington, DC: Center of Military History, U.S. Army.

Horn, L. J. (1998). *Confronting the odds: Students at risk and the pipeline to higher education.* Washington, DC: National Center for Education Statistics.

Kaestle, C. F., Campbell, A., Finn, J. D., Johnson, S. T., & Mickulecky, L. J. (2001). *Adult literacy and education in America.* Washington, DC: National Center for Education Statistics.

Kirsch, I. S., Braun, H., Yamamoto, K., & Sum, A. (2007). *America's perfect storm: Three forces changing our nation's future.* Princeton, NJ: Educational Testing Service.

Kirsch, I. S., Jungeblut, A., Jenkins, L., & Kolstad, A. (1993). *Adult literacy in America: A first look at the findings of the National Adult Literacy Survey.* Washington, DC: National Center for Education Statistics.

Klare, G. R. (1984). Readability. In P. D. Pearson, R. Barr, M. L. Kamil, & P. Mosenthal (Eds.), *Handbook of reading research, Vol. I* (pp. 681–744). Newark, DE: International Reading Association.

Knepper, P. (1990). *Trends in postsecondary credit production: 1972 and 1980 high school graduates*. Washington, DC: National Center for Education Statistics.

Lennon, C., & Burdick, H. (2004). *The Lexile Framework as an approach for reading measurement and success* (The Lexile Framework for Reading white paper). Durham, NC: MetaMetrics.

Lively, B. A., & Pressey, S. L. (1923). A method for measuring the "vocabulary burden" of textbooks. *Educational Administration and Supervision, 9,* 389–398.

MetaMetrics, Inc. (2007). *Figure 1: Typical reader and text measures by grade.* Retrieved October 2, 2007, from http://www.lexile.com/DesktopDefault.aspx?view=ed&tabindex=6&tabid=18#18

McCormick, A. C. (1999). *Credit production and progress toward the bachelor's degree: An analysis of postsecondary transcripts for beginning*

students at 4-year institutions (NCES 1999–179). Washington DC: U.S. Department of Education, National Center for Education Statistics.

Parker, R. (2004, May 1). Researcher: Graduates need the skills to compete in global marketplace. *Naples Daily News.* Retrieved October 2, 2007, from http://www1.naplesnews.com/news/2004/may/01/ndn_researcher__graduates_need_the_skills_to_compe/

Parsad, B., & Lewis, L. (2003). *Remedial education at degree-granting postsecondary institutions in fall 2000* (NCES 2004-010). Washington, DC: U.S. Department of Education, National Center for Education Statistics.

Pennsylvania Department of Education. (2004). *Pennsylvania reading requirements for school, the workplace and society: Executive summary of findings* [Electronic version]. Retrieved October 2, 2007, from http://www.pde.beta.state.pa.us/career_edu/lib/career_edu/pennsylvania_reading_requirements_for_school_summary_reporà.pdf.

Rasch, G. (1980). *Probabilistic models for some intelligence and attainment tests* (Expanded ed.). Chicago: The University of Chicago Press.

Ready. (n.d.) In *Merriam-Webster collegiate dictionary*. Retrieved September 10, 2007, from http://unabridged.merriam-webster.com/ready

Readiness. (n.d.). In *Dictionary.com unabridged (v 1.1)*. Retrieved September 10, 2007, from http://dictionary.reference.com/browse/readiness

Rock, D. A., & Stenner, A. J. (2005). Assessment issues in the testing of children at school entry. *The Future of Children, 15*(1), 15–34.

Rosenbaum, J. E. (2004, Spring). It's time to tell the kids: If you don't do well in high school, you won't do well in college (or on the job) [Electronic version]. *American Educator.* Retrieved October 2, 2007, from http://www.aft.org/pubs-reports/american_educator/spring2004/tellthekids.html

Sanderson, A., Dugoni, B., Rasinski, K., Taylor, J., & Carroll, C. D. (1996). *NELS:88/94 Descriptive summary report with an essay on "Access and choice in postsecondary education*." Washington, DC: National Center for Education Statistics.

Scholastic, Inc. (1999). *Scholastic Reading Inventory technical manual.* New York: Author.

Stenner, A. J. (2003). *Matching students to text: The targeted reader* (Scholastic Professional Paper). New York: Scholastic. Retrieved

October 2, 2004, from http://www.tomsnyder.com/reports/Target_Reader_Web2.pdf

Stenner, A. J., & Burdick, D. (1997). *The objective measurement of reading comprehension—In response to technical questions raised by the California Department of Education Technical Study Group*. Durham, NC: MetaMetrics.

Stenner, A. J., & Smith, M., III. (1982). Testing construct theories. *Perceptual and Motor Skills, 55,* 415–426.

Stenner, A. J., Smith, M., III, & Burdick, D. S. (1983). Toward a theory of construct definition. *Journal of Educational Measurement, 20*(4), 1–12.

Stenner, A. J., & Stone, M. H. (2004, May). *Does the reader comprehend the text because the reader is able or because the text is easy?* Paper presented at the meeting of the International Reading Association, Reno-Tahoe, NV.

Sum, A. (1999). *Literacy in the labor force: Results from the National Adult Literacy Survey.* Washington, DC: National Center for Educational Statistics.

U.S. Department of Defense. (1998). *Population representation in the military services.* Washington, DC: Office of the Assistant Secretary of Defense, U.S. Department of Defense.

U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. (2003). *The nation's report card: Reading highlights 2003* (NCES 2004-452). Washington, DC: National Center for Education Statistics. Retrieved October 2, 2004, from http://nces.ed.gov/nationsreportcard/pdf/main2003/2004452.pdf

U.S. Department of Labor. (1991). *What work requires of schools: A SCANS report for America 2000.* Washington, DC: The Secretary's Commission on Achieving Necessary Skills (SCANS). Retrieved October 2, 2004, from http://wdr.doleta.gov/SCANS/whatwork/whatwork.pdf

Venezia, A., Kirst, M. W., & Antonio, A. L. (2003). *Betraying the college dream: How disconnected K–12 and postsecondary education systems undermine student aspirations.* Stanford, CA: Stanford Institute for Higher Education Research.

Williamson, G. L. (2006). *Aligning the journey with a destination: A model for K–16 reading standards* (Lexile Framework for Reading White paper). Durham, NC: MetaMetrics.

Williamson, G. L., & Koons, H. (2007, June). *The text continuum in 2007*. Paper presented at the 2007 Lexile National Reading Conference, Lake Buena Vista, FL.

Wright, B. D., & Linacre, J. M. (1994). *The Rasch model as a foundation for the Lexile Framework.* Durham, NC: MetaMetrics.

Wright, B. D., & Stenner, A. J. (1998, May). *Readability and reading ability*. Paper presented at the meeting of the Australian Council on Educational Research, Melbourne, Australia.

Wright, B. D., & Stone, M. H. (2004). *Making measures.* Chicago: Phaneron Press.

Zakaluk, B. L., & Samuels, S. J. (1988). *Readability: Its past, present, and future.* Newark, DE: International Reading Association.

Author Note

This paper evolved from a presentation at the annual meeting of the American Educational Research Association in 2006, which in turn was an update of research originally presented to the National Assessment Governing Board (NAGB) in August 2004.

Appendix A
Selected Text and Corresponding Lexile Measures

Textbook Title	Lexile
American Literature	910
The American Tradition	1120
American Literature	1040
Elements of Literature (fifth course: Am Lit)	1100
The Language of Literature: American	1050
Timeless Voices, Timeless Themes: American	1090
Algebra 2	790
Algebra 2	1070
Contemporary Mathematics in Context (3B)	1130

Textbook Title	Lexile
Contemporary Mathematics in Context (3A)	1140
Algebra 2	970
Discovering Advanced Algebra	1160
Algebra 2	1160
Algebra 2	1010
Algebra 2	1140
Chemistry: Principles and Reactions	1200
Chemistry: Matter and Change	1170
Chemistry: Concepts and Applications	1180
Chemistry	1110
Modern Chemistry	1150
Chemistry: Visualizing Matter	1050
Active Chemistry	1050
World of Chemistry	1230
Chemistry: Connections to Our Changing World	1120
United States History	880
Psychology and You	1070
The American Republic Since 1877	1110
The American Vision	1110
American Odyssey: The 20th Century and Beyond	1130
Understanding Psychology	1140
American Nation in the Modern Era	1090
Psychology: Principles in Practice	1140
American Nation (Beginnings–1877)	880
The Americans	1150
The Americans: Reconstruction to the 21st Century	1200
Psychology: Concepts and Applications	1270
A History of Western Society: From 1300	1290
The American Pageant	1290
The Enduring Vision	1330
America: Pathways to the Present	1070
Magruder's American Government	1120
The British Tradition	1040
The Reader's Choice: British Literature	1050
Elements of Literature (sixth course, Brit Lit)	1130
The Language of Literature: British	1130

Textbook Title	Lexile
Timeless Voices, Timeless Themes: British	1120
Advanced Mathematical Concepts: Precalculus with Applications	1220
Precalculus: A Graphing Approach	1130
Calculus: Early Transcendentals	1380
Precalculus: Discrete Math	1220
Advanced Mathematics: Precalculus	1220
Functions Modeling Change: A Preparation for Calculus	1050
Algebra and Trigonometry	1130
Advanced Math	1300
Foundations of Physics and Investigations	1070
Physics: Principles & Problems	1130
Understanding Human Anatomy and Physiology	1210
Hole's Essentials of Human Anatomy and Physiology	1270
Physics	1120
Active Physics: Communication	850
Active Physics: Medicine	890
Active Physics: Predictions	910
Active Physics: Transportation	990
Active Physics: Core Select	1110
Active Physics: Home	1110
Active Physics: Sports	1160
Anthony's Textbook of Anatomy and Physiology	1290
Conceptual Physics	1130
Intro to the Human Body: Essentials of Anatomy and Physiology	1260
Principles of Anatomy and Physiology	1300
United States Government: Democracy in Action	1130
Street Law	1180
American Government	1150
American Government	1350
Magruder's American Government	1120