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Academic Outcomes in Higher Education for Students Screened as Twice-Exceptional: Gifted with a Learning Disability in Math or Reading

Elizabeth Ann Hays
University of Tennessee - Knoxville, ehays2@vols.utk.edu

To the Graduate Council:

I am submitting herewith a dissertation written by Elizabeth Ann Hays entitled "Academic Outcomes in Higher Education for Students Screened as Twice-Exceptional: Gifted with a Learning Disability in Math or Reading." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in School Psychology.

R. Steve McCallum, Major Professor

We have read this dissertation and recommend its acceptance:

Sherry M. Bell, Dennis J. Ciancio, Gary J. Skolits, Denise Gardner

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Abstract

To investigate academic outcomes for twice-exceptional (2e) students who pursue higher education, a pool of 20,761 undergraduate students at the University of Tennessee were screened and 244 were selected as potentially 2e because they matched certain criteria traditionally used for the determination of giftedness and a specific learning disability (SLD) in math or reading. First-year retention rate and final college GPA were significantly lower for students screened as gifted with a SLD in math or reading than for students screened as gifted without a SLD ($p< .05$), but were not significantly different from other students in the general population. Students screened as 2e were more likely to be undecided in their choice of major than students screened as gifted ($p<.001$), and their composite ACT score was not correlated significantly with first-year retention, graduation, or college GPA as it was for students screened as gifted and students in the general population. For students screened as 2e, high school GPA was correlated with college GPA, but not retention or graduation, as it was for the other groups. For all students, high academic ACT variability predicted graduation and retention. High variability contributed incrementally to the prediction of first-year retention when added to a model using high school GPA and composite ACT score ($p<.001$).

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CHAPTER I

Literature Review

Twice-exceptional students are those who are gifted while also experiencing some form of disability, such as a specific learning disability (SLD), developmental disability, physical impairment, or attention deficit hyperactivity disorder (Nielsen, 2002). Only in the past 30-40 years has twice-exceptional been recognized as a singular disability. Twice-exceptional students are likely to demonstrate characteristics typically associated with both giftedness and their disability, but experts recognize that these students may have a unique set of needs that cannot be adequately defined by either exceptionality in isolation or in simple combination. Furthermore, the two exceptionalities do not appear to "cancel each other out." Rather, twice-exceptional students are believed to possess a third category of characteristics that are unique to the interaction of both giftedness and the disability (Olenchak, 1995; Reis et al., 1995). Therefore, to understand the academic and social/emotional profile of students who are gifted with a SLD, the focus of this study, characteristics of giftedness, learning disabilities, and the interaction between the two exceptionalities should be considered.

Characteristics of Gifted Students

In 1972, the first national definition of giftedness was issued in what is commonly referred to as the Marland Report, or *Education of the Gifted and Talented* (Assouline, Foley Nicpon, & Huber, 2006; Colangelo & Davis, 2003). This first national report on gifted education defined gifted children as

> those identified by professionally qualified persons who, by virtue of outstanding abilities, are capable of high performance. These are children who require differential

> education programs and/or services beyond those provided by the regular school program in order to realize their contribution to self and the society. Children capable of high performance include those with demonstrated achievement and/or potential ability in any of the following areas, singly or in combination: 1) General intellectual ability, 2) Specific academic aptitude, 3) Creative or productive thinking, 4) Leadership ability, 5) Visual and performing arts, or 6) Psychomotor ability (Marland, 1972).

Although this federal definition has since been modified to exclude the psychomotor ability domain, most state departments of education have characterized giftedness in a manner consistent with this definition, defining giftedness as high aptitude in a particular area, such as cognition, creativity, academics, leadership, or art (Assouline et al., 2006; Stephens & Karnes, 2000). In schools, most students identified as gifted have demonstrated intellectual giftedness, traditionally identified, in part, by using norm-referenced intelligence tests (Assouline, et al., 2006; Crepeau-Hobson & Bianco, 2011). Much of what is known about gifted students, therefore, pertains specifically to students who are intellectually gifted. Although methods for identifying gifted students vary considerably, best estimates are that gifted children account for between 5% and 20% of students in U.S. schools (Pfeiffer, 2001).

While some educators still make the argument that gifted students are bright enough to fend for themselves and do not need special services, this perspective has been criticized as the need for explicit programming for gifted students has been demonstrated in the classroom (Assouline, et al., 2006; Colangelo & Davis, 2003). Because their educational needs cannot be met optimally without additional services, students identified as gifted are sometimes placed in special classes and programs where they are challenged and encouraged to apply their strengths

within an enriched curriculum (Newman & Sternberg, 2004; Silverman, 2003). These students generally do well academically and excel in advanced education settings, such as in college, graduate school, or professional school, *unless* they have twice-exceptional characteristics.

Characteristics of Students with Specific Learning Disabilities

The legal definition of a specific learning disability according to the Federal Register (2005) is

> A disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations … it does not include learning problems that are primarily the result of visual, hearing, or motor disabilities; of mental retardation; or emotional disturbance; or of environmental, cultural, or economic disadvantage (as summarized by Assouline , Foley-Nicpon, & Huber, 2006).

The traditional assessment model in the schools for identifying students in need of special services for learning disabilities has been to compare the discrepancy between general cognitive ability and academic achievement, and if achievement was below the expected level, the student could qualify for certain services and accommodations. The discrepancy model has been criticized as a "wait-to-fail model," as referral for assessment is generally contingent upon a student's noticeable failure to meet grade-level expectations. Furthermore, the specific cognitive processes that would be expected to predict academic achievement level in a particular domain are not directly considered when the composite intelligence test score is used as the criterion for establishing a discrepancy.

Since the Individuals with Disabilities Education Improvement Act of 2004 (IDEA 2004), many states now are shifting to other models of identification, one of which is the Patterns of Strengths and Weaknesses (PSW) model. Several variations of PSW have been proposed, including the Aptitude-Achievement Consistency model (Flanagan, Ortiz, & Alfonzo, 2007), the Consistency-Discrepancy model (Naglieri, 1999), and the Concordance-Discordance model (Hale & Fiorello, 2004). These models address some limitations of the IQ-achievement discrepancy model by requiring that specific cognitive weaknesses be tied to specific and related achievement limitations. Though PSW models offer more discrimination among cognitive abilities, they require a comprehensive psychoeducational evaluation and are also dependent upon referral of the student.

Another common alternate to the traditional discrepancy model is the response to intervention (RTI) model, in which students' academic skills are screened and at-risk students' progress is monitored after interventions have been implemented (Fuchs, Mock, Morgan, & Young, 2003). Students who are identified as at-risk based on certain cut scores (e.g., less than 20% on a Curriculum Based Measurement tool) continue to receive increasingly intensive intervention until they "catch up" with their peers within in a general education setting. Since all students are screened for proficiency, identification of students with a SLD may occur even before their disability manifests in poor academic performance.

While students who are intellectually gifted typically do well in school, students with specific learning disabilities generally struggle, particularly in subject areas where their disability is most salient. These students account for about half of those who are eligible to receive special education in U.S. schools, with about five percent of students accessing these services through the SLD category (National Joint Committee on Learning Disabilities, 2011). Students with

identified learning disabilities often spend time in special education classes or receive special services to address difficulties associated with the specific disability (Yewchuk & Lupart, 2000).

Masking

It is the interaction of giftedness and the disability that makes the needs of twice-exceptional students so difficult to identify. This interaction is characterized by masking, wherein the difficulties associated with the student's disability are hidden by the strengths associated with the student's giftedness, and vice versa (Baum, 1990; Silverman, 2003). This masking of twice-exceptional students' strengths and weaknesses often precludes identification for special education services (Brody & Mills, 1997). Usually, when twice-exceptional students are noticed, either the giftedness or the SLD will be identified in isolation, the student will be classified accordingly, and the second exceptionality will go unrecognized (McCoach, Kehle, Bray, & Siegle, 2001; Minner, 1990).

Although there is much diversity among the twice-exceptional population in terms of their academic and social/emotional characteristics, Baum (1990) has identified three categories of twice-exceptional students who experience masking: these include 1) students for whom only giftedness is identified, 2) students for whom only the SLD is identified, and 3) students for whom neither exceptionality is identified. Regardless of which category a twice-exceptional student is placed, these students are likely to experience certain academic and social/emotional consequences due to the interaction of their exceptionalities (Olenchak, 1994; Reis et al., 1995; Reis & Colbert, 2004).

Identification of Twice-Exceptional Students

Given the complex academic profile of twice-exceptional students, identification of this population has been difficult in practice. Most diagnostic models (e.g., Diagnostic and Statistical

Manual of Mental Disorders, Fifth Edition[DSM-5]; American Psychiatric Association, 2013; state departments of education) require that students who have a SLD demonstrate "unexpected achievement deficits," that are not better explained by other factors, such as an intellectual disability or inadequate instruction (McCallum, Bell, Coles, Miller, Hopkins, Hilton-Prillhart, 2013). To receive services in the schools in most states, students must be performing at a level that is significantly below the performance of their peers. This approach to identification is consistent with the argument that academic achievement must be below average to be evidence of a disability that warrants intervention (Flanagan, et al., 2013; Lovett & Sparks, 2013; Stanovich, 1999). This implies that no matter how far a student's academic achievement level is from his/her cognitive ability level, a student will not receive services as long as he/she is performing within the average range. Advocates for the needs of twice-exceptional students find fault with this philosophy, contending that it is intra-individual variability that determines the presence of a learning disability, not normatively low achievement (e.g. Assouline et al., 2010; Mastropieri & Scruggs, 2005; McCallum et al., 2013; Scruggs & Mastropieri, 2002).

Twice-exceptional students were often overlooked by the traditional cognitive/achievement discrepancy model, as their high ability would often prevent their academic performance from dropping low enough to qualify as having a learning disability. Although PSW models offer the advantage of delineating specific cognitive strengths and weaknesses, which may otherwise be masked by full scale IQ scores, a twice-exceptional student's learning disability is still likely to be missed by PSW models when normatively low academic achievement is a requirement for identification. As generally applied, the RTI model misses twice-exceptional students just as much, if not more than, the traditional discrepancy model and PSW models (Adams, Yssel, & Anwiler, 2013; Crepeau-Hobson & Bianco, 2011;

McKenzie, 2010; Volker Lopata & Cook-Cottone, 2006). If twice-exceptional students are able to somewhat compensate for their disabilities, enough to achieve average academic performance, they may not perform low enough on the screening measures for their learning disabilities to be identified.

Recent developments in twice-exceptional identification have yielded a systematic method to screen for twice-exceptional within the RTI model (i.e. McCallum, et al., 2013). According to this screening model, a large discrepancy between subject area scores on an assessment of academic achievement, when one of those scores is significantly above average, is an indication that a student may be gifted with a SLD. This method of identification is consistent with the original definitions of learning disabilities (i.e., variability in performance) and giftedness (i.e., high achievement). A major advantage of this model is that it better controls for masking effects by taking into account performance in specific skill areas, typically math and reading, as opposed to relying on a composite score to reflect skills and abilities. A practical advantage of the model is that cut scores for giftedness and discrepancy level can be adjusted for both liberal and conservative screening for twice-exceptional. While McCallum et al. reject the use of this method for diagnostic purposes, a more conservative application of the model might be acceptable to some for identification if extreme variability is the primary criterion. On the other hand, a more liberal application is typically used for screening, where level in cut scores for discrepancy and area of giftedness is less extreme, i.e., when the goal is to be more inclusive, leading to additional testing.

The notion that students who are gifted should be expected to have equally high ability across all domains of intellectual functioning has been rejected in the literature, though this misperception has continued to permeate traditional identification methods and programming for

gifted students in U.S. schools (Assouline, et al., 2006). This new method of screening twice-exceptional status focuses on comparing differences in subject area scores rather than relying on composite scores and is more consistent with thought about the nature of giftedness, i.e., that giftedness might best be thought of as superior talent in a particular domain.

Academic Characteristics of Students who are Gifted with a SLD

Variability in academic performance is considered a hallmark characteristic of twice-exceptional students (McCallum, et al., 2013). By definition, intellectually-gifted students with a SLD have normative strengths in one cognitive area with normative weaknesses in another, and naturally, this variability translates to uneven academic achievement. Gifted students with a SLD are likely to excel on tasks that primarily relate to their area of strength, while they are likely to struggle on tasks that pertain mostly to their disability. For example, a twice-exceptional student with exceptionally high verbal comprehension skills but poor quantitative reasoning may well have a SLD in math. The student may do very well in English or writing courses, while doing poorly in math courses.

While wide variability in performance across subject areas is typical for twice-exceptional students, the interaction of giftedness with a learning disability can result in academic performance that falls closer to the mean than the extremes, even in areas where the student's performance would be expected to be exceptionally above or below average. Especially in younger grade levels, twice-exceptional students may be able to apply their intellectual giftedness to compensate for some of the deficits associated with their SLD, perhaps enough so that they are able to maintain average grades. Conversely, twice-exceptional students who are gifted in a particular area may not achieve exceptionally high performance in the areas in which they are talented, when achievement in those areas depends to some extent on the skills affected

by their disability. For example, students who are academically gifted in math but have a SLD in reading may not necessarily outperform their classmates on math exams when test items have a high verbal loading (Bell, Taylor, McCallum, Coles, & Hays, in press).

The academic profile of the twice-exceptional student is complex, with traditional indicators of academic success, such as composite test scores, being confounded by the effects of masking and overlap of skills across different academic domains. For example, when 14 students who were identified as gifted with a SLD in written expression completed the Woodcock Johnson-III Tests of Achievement, their scores revealed a general pattern of high-average performance in math and reading with average to low-average performance in the area of disability, written expression (Assouline, Foley-Nicpon, & Whiteman, 2010). Although implications based on this finding are limited to the small sample size and pertain specifically to twice-exceptional students with a SLD in written expression, these scores provide evidence that twice-exceptional students can sometimes compensate for their disability enough to maintain average performance in their area of weakness.

Social/Emotional Characteristics of Students who are Gifted with a SLD

Twice-exceptional students may be at increased risk for a lack of academic resilience in higher education due to some ill-serving social and emotional tendencies that have been linked to twice-exceptional. The following characteristics have been associated with twice-exceptional primarily in K-12 students, though there is some slight evidence that these characteristics may apply to college students, as well.

Academic frustration. Students who are identified as being gifted but whose learning disabilities are not acknowledged are likely to experience high expectations from their parents and teachers. For these students, their learning problems may not become noticeable until later in

their academic careers when successful completion of their assignments becomes increasingly contingent upon performance in the area of the disability (McCoach et al., 2001; Reis, Neu, & McGuire, 1995). When weaknesses associated with the hidden SLD prevent these students from meeting the high expectations that have been placed on them due to their recognized giftedness, students may appear to be lazy, unmotivated, or underachieving (Reis & Colbert, 2004). These students may initially work hard to maintain their gifted identity, but when their efforts are met with criticism for being lazy and unmotivated, they are likely to experience academic frustration.

Students whose SLD, but not giftedness, has been identified may find themselves held to lower expectations for their academic performance. However, these students are likely to experience frustration as well, as they may languish in classrooms that do not offer opportunities for them to apply their talents (Ritchotte & Matthews, 2012). Regardless of whether a twice-exceptional student's giftedness is recognized by others, students who are gifted often have high expectations for themselves, believing they should be able to excel in all academic areas (Baum & Owen, 1988; Daniels, 1983; Silverman, 1989). Since students with learning disabilities experience failure in academic tasks more frequently than their peers, twice-exceptional students may be particularly prone to experience academic frustration due the combination of their own high expectations and their higher rate of academic failure (King, 2005). Strop and Goldman (2002) have suggested that continually experiencing academic frustration as a result of trying harder than others but still failing to meet high expectations can result in a deep-rooted anger towards school and those that hold them to unrealistically high expectations. However, other researchers have found that that gifted students with a SLD in written expression reported attitudes towards school and teachers that were comparable to their non-exceptional peers (Assouline, Foley-Nicpon, & Whiteman, 2010).

Low motivation and lack of perseverance. While teachers and parents sometimes mistakenly perceive twice-exceptional students to be unmotivated when they fail to meet elevated expectations, researchers have found that some twice-exceptional students actually do lose motivation to succeed academically (Baum, 1994; Newman & Sternberg, 2004; Silverman, 1989; VanTassel-Baska, Swanson, Quek, & Chandler, 2013). Reis and Colbert (2004) propose that this eventual collapse of motivation is a result of prolonged academic frustration. Over time, twice-exceptional students become exhausted from working so hard to meet high expectations and still falling short. Eventually, some students learn that regardless of how much effort they invest in certain academic tasks, they will not be able to perform at the level that is expected of them (Whitmore, 1981; Whitmore & Maker, 1985). This learned helplessness translates to low perseverance in academic tasks that they find difficult (Baum & Owen, 1988; Olenchak & Reis, 2002; Reis & Colbert, 2004).

Reluctance to ask for help. Another common characteristic of twice-exceptional children is a reluctance to ask for help. This may be particularly true for students whose giftedness is acknowledged but their learning disability is not. These students may be aware that they are having difficulties in areas where their gifted peers do not struggle, and in an effort to protect their gifted identity, they may avoid asking for help and drawing attention to the fact that they are struggling (Trail, 2010).

Students for whom both giftedness and the SLD are masked may also be less likely to ask for help than their non-exceptional peers. When students are able to apply the strengths associated with their giftedness to compensate for their SLD, they may be able to sustain average or even above-average academic performance. In these instances, students may be reluctant to ask for help since they are still meeting expectations for the average student they are perceived to

be. If they are meeting expectations without additional help, they may not recognize that they have the potential to do even better academically, with extra support.

Academic self-efficacy. Despite the intellectual giftedness inherent in twice-exceptional students with learning disabilities, many of these students have a low academic self-concept (King, 2005; Leggett, Shea, & Wilson, 2010; Neisen, 1989; Neilsen & Higgins, 2005; Newman & Sternberg, 2004; Reis & Colbert, 2004). When twice-exceptional students receive gifted services, their self-concept has been shown to be similar to that of their non-disabled peers (Nielsen, 1989). However, twice-exceptional students who only receive services for their SLD in the schools have demonstrated significantly lower self-concepts. It is especially likely that twice-exceptional students will struggle with low academic self-concept and self-esteem when they are placed into special education environments with students who have severe developmental disabilities (King, 2005; Leggett, et al., 2010; Neilsen & Higgins, 2005; Nielsen & Morton-Albert, 1989). Furthermore, in cases where only learning disabilities are identified and addressed, twice-exceptional students may come to identify as being at a disadvantage academically and may not recognize their own potential (Neilsen & Higgens, 2005). Strop and Goldman (2002) proposed that low self-esteem in twice-exceptional students develops from a pattern of choosing not to apply effort on tasks that involve application of students' weaknesses, a reluctance that results from academic frustration and fear of failing on difficult tasks.

In a qualitative study, Reis and Colbert (2004) investigated the perceptions of 15 college students who they identified as being gifted with a specific learning ability. Participants were identified using SLD documentation from admissions materials at a university, and the 15 students who were included in the study had a standard score of 125 on at least one index score of a norm-referenced intelligence test. To date, this is one of only a few studies that has explored

twice-exceptional in college students. Students were interviewed about their experiences in primary and secondary school, and their responses showed patterns of low academic self-confidence and self-esteem. Most of these students reported feeling "dumb" during their school years due to histories of negative comments made to them by their peers and teachers, even when they were not yet identified as having learning disabilities. Even though these students were gifted, most students recalled having very little confidence in their ability to do well in school. Students perceived that their teachers had been confused by their mixed academic performance and attributed it to laziness or lack of motivation, telling them to "shape up" and "work harder." These interviews with twice-exceptional college students corroborated findings of other studies investigating the social/emotional implications associated with twice-exceptional; specifically, these students remembered experiencing academic frustration, low academic self-concept, low perseverance, and a reluctance to ask for help.

College Outcomes for Characteristics Tied to Twice-Exceptional Students

Over the past few decades, researchers have accumulated and integrated a foundation of knowledge about the academic, social, and emotional needs of twice-exceptional students in primary and secondary school settings. However, with 65% jobs projected to require advanced education and training beyond high school by the year 2020 (Carnevale, Smith, & Strohl, 2013), the needs of twice-exceptional students cannot be adequately understood or addressed without considering how twice-exceptional affects students' ability to succeed in higher education. Aside from the qualitative study by Reis and Colbert (2004), little information is available pertaining to how twice-exceptional affects students who pursue more advanced degrees. Twice-exceptional status in college students simply has not been a focus of study for researchers to date. However, given K-12 twice-exceptional students' characteristic variability in academic performance,

coupled with their increased likelihood to experience academic frustration and low motivation, low persistence, and low academic self-efficacy, it would seem that college students with a twice-exceptional-like cognitive and academic pattern would be at increased risk for difficulty in higher education. Given the demographics of those who go to college, a sizable portion of that population may exhibit twice-exceptional-like characteristics. That is, many students who go on to college are gifted and the number of those who enter with a SLD has increased over the past decade (Gregg, 2007; Holzer, Madaus, Bray, & Kehle, 2009). About 5% of the K-12 population receive services under the SLD category (National Joint Committee on Learning Disabilities, 2011), and an estimated 10% of students with an identified SLD choose to enroll in a four year university within two years of graduating from high school (Wagner, Newman, Cameto, Garza, & Levine, 2005).

Social/Emotional Factors Affecting College Success

To date, much research pertaining to internal, non-academic factors affecting college success relates to academic self-confidence, achievement motivation, academic goals, social involvement, institutional commitment, social support, and general self-concept. Of these variables, two have also been closely tied to twice-exceptional-like status: academic self-confidence and achievement motivation. In an American College Test (ACT) Policy Report, researchers investigated both academic and nonacademic factors that predict college success; specifically, Lotowski et al., (2004) found that that of the nonacademic factors considered, academic self-confidence and achievement motivation were most directly correlated with college grade point average (GPA). Results from a meta-analysis of 109 studies that addressed the relation between the same factors and postsecondary retention indicate that academic self-confidence also plays a significant role in college retention (Robbins et al., 2004).

Academic self-confidence also may be described as academic self-efficacy, referring to a student's confidence in his/her ability to be successful with academic tasks (Chemers, Hu, & Garcia, 2001; Gore, 2006; Schunk, 1991). Given the strong connection between academic self-efficacy and both college GPA and retention, the low academic self-efficacy associated with twice-exceptional is cause for concern. While low achievement motivation was more closely linked with college GPA than with probability of retention, the low achievement motivation often experienced by twice-exceptional students may place them at greater risk for struggling in a college environment.

Some research also suggests that academic frustration may be linked to college GPA. Wilde (2012) found that the achievement frustration subscale of a frustration intolerance measure was the best predictor of college GPA when compared to other significantly related factors, i.e., emotional intolerance and entitlement. For gifted students with learning disabilities, academic frustration is a product of failure to meet high performance expectations despite increased effort. In college settings, expectations for academic achievement are generally higher than in primary and secondary settings. With increasingly high expectations, twice-exceptional students may find themselves feeling even more academically frustrated in college classes than they did during their school years.

Although academic self-efficacy, achievement motivation, and low academic frustration are the only characteristics that have been consistently tied to both twice-exceptional students and success in higher education, other social/emotional characteristics associated with twice-exceptional seem intuitively problematic for college success. For example, for twice-exceptional K-12 students, academic frustration has been implicated in the development of low levels of academic perseverance. In the context of higher education outcomes, perseverance translates to

retention. With low perseverance being commonly experienced by gifted students with learning disabilities at the primary and secondary education levels, these students may be particularly at risk for not continuing in higher education, a setting where retention is not required by law. Reluctance to ask for help is another characteristic shared by many twice-exceptional K-12 students, and that tendency may be even more problematic at the college level. With the increased demands and expectations that typically come with pursuit in higher education, many students find themselves needing academic assistance for the first time in order to succeed in their classes. For many college students, student support resources such as tutoring, supplemental instruction, and academic coaching serve as lifelines for remaining in fair academic standing. If twice-exceptional students are reluctant to ask for help in college, they are unlikely to benefit from these services. Furthermore, in a college setting, twice-exceptional students are less likely to have parents advocating for them.

Academic Factors Affecting College Success

Among all academic and nonacademic factors, high school grade point average (GPA) is generally accepted as the best indicator of college GPA and college retention, with scores from college readiness tests, such as the ACT and the SAT, being closely tied to academic outcomes in higher education, as well (for review, see Westrick, Le, Robbins, Radunzel, & Schmidt, 2015). While most colleges in the U.S. claim to use a holistic, subjective approach when making admissions decisions, as opposed to entering scores into a mathematical algorithm, it is clear that high school GPA and college readiness test scores are given strong consideration when deciding whether to admit students at many institutions (Rubin, 2014). Little is known about how gifted students with learning disabilities perform on either of these measures relative to their peers. However, given the wide variability across areas of academic achievement that is characteristic

of twice-exceptional students, it is possible that either of these composite measures, high school GPA or college readiness test scores, could overestimate or underestimate a twice-exceptional student's actual ability to succeed in college.

Statement of the Problem

McCoach, Kehle, Bray, and Siegle (2001) have defined twice-exceptional students as having superior intellectual ability while demonstrating a significant discrepancy in their level of performance in a particular academic area. Even when this definition is accepted, identifying twice-exceptional students and addressing their needs has proven to be difficult in practice. Students whose twice exceptionality is based on the dual presence of giftedness and a SLD have been described as "the most misjudged, misunderstood, and neglected segment of the student population and the community" (Whitmore & Maker, 1985, p.204). While knowledge and awareness about twice-exceptional students has increased among educators since this statement first was made, schools still have a long way to go in terms of addressing the academic, social, and emotional needs of these students (Foley-Nicpon, Assouline, & Colangelo, 2013).

While the literature indicates that K-12 twice-exceptional students typically experience high levels of academic frustration throughout their school years that often contributes to the development of low academic self-concept, low motivation, low perseverance in academic tasks, and a reluctance to ask for help, little is known about academic outcomes for twice-exceptional students who pursue higher education. Academically, the most salient characteristic of twice-exceptional students is variable academic performance. To date, there is little documented exploration of how inconsistency in academic achievement relates to success in college settings.

The purpose of the present study is to explore academic outcomes for students who are screened as twice-exceptional, specifically, students who are screened as gifted with a SLD in

math or reading. Data will address the extent to which inconsistency in academic achievement relates to college success. Additionally, traditional academic correlates of college success will be examined to determine whether they predict success for twice-exceptional students (i.e., GPA, graduation, first-year retention) as well as they do for students not screened as twice-exceptional. The following specific research questions address these general questions:

1. In terms of college success (i.e., GPA, first-year retention, six-year graduation), do students screened as twice-exceptional perform as well as: a) the general population of students or b) students screened as gifted?

2. Upon enrollment at the university, are students screened as twice-exceptional with a SLD in math or reading disproportionately represented compared to the general college population or students screened as gifted but not twice-exceptional among: a) STEM majors (i.e., Science, Technology, Engineering, Math), b) Bachelor of Arts and education majors (e.g., humanities, social sciences, etc.), c) business and communication majors, d) agriculture-based majors or d) undecided students?

3. Among all college students, does the size of the discrepancy between reading and math ACT superscores (i.e. highest score obtained in given subject area across all test dates) predict first-year retention or graduation?

4. If discrepancy does predict first-year retention or graduation, does the addition of this variable in a regression model based on high school GPA and composite ACT score contribute incrementally to the prediction of these outcomes?

5. Do traditional indicators of college success (i.e., high school GPA, composite ACT score) predict college GPA, first-year retention, or graduation as well for students screened as twice-exceptional as they do for students in the general population or students screened as gifted?

CHAPTER II

Method

Participants

Data on the demographics, ACT college readiness test scores, high school and college GPA, choice of major, and year of graduation or exit were obtained for 24,801 undergraduate students at the University of Tennessee (UT). These data were obtained as part of a larger database compiled and maintained by the UT Office of Institutional Research, and the dataset includes information on all students who enrolled at the university as first-time freshmen within the years 2007 and 2012. ACT test scores were unavailable for 1,308 students, and these students were removed from the dataset. Due to possible confounds related to English language fluency, students who were classified as non-resident/ alien were also excluded from the dataset, resulting in a final sample size of 23,249 students. The 2011 cohort of students was set aside for the purpose of establishing cutoff criteria for screening for giftedness and twice-exceptional.

These criteria were applied to the remaining dataset (N=20,761), which was used for analyses. Of the full sample, 50.5 % were female (N=11,738) and 49.5% were male (N=11,511). 83.2% of students were White (N=19,354), with Black (N=1,919), Asian (N=620), and Hispanic students (N=570) comprising an additional 13.5% of the sample population. Students in the sample had an average high school GPA of 3.79 (SD=.47) and average ACT composite score of 26.46 (SD=3.38). Approximately 70% of students were undecided in their choice of major upon initial enrollment (N=16,187), while around 30% of students declared an intent to pursue a specific major (N=7,062).

Establishing criteria for gifted and twice-exceptional screening. To screen for twice-exceptional students in the present study, the discrepancy identification method proposed by

McCallum et al. (2013) was modified and applied using the distributions of math and reading ACT superscores of students in the 2011 freshmen class of The University of Tennessee, as shown in Table 1. In the 2011 cohort, the average reading ACT score was 27 (M=27.37, SD=4.50) and the average math ACT score was 25 (M=25.50, SD=3.88).

Based on these distributions, students in the large dataset were screened for giftedness and then subsequently screened for twice-exceptional. Table 2 summarizes how groups were defined. First, students were separated into two groups, those who were screened as gifted and those who were not. Students were screened as gifted if they earned a reading or math superscore that was 1 standard deviation above the mean or higher. While some (e.g., Lovett & Sparks, 2011) recommend 1 and 1/3 standard deviations above the mean as the cutoff criterion for gifted eligibility on standardized instruments, McCallum et al. have recommended a more inclusive range of 1 standard deviation above the mean or higher when the assessment is being used for screening purposes, given means and standard deviations of the subject area score distributions. Following these recommendations, students were screened as gifted in math if they earned an ACT math superscore of 30 or higher and were screened as gifted in reading if they earned an ACT reading superscore of 32 or higher.

Among the students who were screened as gifted, those who also exhibited a discrepancy between their math and reading superscores higher than two standard deviations above the mean discrepancy level (M=5.17, SD=3.38) of students screened as gifted in the reference dataset were screened as twice-exceptional. This level of discrepancy ensures a cutoff beyond the typical variability across academic areas that would be expected for gifted students who are only screened as gifted in one domain. Among all students in the 2011 cohort, the mean discrepancy between math and reading superscores was about 4 points (μ=3.86, SD=2.93). For students

screened as gifted in the reference subset, the mean discrepancy between scores was slightly higher, at about 5 points (μ=5.39, SD=3.28). In the large dataset, a discrepancy between reading and math superscores greater than two standard deviations plus the mean discrepancy in scores of students screened as gifted (i.e., greater than or equal to 12 points) was experienced by only 1.7 % of all students and by 4.2% of the students screened as gifted. This level of overlap between students meeting screening criteria for both giftedness and a SLD is consistent with rough estimates in the literature that the percentage of gifted students who also have a SLD is between two and five percent (Bracamante, 2010). While these cut score criteria appear to be appropriate for screening for giftedness and twice-exceptional in the present study, the definition of giftedness used here (i.e., Math ACT score greater than or equal to 32 or Reading ACT score greater than or equal to 30) may not be appropriate for screening for giftedness in the general population, as the ACT scores of students at the University of Tennessee were well above the national average of all high school students who took the test. Since these criteria were established based on the 2011 cohort of students at the University of Tennessee, these screening criteria for giftedness may only be appropriate for higher education settings with similar demographics and ACT score distributions.

Students screened as gifted in math. Of all students screened as gifted (*N*=5,820), 53.1% (*N*=3,093) were screened as gifted in math. Less than half of students who were screened as gifted in math were also screened as gifted in reading (*N* =1,340). The average reading superscore for students screened as gifted in math was 30.35 (SD=3.75), while the average reading superscore for all students in the sample was 27.22 (SD=4.50).

Students screened as gifted in reading. Of the students screened as gifted, 69.9% (*N*=4,067) were screened as gifted in reading. Only 32.9% of students who were screened as

gifted in reading were also screened as gifted in math (*N*=1,340). The average math superscore for students screened as gifted in reading was 27.91 (SD=3.72), while the average math superscore for all students in the sample was 25.40 (SD=3.99).

Students screened as twice-exceptional. Students screened as gifted with a possible SLD in reading or math accounted for 1.2 % of students (*N*=244).

Twice-exceptional-Gifted with a SLD in math. Students screened as gifted with a SLD in math (*N*=210) scored an average ACT superscore of 33.89 in reading and 20.61 in math, with an average high school GPA of 3.64. This GPA was lower than the average GPA of all students in the sample, which was 3.79. The majority of these students were female (*N*=144), comprising about 69% of the group. About 91% of these potentially twice-exceptional students were White (*N*=191), with Black students accounting for about 3% (*N*=6), and Multiracial students accounting for an additional 3% (*N*=6).

Twice-exceptional-gifted with a SLD in reading. For students screened as gifted in math with a SLD in reading (*N*=34), the average ACT scores for math and reading were 33.12 and 20.09, respectively. These students had an average high school GPA of 3.79, similar to the average GPA of 3.78 for all students in the sample. About 79% of these students were male (*N*=27), with about 68% being White (*N*= 23) and 26.5% being Asian (*N*= 9). The remaining two students were Black (*N*=1) and Hispanic *(N*=1).

Measures

The mean, standard deviation, skewness, and kurtosis of the distribution for each numeric measure relative to all students in the sample are displayed in Table 3. The scores were as expected, with negative skewness characterizing some measures (e.g., high school and college

GPA). Almost all kurtosis values were within the range of -1.0 to +1.0, with college GPA being the only exception.

ACT Superscores. Since 1956 the ACT Test of College Readiness has been used to gauge high school students' probability of being successful in college coursework. The test is divided into four multiple-choice tests of academic achievement in the areas of English, Mathematics, Reading, and Science, and these scores contribute to an overall composite score. For admissions decisions, the University of Tennessee uses ACT superscores, or the highest scores obtained across all test administrations. The highest score across all testing dates is individually identified for each subject area superscore and for the composite superscore. Distributions of the national scores for ACT composite and subject area are reproduced in the Appendix. However, national norms were not used to establish cutoff criteria in the present study, as these norms pertain to all high school students who took the test, not college students, specifically. National averages for discrepancy between subject area scores are not available.

Reliability estimates for the ACT are based on systematic samples of 2,000 examinees who participated in one of six national administrations of the ACT during the 2005-2006 academic year. Scale score reliabilities were high, with a scale score reliability of .85 for Reading, .91 for Math, and .96 for Composite. The correlation coefficient between Math and Reading scale scores was .64.

Information about test development and evaluation in the ACT technical manual (2014) suggests that this commonly-used instrument has high content validity. The test item development process is described as beginning with a curricular analysis to identify appropriate content for the test. Content specialists in subject areas assessed by the ACT are recruited and trained in writing test items. Consultant panels meet regularly to review the items and determine

whether test items continue to reflect relevant curricular content and whether they match content specifications of the test. To ensure discrimination among high and low academic achievement levels, the target mean item difficulty for ACT test items is .58 for high school students taking the test, with a range of item difficulties of approximately .20 to .89. Scores for each test item are assessed and required to meet a biserial correlation of .20 or higher, indicating that each item has a correlation of .20 or higher with the corresponding content area subscore.

Predictive validity of the ACT is well-established in the literature and has been accepted by many institutions as a valid indicator of academic success and retention, with most estimates of the correlation between ACT scores and outcomes such as retention status and college GPA at various time points ranging from .19 to .41 (ACT, 2008). Convergent validity has been demonstrated in studies showing the strong associations between ACT scores, subject-matched high school course work, and high school GPA (for review, see ACT, 2006). Together, high school GPA and course work completed have been shown to account for between 30% and 55% of variance in ACT scores (Nobel, Davenport, Schiel, & Pommerich, 1999).

ACT Discrepancy. The size of the discrepancy between math and reading ACT scores was computed by taking the absolute value of the difference between reading ACT superscore and math ACT superscore for each student.

GPA. Two grade point averages (GPA) were used in this study: high school GPA and college GPA.

High School GPA. High school GPA is a grade point average assigned by the university for admissions purposes, and it is based on grades in the core academic classes on applicants' high school transcripts. High school GPA is calculated by dividing total quality points (i.e. A-F grade assignment in class converted to a 4.0 scale plus 0.5 quality points per Honors class and

plus 1.0 quality points per Advanced Placement, International Bachelorette, or Dual Enrollment class) by the total number of core academic classes taken by the student in high school.

College GPA. College GPA is the GPA used to determine whether students at the university are in good academic standing. This GPA is based on a 0.00-4.00 scale and reflects students' grades in classes taken only at the University of Tennessee. College GPA is calculated by total quality points (i.e. grade assignment in class converted to 4.0 scale multiplied by the number of credit hours) divided by the total number of credit hours taken by the student that are contributing to the student's GPA. To remain in good academic standing, students must maintain a UT GPA of 2.0 (i.e., a C average). If a student's cumulative GPA drops below 2.0, or if a student earns less than a 2.0 two terms in a row, the student is automatically placed on academic probation. A student is automatically dismissed from the university if he/she is on academic probation, fails to make a 2.0 term GPA during the term he/she is on probation, and his/her cumulative GPA is below 2.0 by the end of the term. After a first academic dismissal, students are able to return to the university after sitting out for one fall or spring semester. After a second dismissal, students must complete a more intensive reapplication process and are required to successfully complete 12 credit hours at another institution before being eligible to reapply after a year of absence.

The college GPA may reflect up to three total grade replacements among lower-division courses. A student is eligible to repeat a course and have the new grade replace the old grade for the college GPA if the original grade was a C- or below and the class was a lower-division, introductory level, class. Grades that do not affect the college GPA are grades of withdraw (the student dropped out of a course before the end of the semester), satisfactory (the student passed the course but the class was not on an A-F grading scale), or no-credit (the student failed the

class but the class was not on an A-F grading scale). To graduate from the University of Tennessee, students must have a cumulative college GPA of 2.0 or higher. At the time of data collection, college GPA information was only available for the 2008 entering freshman cohort of students. All analyses using college GPA are limited to students in the 2008 cohort (N=3,739.)

First-Year Retention. First-Year Retention is defined as continuing from the first fall term of enrollment to the next fall term. Students who are retained after their first year at the university are those who re-enroll for the next fall term at the end of their first academic year. At the University of Tennessee, the retention rate of students who enroll as first time freshmen and continue into their second year is currently 85%.

Graduation. For this study, graduation is defined as graduating within six years upon initial enrollment at the university. The University of Tennessee's current graduation rate is 66%, meaning that for all students who enroll at the university as first time freshmen, there is a .66 probability that they will graduate with in a six year period. Students who took longer than six years to graduate, left the university without returning, or who are currently enrolled are not classified as having graduated in the present study. At the time of data collection, the 6 year graduation rate could only be determined for students in the 2007 freshmen cohort. Therefore, for all analyses where graduation was used as an outcome measure, only students in the 2007 cohort were included in the sample.

Major Type. Upon enrollment at the University, freshmen students were given the opportunity to declare intent to pursue a specific major or to be classified as undeclared. Students in the present study declared an interest in a range of 74 majors. For the purposes of this study, each major was classified into one of five general categories: STEM (science, technology, engineering, math) majors, Bachelor of Arts (B.A.) and education majors, business and

communications majors, and agriculture majors. Discretion was used to classify majors that seemed to fit in more than one category (e.g., Agricultural Leadership, Education, & Communication). Students who did not declare an intent to pursue a specific major were assigned to a sixth category: Undeclared. Table 4 shows how each major was classified.

Analyses

The analyses used to address each research question are summarized in Table 5.

Academic outcomes. Chi-square and one-way analysis of variance (ANOVA) analyses were used to address research question one. To determine whether students screened as twice-exceptional were as likely to graduate or to be retained at the university after their first year as other groups (i.e., students screened as gifted, general population of students), each student was first identified according to whether he/she had graduated and whether he/she had been retained after the first year. Once students were identified based on these binary classifications, chi-square analyses were used to determine whether a greater percentage of students screened as twice-exceptional were not retained after the first year or did not graduate than could be reasonably attributed to chance.

To determine whether final College GPA was significantly higher or lower for students screened as twice-exceptional than for other groups (i.e., students screened as gifted, students in the general population), a one-way ANOVA was used. Due to availability of data for college GPA, the sample for this particular analysis was limited to students who first enrolled at the university in the fall of 2008 (N = 3,739). Forty-five students in the 2008 cohort were screened as twice-exceptional.

Choice of major. Chi-square analyses were also used to answer the second research question of this study. These analyses yielded information about whether certain types of majors

(i.e., STEM majors, B.A. and education majors, business and communication majors, agriculture majors, and undecided majors) were disproportionately represented for twice-exceptional students compared to other students. Students screened as twice-exceptional were differentiated according to whether their potential SLD was in reading or math.

Relation of discrepancy to retention and graduation. Binary logistic regression analyses, ROC curve analyses, and one-way ANOVA analyses were used to evaluate whether size in discrepancy between reading and math ACT superscores predicted first-year retention or graduation for all students. Binary logistic regression analyses were performed initially to determine whether discrepancy size predicted retention or graduation. ROC curve analyses were also used to address this question. ROC curve analyses yield an Area Under the Curve (AUC) statistic, which has been referenced as an acceptable indicator of effect size (e.g., Shapiro, Solari, & Petscher, 2008; Swets, 1988). The sensitivity (i.e., the likelihood that students identified as at-risk would not graduate/be retained) and specificity (i.e., the likelihood that students screened as not at-risk would graduate/be retained) of each potential discrepancy cut score were considered, and cut scores were identified that yielded sensitivity levels as close as possible to 90%. Indices for positive likelihood ratio (PLR), negative likelihood ratio (NLR), positive predictive value (PPV), negative predictive value (NPV), and classification accuracy were also calculated. Finally, one-way ANOVA analyses were used to determine whether there were significant mean differences in discrepancy score between students who were retained and not retained and students who graduated and did not graduate.

Incremental contribution of discrepancy to prediction of graduation and retention. A cut score previously obtained through ROC curve analyses was used to create a new categorical "at-risk" variable, where risk was determined by discrepancy level. This variable was

then added as a second step to binary logistic regression models to predict retention and graduation. The graduation analysis was limited to students whose first year of enrollment was 2007. The first step of both models included the constant, high school GPA, and composite ACT score. Results of the standardized coefficents and corresponding significance levels were used to determine whether inclusion of this new variable contributed incrementally to the accurate prediction of first-year retention and six-year graduation.

Traditional indicators of college success. Pearson product moment correlation coefficients were used to address the final research question (i.e., do traditional indicators of college success such as high school GPA and composite ACT score predict college success as well for twice-exceptional students as they do for non-twice-exceptional students). College GPA, graduation, and first-year retention were each examined as indicators of college success. So that the correlation coefficients between traditional predictors and the categorical outcomes of graduation and retention could be calculated, these categorical variables were first dummy-coded (Graduation: 1=yes 0=no; First-Year Retention: 1=yes; 0=no). Fisher r-to-z transformations were then used to determine whether differences in correlations of various predictors and outcomes differed significantly between students screened as twice-exceptional and students screened as gifted or in the general population.

CHAPTER III

Results

Demographic Information

Of the 20,761 students in the sample, 244 were screened as twice-exceptional and 5,693 were screened as gifted in math or reading. For the remaining students in the general population, the average high school GPA was 3.69 (*SD*= 0.45) and the average composite ACT score was 25 (*SD*= 2.59). For students screened as gifted, the average high school GPA was 4.01 (*SD*= 0.43) and the average composite ACT score was 30 (*SD*= 2.61). For students screened as twice-exceptional, the average high school GPA was 3.66 (*SD*= 0.46) and the average composite ACT score was 27 (*SD*= 1.76).

In regard to college academic outcomes, six-year graduation information was limited to the 2007 cohort of students, and college GPA information was limited to the 2008 cohort of students. The first-year retention rate was about 84% for students in the general population, about 89% for students screened as gifted, and about 82% for students screened as twice-exceptional. The six-year graduation rate was about 66% for students in the general population, about 75% for students screened as gifted, and about 71% for student screened as twice-exceptional. Across all three groups, the majority of students were undecided in their choice of major when they started college, with the percentage of students in the general population, gifted, and twice-exceptional groups who were initially undecided being about 73%, 65%, and 76%, respectively.

Academic Outcomes for Students Screened as Twice-Exceptional Compared to Other Groups

Chi-square analyses were used to determine whether students screened as twice-exceptional were as likely to be retained after the first year in college or to graduate within six years as students screened as gifted and students in the general population. First-year retention rates for students screened as twice-exceptional, students screened as gifted, and students in the general population are displayed in Table 6. Because first-year retention did not vary significantly between twice-exceptional-screened students whose giftedness was in math and those whose giftedness was in reading, $x^2(1) = 0.93$, $p = .33$, all students screened as twice-exceptional were combined into the same group for comparison. The percentage of students who were retained after the first year of college was highest for students screened as gifted (88.8%), followed by students in the general population (83.9%), and by students screened as twice-exceptional (82.4%). A chi-square analysis revealed that students screened as twice-exceptional were significantly less likely to be retained after their first year in college than their gifted-screened peers, $x^2(1) = 9.49$, $p < .01$. Though first-year retention was slightly lower for students screened as twice-exceptional than for students in the general population, this difference was not statistically significant, $x^2(1) = 0.39$, $p = .53$.

Six-year graduation rate data were available for only the 2007 cohort of students (N= 3,980). The number and percentage of students in the 2007 cohort who graduated within six years of initial enrollment at the university are shown in Table 7 for each group of students. All students screened as twice-exceptional again were combined in the same group for comparison, as graduation rate did not differ significantly between the twice-exceptional-screened students whose giftedness was in math and those whose giftedness was in reading, $x^2(1) = 0.00$, $p = .95$.

Within six years, 65.6% of students in the general population, 75.1% of students screened as gifted, and 70.5% of students screened as twice-exceptional graduated. The six-year graduation rate for students screened as twice-exceptional was not significantly different from students screened as gifted, $x^2(1) = 0.47$, $p = .49$, nor students in the general population, $x^2(1) = 0.46$, $p = .50$.

Final college GPA was only available for the 2008 cohort of students ($N = 4{,}171$). Due to the smaller sample size, all students screened as twice-exceptional were combined into one group for comparison. A one-way ANOVA was performed to determine whether significant variation in college GPA was present among students screened as twice-exceptional, students screened as gifted, and the remaining general population of students. Descriptive statistics for mean college GPA for each group are presented in Table 8. Significant mean differences in College GPA were observed among the three groups, $F(2, 3969) = 82.11$, $p < .001$. Using η^2 as the measure of effect size, group membership as twice-exceptional, gifted, or general population accounted for 4% of variability in college GPA. Students screened as gifted had the highest mean college GPA ($M = 3.25$, $SD = 0.61$), followed by students in the general population ($M = 2.97$, $SD = 0.61$), followed by students screened as twice-exceptional ($M = 2.91$, $SD = 0.63$). The mean college GPA for students screened as twice-exceptional was 0.35 points lower than students screened as gifted and 0.07 points lower than students in the general population, 95% CIs [0.57, 0.13] and [0.28, 0.15]. Post-hoc comparisons using the Tukey HSD test revealed that mean College GPA was significantly lower for students screened as twice-exceptional than for students screened as gifted without the second exceptionality, $p < .001$. However, mean college GPA did not differ significantly between students screened as twice-exceptional and students in the general population, $p = .74$.

Choice of Major Comparisons

The types of majors chosen by students screened as twice-exceptional were compared to the types of majors chosen by students screened as gifted and students in the general population. Major types included STEM majors (i.e., science, technology, engineering, math), Bachelor of Arts and education majors, business and communication majors, agriculture majors, and undecided majors. Students screened as gifted or twice-exceptional were further classified by whether they were gifted in reading or in math. The percentages of students in each group who chose a major in each of the five major-type classifications are displayed in Table 9. Chi-square analyses were used to compare the percentage of students in each group who chose each type of major. The following group comparisons were made: students screened as twice-exceptional and students screened as gifted, students screened as twice-exceptional and students in the general population, students screened as twice-exceptional with giftedness in reading and students screened as gifted in reading, students screened as twice-exceptional with giftedness in reading and the general population, students screened as twice-exceptional with giftedness in math and students screened as gifted in math, and students screened as twice-exceptional with giftedness in math and the general population. Chi-square values and significance levels for each of these comparisons across major type are presented in Table 10.

Results of these analyses indicated several significant discrepancies, mostly between students screened as twice-exceptional and students screened as gifted. Students broadly screened as twice-exceptional were less likely than students broadly screened as gifted to declare an intent to pursue a STEM major, $x^2(1) = 29.81$, $p < .001$, but were more likely than students broadly screened as gifted to pursue a Bachelor of Arts or education major, $x^2(1) = 4.97$, $p = .03$. Furthermore, students broadly screened as twice-exceptional were more likely than students

broadly screened as gifted to be Undecided, $x^2(1) = 12.95$, $p < .001$. In comparison to students in the general population, none of the five major types were significantly overrepresented or underrepresented by students broadly screened as twice-exceptional.

Additional comparisons differentiated students screened as gifted and students screened as twice-exceptional according to whether their area of giftedness was in reading or in math. In comparison to the general population, students screened as twice-exceptional with giftedness in reading were significantly less likely to declare an intent to pursue a STEM major, $x^2(1) = 12.91$, $p < .001$, and were significantly more likely to be undecided $x^2(1) = 4.94$, $p = .026$. Similar results were found when students screened as twice-exceptional with giftedness in reading were compared to students screened as gifted in reading without the second exceptionality. Twice-exceptional students whose giftedness was in reading were less likely to pursue STEM majors $x^2(1) = 32.85$, $p < .001$, and were more likely to be undecided, $x^2(1) = 13.62$, $p = <.001$ than students screened as gifted in reading.

Between students screened as twice-exceptional with giftedness in math and students screened as gifted in math, no significant differences were found in the types of majors they chose. However, students screened as twice-exceptional with giftedness in math were significantly more likely to choose a STEM major than students in the general population, $x^2(1) = 17.79$, $p < .001$. Twice-exceptional students with giftedness in math were significantly less likely than students in the general population to be undecided in their choice of major, $x^2(1) = 7.06$, $p < .01$.

Using Discrepancy Size to Predict Graduation and Retention for All Students

Retention. A binary logistic regression initially was used to determine the relation of size of discrepancy between Reading and Math ACT Score to the probability that a student would be

retained after his/her first year at the university. Results of the analysis are presented in Table 11. The Wald test was used to determine whether the discrepancy variable was significant and the Wald Chi Square of 28.57 is considered statistically significant, $\chi^2(1) = 28.57$, p=.001; OR= 0.97. This model explained 0.2% (Nagelkerke R^2) of variance in retention and correctly predicted retention for 85.2% of students. However, retention also was predicted correctly for 85.2% of students whose discrepancy score was zero. Statistical significance of the discrepancy value may be attributable to the large sample size, as the odds ratio value was very close to 1.0. In practice, it appears that discrepancy size as a continuous variable is not a useful tool for predicting first-year retention, except when making relative decisions (i.e., vs. gifted students without a discrepancy).

A receiver operating characteristic (ROC) curve analysis was performed to investigate further whether discrepancy size between Reading and Math ACT score predicted first-year retention among all students in the sample. The resulting AUC value of .53 (p=.001) indicates that there would be about a 53% chance that any given student who was not retained after the first year had a higher discrepancy score than any given student who was retained. While this value is statistically significant, given the relatively large sample size, it shows that discrepancy level is only slightly better than chance at predicting first-year retention. Sensitivity and specificity levels for each possible discrepancy level were reviewed to determine what discrepancy score would result in about 90% of students who were not retained being identified as at-risk when that score was used as a cutoff. A visual of the curve representing the sensitivity and specificity levels of various discrepancy scores to predict retention is presented in Figure 1. A cut score of 7.5 was chosen, and this score yielded a sensitivity value of 88.2% and a specificity value of 15.5%. Since discrepancy scores in this study are whole number values, this

cut score was rounded to 8 points, with students classified as at-risk for non-retention if their discrepancy score was 8 points or higher. Positve/Negative Likelihood Ratios (PLR, NLR) and Positive/Negative Predicted Values (PPV, PNV) were calculated, as shown in Table 13. Using this cut score, first-year retention was correctly predicted for 77.4% of all students in the sample. The NPV was calculated as 85.7%, meaning that 85.7% of students with discrepancy scores below 8 points were retained after the first year, as predicted. The PPV was calculated as 18.6%, indicating that students predicted to be at-risk for non-retention due to discrepancy scores of 8 or higher only actually left the university 18.6% of the time after the first year. This low value suggests that this method of prediction is likely to result in many students being identified as at-risk when they will actually end up being retained.

To further clarify the relation between discrepancy size and retention, a one-way ANOVA was used to determine whether students who were retained after their first year of college had a lower discrepancy size between Reading and Math ACT than students who were not retained. Descriptive statistics for discrepancy size of students' scores by retention status are displayed in Table 14. Significant mean differences were found, $F(1, 20759) = 29.221$, $p = .001$. On average, students who were retained had a discrepancy size of 3.84 points (SD= 2.91), while students who were not retained had a significantly higher discrepancy size of 4.15 points (SD= 3.11). When η^2 is used as the measure of effect size, retention status accounted for 0.14% of variability in discrepancy size.

Graduation. Because six-year graduation information was available for only students in the sample who began college in 2007, a separate binary logistic regression was performed to determine how size of discrepancy between Reading and Math ACT scores affected odds of six-year graduation. The results of the analysis are shown in Table 12. The Wald statistic for the

discrepancy variable is equal to 5.82, and the Wald test showed that the discrepancy variable was statistically significant, $\chi^2(1) = 5.79$, $p = .02$; OR= 0.97, explaining 0.2% (Nagelkerke R^2) of variance in graduation and correctly predicting graduation for 67.9% of students. As with the binary logistic regression used to predict retention, graduation was predicted just as accurately when discrepancy size was not included as a continuous variable. Considering the odds ratio value which is close to one, discrepancy as a continuous variable may not offer practical significance for the prediction of odds of graduation, with the caveat mentioned above.

A ROC curve analysis was used as an alternate method of determining whether discrepancy predicted graduation. Results provided an AUC value of .519, meaning that a randomly selected student who did not graduate within six years would only be marginally more likely to have a discrepancy score that was higher than a randomly selected student who did graduate, and this slight difference is not considered statistically significant ($p = .055$). Though discrepancy score as a continuous variable did not predict graduation, individual cut scores were reviewed to see whether any score came close to a 90% sensitivity rate. The curve of sensitivity and specificity levels for various discrepancy sizes to predict graduation is presented in Figure 2. As in the ROC curve analysis for retention, a discrepancy score of 7.5 corresponded to a sensitivity value closest to 90%, with an actual sensitivity value of 88.8% and a specificity value of 13.4%. This cut score was again rounded to 8 points for the calculation of Positive/Negative Likelihood Ratios and Positive/Negative Predicted Values for six-year graduation, and these figures are also presented in Table 13. When an 8-point discrepancy was used as a cut score, six-year graduation was accurately predicted 64.5% of the time. This test is more likely to over-identify students as being at risk for not graduating than to under-identify them, as the PPV indicates that only 36.2% of the students screened as at-risk actually did not go on to graduate

within six years. Only 68.4% of students with discrepancy scores lower than 8 points graduated within six years, as determined by the NPV.

A one-way ANOVA was performed to determine whether there were significant mean differences in discrepancy size between students who graduated within six years of enrollment and students who did not graduate. Students who graduated had an average discrepancy size of 3.78 (*SD* = 2.86), which was slightly lower than the 4.02-point average discrepancy of students who did not graduate, $F(1, 3978) = 5.841$, $p = .016$. This difference is considered statistically significant. However, when η^2 is used as the measure of effect size, graduation status accounted for only 0.15% of variability in discrepancy size.

Adding High Discrepancy to Model Predicting Retention and Graduation for All Students

Results of the ROC curve analysis showed that when an 8-point discrepancy size was used as a cut score to identify students at risk, first-year retention was correctly predicted for 77.4% of students and six-year graduation was correctly predicted for 64.5% of students. A new categorical variable was created, with students being classified as "at risk" due to high discrepancy if their discrepancy score was 8 points or higher and "not at risk" if their discrepancy score was seven points or lower. This variable was then entered as a second step in a binary logistic regression model predicting first-year retention, with the first step including the constant, high school GPA, and composite ACT score, and the second step including the constant and all three variables. These models are summarized in Table 15. The new categorical at-risk variable, based on a discrepancy cut score of 8 points, has a Wald Chi-square statistic equal to 19.51, $p < .001$, which indicated that the categorical at-risk variable contributed incrementally to the prediction of first-year retention when it was added in step two $x^2(1) = 18.84$, $p < .001$; OR= 0.78. A comparison of the odds ratios in Table 14 shows that the at-risk

discrepancy variable (OR= 0.78) was slightly more influential in predicting odds of retention than the composite ACT variable (OR= 1.04).

A second step-wise binary logistic regression analysis was performed to determine whether the at-risk discrepancy variable contributed incrementally to the prediction of six-year graduation. Due to availability of six-year graduation data, this analysis was limited to cases where the first term of enrollment was 2007 (N=3,980). The contribution of the at-risk variable in step two to the model using the constant, high school GPA, and composite ACT was not significant ($p = .18$). The results of this model are shown in Table 16. While the contribution of the at-risk variable was not statistically significant, the odds ratio value of .87 is considerably different from the null value of 1. This relative difference is higher than that found in previously-mentioned analyses where statistical significance was found despite an apparent lack of practical significance. Perhaps the at-risk discrepancy variable did not result in statistical significance in this analysis due to the smaller sample size of students with available six-year graduation data, whereas statistical significance in previous analyses may have been attributable to the extremely large sample size. It is also possible that some of the variance associated with the at-risk discrepancy variable was already accounted for by the other measures.

Validity of Traditional Indicators of College Success for Students Screened as Twice-Exceptional

Pearson product moment (PPM) correlations between traditional indicators of college success (i.e., high school GPA and composite ACT score) and college outcomes (i.e., retention, graduation, and College GPA) were individually computed for students screened as gifted, students who were twice-exceptional, and students in the remaining general population. Due to limitations in the availability of data, correlations between graduation and traditional predictors

were limited to students in the 2007 cohort, and correlations between College GPA and traditional predictors were limited to students in the 2008 cohort. PPM correlations and significance levels for each comparison, by group, are shown in Table 17.

For students screened as gifted and for students in the general population, all correlations between the two predictor variables and three college outcomes were statistically significant. However, for students screened as twice-exceptional, only one statistically significant correlation was found: the correlation between college GPA and high school GPA $r(44) = .34$, $p = .023$. To determine whether the correlation between high school GPA and college GPA was significantly different for students screened as twice-exceptional than for students in the general population, $r(2863) = .42$, $p < .001$, or for students screened as gifted, $r(1060) = .47$, $p < .001$, Fisher r-to-z transformations were performed. The difference in the strength of correlations of college GPA and high school GPA between students screened as twice-exceptional and students in the general population was not statistically significant, $Z = -.609$, $p = .542$. The difference in correlations for students screened as twice-exceptional and students screened as gifted was statistically non-significant, as well $Z = -1.003$, $p = .316$.

Unlike the group of student screened as gifted and the group of students in the general population, for students screened as twice-exceptional, composite ACT was significantly associated with neither retention, $r(242) = .06$, $p = .39$, graduation, $r(42) = .02$, $p = .890$, nor college GPA, $r(44) = .034$, $p = .812$. Furthermore, high school GPA was significantly correlated with neither retention, $r(242) = .07$, $p = .271$ nor graduation, $r(42) = -.13$, $p = .419$, for these students.

CHAPTER IV

Discussion

Summary of Findings

Results of the present study show that college students screened as academically gifted with a SLD in Math or Reading do not achieve to the same level as their gifted-screened peers. First-year retention rate was significantly lower for students screened as twice-exceptional than for students screened as gifted, x^2 (1) = 9.49, $p < .01$. Furthermore, when mean college GPA was compared among the two groups, results revealed that college GPA was significantly lower ($p < .01$) for students screened as twice-exceptional. Also, twice-exceptional-screened students were significantly less likely than their gifted-screened peers to have decided on a major when they began college ($p < .001$), even though these students had clearly-demonstrated academic strengths and weaknesses. Finally, common indicators of college success appeared to be less useful in predicting actual outcomes for students screened as twice-exceptional as for other groups. High school GPA, which was significantly correlated with first-year retention, graduation, and college GPA for other students, was correlated with college GPA but not first-year retention or graduation for students screened as twice-exceptional. Composite ACT score was associated with neither first-year retention, graduation, nor college GPA for students screened as twice-exceptional, though these correlations were significant for other students. These findings have several implications for advocating for the needs and treatment of twice-exceptional students who pursue college.

Additional Evidence for Masking Effects on Composite Measures of Achievement

Masking is commonly experienced by students who are gifted with a SLD. Though these students may be exceptional in more ways than one, they often appear to be average when their

abilities are inferred from composite test scores. Due to these masking effects, it is important for intraindividual variability to be considered in twice-exceptional assessment (Assouline et al., 2010; Mastropieri & Scruggs, 2005; McCallum et al., 2013; Scruggs & Mastropieri, 2002). Results of the present study provide further evidence that the exceptionality of gifted students with learning disabilities is masked by composite measures of achievement. High school GPA is considered the best predictor of academic success in college (for review, see Lotowski et al., 2004). For students in the general population and students screened as gifted in this study, high school GPA was significantly correlated with first-year retention, six-year graduation, and college GPA. However, for students screened as twice-exceptional, high school GPA was not significantly correlated with retention or graduation, and in fact, the correlation between high school GPA and graduation was negative. Though high school GPA was significantly correlated with college GPA, these results indicate that high school GPA may not be a good predictor of academic success in college for many twice-exceptional students. Furthermore, because high school GPA did not predict graduation or retention in college, it is possible that college GPA may not be a good predictor of success for twice-exceptional students who pursue entry into competitive graduate or professional programs which use college GPA in admissions decisions. As with the high school GPA, the college GPA reflects an overall average level of performance that takes into account the student's performance in a wide variety of classes, and such an average may not be meaningful when evaluating the potential of a twice-exceptional student with extreme strengths and weaknesses to succeed in a particular type of program. For example, the college GPA of a twice-exceptional college student who is gifted in math with a SLD in reading may mask the potential of the student to succeed in a math-based graduate program, as the cumulative college GPA is likely to reflect the student's performance in classes such as English

composition, literature, or foreign language courses that may have been required for the college degree but may be less relevant to the student's ability to succeed in a graduate program suited to his/her strengths.

Composite ACT score is another widely-referenced measure of high school students' academic achievement (National Association for College Admission Counseling, 2013). In this study, it was significantly correlated with first-year retention, six-year graduation, and college GPA for both students in the general population and students screened as gifted in math or reading. However, for students screened as twice-exceptional, composite ACT was not significantly associated with any of these important outcomes. As with high school GPA, composite ACT was negatively correlated with graduation for students screened as twice-exceptional, though this correlation was insignificant. Apparently, two of the most widely used predictors of college success may not be valid indicators of first-year retention or six-year graduation for students screened as twice-exceptional. Since composite ACT did not predict graduation or retention for college students screened as twice-exceptional, future research should explore whether composite scores of tests used for entrance into graduate schools or other professional programs predict success in programs for these students. If the student who is gifted in reading with a SLD in math takes the Graduate Record Exam (GRE) to be considered for admission to a math-based graduate program, it is likely that the student's cumulative score that combines the verbal and quantitative reasoning sections will mask the student's talent in math. Future research is needed to explore the use and appropriateness of composite measures, such as college GPA and graduate and professional-level admissions exams, to predict success in post-graduate academic pursuits.

Average Performance with Above Average Potential

Results of this study show that students screened as gifted with a SLD in math or reading earned significantly lower college GPAs and were significantly less likely to stay in college after the first year than students screened as gifted without a SLD. However, college GPA, first-year retention rate, and graduation rate did not differ significantly between students screened as twice-exceptional and students in the general population, though College GPA and retention rate were slightly lower for students screened as twice-exceptional.

These findings indicate that twice-exceptional students may continue to fall short of their academic potential, even once they reach higher education levels. However, there is debate in the literature as to which type of student (average or gifted) best matches the expectations educators should have for twice-exceptional students. Some posit that average performance is adequate, and that if twice-exceptional students are performing at the level of an average student, then there is no need to provide extra services. Others argue that because twice-exceptional students are gifted by definition, they are not reaching their potential unless they are achieving at a level comparable to their gifted peers. In K-12 settings, twice-exceptional students have been shown to underachieve academically (e.g., Reis, Neu, & McGuire, 1995). Often, masking occurs, and their academic performance is not high enough for their potential to be noticed or low enough to raise concern (Baum, 1990; Brody & Mills, 1997; McCoach et al., 2001; Minner, 1990). The results of this study show that the pattern appears to continue into college. Twice-exceptional-screened students' GPAs, retention rate, and graduation rate were average. Whether or not these findings are considered problematic for students screened as twice-exceptional depends on the answers to two questions: 1) What level of academic performance can be

considered the true potential of the twice-exceptional student, and 2) If the potential of the twice-exceptional student is defined as above average, does average performance warrant intervention?

Determining the true academic potential of a twice-exceptional student who is gifted with a SLD in math or reading is not a simple task. To say that the student has below average potential due to their SLD is inappropriate, because twice-exceptional students typically perform at least as well as the average student. To say that the twice-exceptional student has average potential seems inappropriate as well, when he/she has a clearly-demonstrated superior academic talent in at least one subject area. But to say that a twice-exceptional student's potential is most in line with that of a gifted student may not be warranted either, given that the student has a SLD that, by definition, negatively impacts that student's learning.

One way to think about this problem is to consider how academic potential is defined for a K-12 student with a disability, such as students with a SLD in math. Within an RTI framework, the student is identified when he/she performs below average in math relative to the student's peers (Fuchs, Mock, Morgan, & Young, 2003). The student receives increasingly intensive support with the goal of ultimately catching the student up to the average level, relative to his/her peers. In this paradigm, the student's potential is inferred as being average performance, even though the student has a SLD. Within a cognitive/achievement discrepancy framework, a student is identified as having a SLD in math when his/her academic achievement in math is lower than expected, based on the student's cognitive ability level. Within this intrainidivdual or ipsative model, the student's potential is assumed to be the student's overall ability despite the SLD. Evidence of this assumption may be found in how cognitive ability is interpreted using standardized intelligence tests. When ability indexes of intelligence tests are highly discrepant, it is common practice for psychologists to disregard the composite index score

and report the higher index score as being most representative of the student's ability. For example, when interpreting the results of the Wechsler Intelligence Scales for Children, the General Ability Index (GAI) is recommended as a more appropriate measure of intellectual ability than the traditional Full Scale Intelligence Quotient for students with Attention-Deficit Hyperactivity Disorder, as the GAI does not factor in the scores of certain subtests which primarily assess working memory and processing speed (Wechsler, 2003). The student then receives services with the goal of helping him/her achieve at the level that would be expected of someone with the same overall ability level. Again, potential is inferred in terms of the student's strengths. When a Patterns of Strengths and Weaknesses (PSW) model is used, such as the Aptitude-Achievement Consistency model (Flanagan, et al., 2007), a student is identified as having a SLD in math when he/she has below average academic achievement in math and a corresponding lower ability in related cognitive processes, with overall ability being average or better. The student is then given services with the goal of helping him/her perform at a level consistent with his/her overall cognitive abilities not directly linked to the SLD.

Using any of these three models for SLD identification, the student's areas of strength are used to infer the student's academic potential, not the limitations inherent within the learning disability. When a student is identified as having a SLD, the result is not to lower expectations and settle for below average academic achievement. Instead, the diagnosis is intended to inform intervention so that the student might achieve to his/her true potential. If the same standards are applied to twice-exceptional students, where the student's strengths and not weaknesses are the source for determining the student's academic potential, then the student's ability in his/her area of giftedness that should be used to establish an expectation of performance. According to this philosophy, a student who is gifted in reading with a SLD in math is considered to have the

potential to achieve at a level comparable to other gifted students. His/her potential is defined by his/her strengths, not weaknesses.

Even when it is assumed that twice-exceptional students have the potential to achieve at a level comparable to gifted peers, the question remains as to whether falling short of that potential and achieving at an average level is problematic. To some, a disability that warrants intervention is only present when normative deficits are manifest, regardless of intraindividual deficits (e.g., Flanagan et al., 2013; Lovett & Sparks, 2013; Stanovich, 1999). The idea is that average performance is adequate performance, and so there is no problem to remedy. Others argue that when a student is not performing to his/her own potential, regardless of how that achievement compares to the student's peers, there is cause for intervention and support (e.g., Assouline et al., 2011; Mastropieri & Scruggs, 2005; McCallum et al., 2013; Scruggs & Mastropieri, 2002). This belief is in line with the argument for gifted education services in K-12 settings. Students with academic gifts and talents are at a disservice when they are not encouraged and supported to reach their potential, even if their academic achievement is sufficient in comparison to their same-grade peers. Similarly, twice-exceptional university students may be served best when they are given the support they need to achieve to their potential.

When students who are gifted with a SLD drop out of college at faster rate than their gifted peers, colleges miss the potential contributions of these students, both in the classroom and in the college community. These are students with demonstrated academic talents, but because universities do not maximize these talents or fail to provide adequate support, many students drop out after their first year in school. Academically talented students are valuable assets to colleges. Universities that invest in twice-exceptional students and help them better achieve their potential, which benefits everyone as these students go on to become more productive as

students and citizens. These students have the capacity to succeed, but apparently many need support to achieve this potential, as students screened as gifted with a SLD in math or reading in this study exhibit significantly lower first-year retention success and final college GPAs than students screened as gifted.

Recommendations for Screening College Students who are Gifted with a SLD

Colleges interested in better supporting twice-exceptional students can easily screen for these students using the methods described in this study. For example, students were screened as gifted if they earned a Reading ACT score of 32 or higher, and they were screened as gifted in math if they earned a Math ACT score of 30 or higher. Students screened as gifted were further classified as potentially twice-exceptional if the discrepancy between their reading and math score was greater than or equal to 12. Generalizability of the cut scores identified in this study may be limited to large public schools with similar demographics and test scores within their student population. Though these cut score values may not be generalizable to some institutions, the basic formula for screening for students who are gifted with a SLD used in this study can be applied to any school, assuming school personnel use the data appropriate for their institution (e.g., the institution's individual distribution of math and reading admission test scores). For example, in the reference sample of the current study, the average Reading ACT score was 27.37 with a standard deviation of 4.50. When one standard deviation above the mean is used as the cut off for gifted screening, 32 is the resulting cut score. At a school where test scores are slightly lower, the school's own average Reading ACT score and standard deviation statistic may be entered into the same formula, to yield a lower cut score when screening for giftedness in Reading. At institutions where another standardized, normally-distributed admissions test is preferred (e.g., Scholastic Aptitude Test; SAT), the same formula still may be applied.

When using test scores to screen for twice-exceptionality, the formula can be altered to yield a larger or smaller percentage of students at the discretion of the relevant educational decision makers (McCallum, et al., 2013). Institutions with an abundance of resources to distribute to students who they screen as twice-exceptional may decide to use more liberal criteria, such as only one standard deviation above the mean to indicate giftedness, and/or only 1 standard deviation above mean discrepancy level to indicate high intraindividual variation in achievement. Conversely, institutions seeking to identify fewer students may choose to employ more conservative criteria, such as a minimum of two standard deviations above the mean to screen as gifted and/or a minimum of two standard deviations above mean discrepancy level to further screen as twice-exceptional. In short, twice-exceptional status may vary somewhat as a function of each institution's demographics.

At a majority of public four-year colleges across the country, it is common practice to reach out to select populations who may be considered at increased risk for non-retention and to encourage these students to take advantage of various university support services, such as tutoring, academic coaching, academic/career counseling, etc. (ACT, 2010). When screening for students to target for outreach efforts, prospective twice-exceptional students may be readily identified using the methods described in this study. When university officials are interested in screening more broadly for students who are at-risk, they may focus on those who are twice-exceptional but also consider using Reading/Math ACT discrepancy as a single indicator of at-risk status. This screener would identify not only potentially twice-exceptional students, but also students who may be at risk due to high variability in academic achievement. In addition, other discrepancy scores may be considered, such as reading or science.

In the present study, when an 8-point discrepancy score was used to predict at-risk status among all students in the sample, first-year retention was predicted with 77.4% accuracy and six-year graduation was predicted with 64.5% accuracy. This "high discrepancy" variable significantly improved the accuracy of a logistic regression model using high school GPA and composite ACT score to predict first-year retention. While this discrepancy level between Reading and Math ACT scores may not be equally effective at other institutions, the 8-point cut score may be useful as a starting point to screen for students at increased risk for first-year non-retention. As with screening for twice-exceptional status, institutions seeking to be more selective in their screening may use a higher cut score, or they may use a lower cut score to be more inclusive.

Implications for College Students Screened as Gifted with a SLD

The findings of this study show that students screened as gifted with a SLD in math or reading academically underperform in relation to their gifted-screened peers. While these findings do not delineate the specific academic or social/emotional needs of twice-exceptional college students, it is possible to make inferences as to what may be beneficial to these students, given what we know about twice-exceptional students in K-12 settings.

The Critical First Year. While the first year is widely recognized as being critical to students' overall success in college (e.g., Tinto, 1993), the first year may be particularly crucial for students screened as twice-exceptional. Students screened as twice-exceptional in this study had a first-year retention rate that was slightly lower than the general population of students and significantly lower than students screened as gifted. This is not necessarily surprising, considering that researchers have observed that the academic frustration experienced by many

twice-exceptional students often results in a lack of perseverance (Baum & Owen, 1988; Olenchak & Reis, 2002; Reis & Colbert, 2004).

Interestingly, despite having a lower first-year retention rate, the twice-exceptional group was able to achieve a six-year graduation rate similar to students screened as gifted and even slightly higher than students in the general population. These findings imply that students screened as twice-exceptional may be particularly vulnerable during their first year of college, but that the ones who make it to the second year are generally resilient and go on to graduate. For this reason, it appears that the first year of college is a critical opportunity for intervention for students screened as twice-exceptional. After review of the results of a national survey of over 1,000 participating college institutions, American College Testing (2004) cited first-year programs, academic advising, and learning support as the three strategies that made the greatest contribution to student retention. Among the 228 four-year public colleges that participated in the survey, the most frequently endorsed specific interventions were first-year seminar courses for credit, learning communities, and advising interventions for target populations. A more recent replication of the survey (ACT, 2010) revealed that these strategies continue to be influential in promoting retention at four-year schools. Considering the social/emotional characteristics that have been linked to twice-exceptional students in K-12 grade levels, these interventions appear to be particularly well-suited for twice-exceptional students in college.

First-year seminars. Many universities offer special classes to support first-year students as they make the transition from high school to college, and the positive effects of such seminar courses on academic success have been widely researched (for review, see Cuseo, 2012). At the University of Tennessee, a one-credit-hour seminar class called First Year Studies is offered as an elective to all freshmen students. The course has a relatively small class size of

about 15 to 20 students and is typically taught by a university staff member in a student support role, such as an academic advisor or career counselor, with the added support of one or more peer mentors. Course topics address a variety of college concerns, including time management strategies, note-taking strategies, campus engagement, and academic support resources.

The success of similar first-year seminar programs in promoting first-year retention has been demonstrated in numerous self-report studies where the retention rates of students who elect to take such classes were compared to students who opted out (e.g., Belcher, in Barefoot, 1993; Fidler, 1991; VerDuin, 2005). An experimental design study at the University of Maryland at College Park showed that students who were randomly assigned to take the university's first-year seminar course were more likely to be retained after both the first and second year of college, compared to students who were assigned to the control group (Strumpf & Hunt, 1993).

Students screened as twice-exceptional, who have been characterized as having a reluctance to ask for help (Trail, 2010), would likely benefit from this type of first-year college transition course. An experimental study at Bloomsburg University showed that students who were randomly assigned to take a first-year seminar course were more likely to use student support services and had a stronger commitment to educational goals than students who did not take the course (Yale, 2000). Similarly, a self-study study at Champlain College showed that students who voluntarily completed a first-year seminar class were more likely to take advantage of the school's tutoring services and Learning Resource Center (cited in Barefoot, Warnock, Dickinson, Richardson, & Roberts, 1998). Another self-study at the University of Wyoming showed that the use of student services increased significantly when the first-year seminar became a required class (Reeve, in Barefoot, 1993), and yet another self-study showed that students who chose to complete a first-year seminar course used learning resource and tutoring

services twice as much as students who did not take the course, even as sophomores and juniors (Wilkie & Kuckuck, 1989). These outcomes show that students who take these seminar classes develop support-seeking skills, a critical skillset for twice-exceptional students, who otherwise may be reluctant to seek out academic support services on their own volition.

First-year seminar programs have been linked not only to higher retention rates, but also to higher GPAs. In the present study, students screened as twice-exceptional earned final college GPAs that were slightly lower than students in the general population and significantly lower than their gifted-screened peers. At Indiana University in Pennsylvania, students who were randomly assigned to enroll in a first-year seminar course earned significantly higher GPAs after three years than students who were not assigned to the course (Wilkie & Kuckuck, 1989). Considering that twice-exceptional students have been characterized as having a reluctance to ask for help and a lack of perseverance, and that students screened as twice-exceptional in the present study were more vulnerable to dropping out after their first year and earned lower final GPAs in comparison to their gifted-screened peers, first-year seminar courses appear to be a promising intervention for twice-exceptional college students.

Academic advising. In addition to participation in a first-year seminar class, it seems likely that twice-exceptional students would benefit from early academic advising and/or career counseling. ACT's national survey of "What Works in Student Retention" showed that advising interventions for selected student populations were among the most influential strategies for improving retention, and this practice also differentiated the high-performing four-year schools from the low-performing four-year schools (ACT, 2004). At institutions where select populations are already being identified to receive supplemental academic advising, the

screening method proposed in this study could be used to identify prospective twice-exceptional students as another target population.

Results of the present study show that approximately 76% of students screened as twice-exceptional were undecided in their choice of major when they began college, compared to only 65% of students screened as gifted and 73% of students in the general population. Being undecided when starting college is not necessarily a disadvantage, though experts' opinions on this subject have shifted over the years. The prevailing perception of the 1980's that undecided students are at-risk for dropping out of college due to a lack of motivation or direction (e.g., Anderson, 1985; Beal & Noel, 1980; Noel, 1985) generally has been discredited in more recent research (e.g., Graunke et al., 2006; Lewallen, 1993).

Even though being undecided may not be a vulnerability in itself, the high percentage of students screened as twice-exceptional who were initially undecided in this study shows that assistance with choosing a major may be a problem for them. Early consultation with twice-exceptional students about which majors and classes would fit both their aptitude and their interest is needed. When gifted students with a SLD are continually engaged in tasks that aggravate the limitations of their learning disability, they have been shown to experience high levels of academic frustration that reportedly weaken their academic motivation and compromise their perseverance in K-12 settings (Baum & Owen, 1988; Olenchak & Reis, 2002; Reis & Colbert, 2004). It is therefore important for twice-exceptional students, in particular, to choose majors and classes that are well-suited to their strengths and to obtain support for the difficult ones.

Most U.S. institutions set general education course requirements to ensure that graduates achieve proficiency across core academic areas (e.g., English composition, quantitative

reasoning, etc.). Some of these required classes surely will be a struggle for twice-exceptional students who have a SLD in math or reading. However, when academic advisors work with students screened as twice-exceptional to create first and second semester schedules that align primarily with the students' strengths, some academic frustration during the critical first year may be circumvented. Classes that promise to be more challenging for a twice-exceptional student, when possible, should be suspended until later in the student's curriculum, once he/she has had an opportunity to transition to the demands of college and to become familiar with the school's support services. Loading a twice-exceptional student's first year schedule with compatible classes in which the student is likely to succeed may not only prevent early academic frustration, but also offer the opportunity to build academic self-efficacy. Researchers have observed that students who are gifted with a SLD tend to have less confidence in their academic abilities than their peers (King, 2005; Leggett, et al., 2010; Neilsen & Morton-Albert, 1989; Neilsen & Higgins, 2005; Newman & Sternberg, 2004; Reis & Colbert, 2004), and for college students, academic self-efficacy has been linked to higher retention rates and higher college GPAs (Lotowski, et al., 2004; Robbins, et al., 2004). Since students screened as twice-exceptional in the present study had lower first-year retention and lower college GPAs than student screened as gifted, development of an academic plan that is conducive to building academic self-efficacy rather than academic frustration is imperative for these students, particularly during the first year.

Another advantage of meeting regularly with an academic advisor is that the advisor can direct students screened as twice-exceptional to appropriate student support services. These services may include individual or group tutoring, writing centers, academic coaching, student advising center aid, and supplemental instruction sessions. Students screened as twice-

exceptional would likely benefit from these services, particularly academic support services in the area of their disability.

Limitations and Recommendations for Future Research

Several limitations are present within this study. One limitation is that group assignment of participants as twice-exceptional, those screened as gifted, and those in the general population was based on screening measures (i.e., ACT) as opposed to individually administered standardized test of cognition and achievement, which are used for actual diagnoses. Those identified with one methodology may not be diagnosed with the other. Consequently, we do not know how many students screened as twice-exceptional truly were twice-exceptional using more rigorous traditional standards, and we do not know how many students screened as gifted or assigned to the general population were actually twice-exceptional but were missed by the screening method. High academic achievement in one subject with wide variability in achievement across subject areas is characteristic of students who are gifted with a SLD. However, use of only two measures of academic achievement, limits diagnostic capability. To actually determine that a student is gifted with a SLD in math or reading, more information would be needed.

A second limitation of this study is that it explores college outcomes for only a fraction of potentially twice-exceptional students: those screened as gifted with a SLD in math or reading who decided to pursue college. While math and reading are two of the most prevalent learning disabilities, students with a SLD in another area, such as written expression or listening comprehension, were not considered in this study. Furthermore, while gifted with a SLD is one type of twice-exceptional student, there are several other types of disabilities that, when paired with giftedness, result in twice-exceptionality, such as attention-deficit hyperactivity disorder

(ADHD) and autism spectrum disorder. Estimates of the prevalence of ADHD among college students have ranged from four to seven percent (for review, see Weyandt & DuPaul, 2006). With ADHD affecting a sizable number of college students, it is probable that a significant number of gifted students with ADHD were among the students in the sample of the present study. However, unless these truly twice-exceptional students showed a large disparity between reading and math ACT scores, they most likely were screened as gifted or assigned to the general population group for the current study. Ideally, other types of twice-exceptional students would have been excluded from the sample for group comparisons. However, it was not possible to screen for other kinds of twice-exceptional students given the available data. Given that all students in this sample were admitted to the university, generalization of these findings may not only be limited to twice-exceptional students with a SLD in math or reading, but also to twice-exceptional students who pursue college. Therefore, twice-exceptional college students (as in this sample) generally may be more resilient than twice-exceptional students in the general population, and may have already learned strategies to compensate for their limitations.

Among the students screened as twice-exceptional in this study, 86% (N=210) were screened as gifted in reading with a SLD in math, while only 14% (N=34) were screened as gifted in math with a SLD in reading. These proportions may vary considerably from the relative prevalence of the two forms of twice exceptionality in K-12 settings. For example, when elementary school-aged students were screened as potentially twice-exceptional using a similar screening method, with giftedness defined as scoring in the top 16% in reading or math (about 1 standard deviation above the mean) on an academic achievement measure, the percentages of students whose area of giftedness was in math versus reading were relatively even, with 53% screened as gifted in reading with a SLD in math and 47% screened as gifted in math with a SLD

in reading (McCallum et al., 2013). The disproportionate underrepresentation of students whose area of SLD was in reading in the present study may be an indication that twice-exceptional students with a SLD in reading are not being accepted into colleges with high entrance requirements (e.g., like the University of Tennessee). Future research is needed to determine whether students who are twice-exceptional with a SLD in reading are more academically vulnerable in college than students who are twice-exceptional with a SLD in math.

An additional limitation of the present study is that findings only pertain to academic outcomes for students who may be twice-exceptional. While these findings show that students screened as gifted with a SLD in math or reading continue to underperform academically in comparison to their gifted-screened peers, more information is needed to explore whether the social/emotional characteristics linked to twice-exceptional students in K-12 settings persist when students enter higher education settings. We know that students screened as twice-exceptional were less likely to be retained after their first year of college and that they, on average, had lower college GPAs than students screened as gifted, but we do not know why. It is possible that these negative outcomes for students screened as twice-exceptional are the direct result of their academic weakness in math or reading; however, it is also possible that the social/emotional implications associated with twice-exceptionality described earlier contributed to their underperformance in relation to their gifted-screened peers. Future qualitative research that explores the social/emotional characteristics of college students screened as twice-exceptional, particularly those students who were not retained after the first year or who did not graduate, may be beneficial.

To determine which academic interventions are most beneficial to twice-exceptional college students, the cause of their apparent underachievement must be identified, whether the

cause is primarily academic, social/emotional, or a combination. While there is evidence that some of the characteristics associated with twice-exceptional students in K-12 settings (i.e., academic frustration, low academic self-efficacy, and low achievement motivation) are linked to poor performance in college (Reis, et al., 1995), more research is still needed to determine whether twice-exceptional students actually experience these social/emotional concerns in college.

In summary, more information is needed to explore the effects of high academic variability for students with and without other disabilities. Results of this study indicate that high variability between math and reading achievement is a risk factor for first-year college retention. Future research may explore the relation of high variability across achievement areas with social/emotional outcomes and other academic outcomes, both at the college and K-12 level.

Summary and Conclusions. In conclusion, the screening method suggested in this study provides an efficient way to screen for students who may be gifted with a SLD in reading or math using readily available admissions test scores. Given findings that students screened as gifted with a SLD in math or reading earn lower College GPAs and are less likely to stay in school after their first year of college than their gifted-screened peers, it is evident that more needs to be done to help these students reach their academic potential in higher education. Considering these outcomes, and the disproportionately high percentage of twice-exceptional-screened students who were undecided in their choice of major when they began college, future research should investigate whether supplemental academic advising, first-year seminar courses, career counseling, and other strategies are effective in helping twice-exceptional students persist in college and choose majors in which they will be successful.

In addition to exploring interventions at the college level that may benefit twice-exceptional students, researchers may also investigate how interventions at the K-12 level later affect higher education outcomes for these students. The long-term efficacy of interventions with demonstrated positive outcomes in K-12 studies may be evaluated by comparing higher education outcomes between twice-exceptional-screened students who reported receiving services and those who did not report receiving intervention. Such research may be useful to educational decision makers in K-12 settings who may doubt whether identifying and supporting twice-exceptional students with extra services is worthwhile and necessary.

More information is needed to explore academic outcomes in higher education for other kinds of twice-exceptional students. This study screened for twice-exceptional students with potential learning disabilities in math or reading, but gifted students with other types of specific learning disabilities (e.g., written expression) should be screened and studied, as well. Furthermore, more research is needed to investigate outcomes for twice-exceptional students with other types of disabilities, such as twice-exceptional students with ADHD, physical disabilities, and Autism Spectrum Disorder.

Finally, future research is also needed to identify the specific academic and social/emotional concerns of twice-exceptional college students so that the development and implementation of interventions for these students may be tailored to address their needs. Results of this study show that students screened as gifted with a SLD in math or reading had lower first-year retention rates and college GPAs than students screened as gifted, but knowledge of more specific, short-term needs of twice-exceptional students may be useful in informing intervention at the college level.

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APPENDICES

Tables

Table 1

Establishing Cutoff Criteria Using Distributions from 2011 Cohort

Measure	*M*	*SD*	Formula to Establish Screening Cutoff Scores	Screening Cutoff
Reading ACT Superscore	27.37	4.50	Gifted in Reading if Reading ACT $\geq \mu$ + 1 SD	≥32
Math ACT Superscore	25.50	3.88	Gifted in Math if Math ACT $\geq \mu$ + 1 SD	≥30
[a]Discrepancy between Reading and Math	5.39	3.28	Twice-Exceptional if Screened as Gifted AND Discrepancy $\geq \mu$ + 2 SD	≥12

Note. [a]For students screened as gifted.

Table 2

Defining Groups in the Present Study

Group	Definition	*N*
Screened as Gifted	Screened as potentially gifted in math and/or reading	5,693
Screened as Twice-Exceptional with SLD in Reading	Screened as gifted AND as potentially having a SLD in reading	34
Screened as Twice-Exceptional with SLD in Math	Screened as gifted AND as potentially having a SLD in math	210
General Population	All remaining students	14,824

Note. Students screened as twice-exceptional excluded from gifted group for all analyses.

Table 3

Shape of Distributions for Numeric Measures for All Students

Measure	*M*	*SD*	Skewness	Kurtosis
High School GPA	3.78	0.47	-0.51	-0.09
College GPA	3.05	0.63	-1.03	1.36
Composite ACT Superscore	26.44	3.39	0.06	-0.28
Math ACT Superscore	25.40	3.99	0.07	-0.13
Reading ACT Superscore	27.22	4.50	-0.15	-0.62
Discrepancy	3.89	2.94	0.92	0.64

Table 4

Classification of Majors to Major Types

[a]STEM	Bachelor of Arts and Education	Business and Communication	Agriculture
Aerospace Engineering	Agricultural Education	Accounting	Agriculture & Natural Resource Management
Animal Science	Architecture	Advertising	Agricultural Economics & Business
Biological Sciences	Art History	Business Administration	Agricultural Leadership Education & Communication
Biomedical Engineering	Child & Family Studies	Business Analytics	Food Science & Technology
Biosystems Engineering	Classics	Communication & Information	Forestry
Chemical Engineering	English	Communication Studies	Natural Resource & Environmental Economics
Civil Engineering	French	Economics	Plant Science & Landscape Systems
Clinical Laboratory Sciences	Graphic Design	Finance	Wildlife & Fisheries Science
Computer Engineering	Hotel Restaurant & Tourism	Human Resource Development	
Computer Science	Kinesiology, Recreation, & Human Sciences	Human Resource Management	
Electrical Engineering	Interdisciplinary Programs	Journalism	
Engineering Physics	Interior Design	Logistics	
Environmental & Soil Sciences	Italian	Management	
Geography	Music	Marketing	
Geology	Philosophy	Public Administration	
Industrial Engineering	Political Science	Sport Management	
Materials Science & Engineering	Recreation		
Nuclear Engineering	Retail & Consumer Sciences		
Nursing	Social Work		
Nutrition	Spanish		
Physics	Special Education		
Pre-professional Programs	Social Work		
	Studio Art		
	Theater		

Note. [a]Science Technology Engineering Math

Table 5

Statistical Analyses Used to Address Research Questions

Research Question	Outcome Measure(s)	Analyses
1. Comparing college success among groups	Graduation, Retention College GPA	Chi-square One-way ANOVA
2. Comparing choice of major among groups	Choice of major	Chi-square
3. Using discrepancy size to predict college success	Graduation, Retention	Binary logistic regression, ROC Curve, One-way ANOVA
4. Determining incremental predictive power of discrepancy size	Graduation, Retention	Binary logistic regression
5. Comparing correlations between traditional indicators of college success and actual outcomes among groups	College GPA, Retention (dummy-coded), Graduation (dummy-coded)	Pearson Product Moment correlations

Table 6

Percentage of Students Retained by Group

Group	Number of Students in Group	Number of Students Retained	Percent Retained
General Population	14,824	12,431	83.9%
Screened as Gifted	5,693	5,055	88.8%
Screened as 2e	244	201	82.4%
2e-SLD in Reading	34	30	88.2%
2e-SLD in Math	210	171	81.4%

Table 7

Six-Year Graduation Rate by Group (2007 Cohort)

Group	Number of Students in Group	Number of Students who Graduated	Percent of Students who Graduated
General Population	3,002	1,969	65.6%
Screened as Gifted	934	701	75.1%
Screened as 2e	44	31	70.5%
2e-SLD in Reading	7	5	71.4%
2e-SLD in Math	37	26	70.3%

Table 8

Descriptive Statistics for College GPA by Group

Group	*M*	*SD*	Minimum	Maximum
Screened as Gifted	3.25	.611	0.62	4.00
Screened as 2e	2.91	.630	0.86	3.94
General Population	2.97	.613	0.41	4.00

Table 9

Type of Major Chosen by Each Group

Group	STEM	B.A.	Business & Comm.	Agriculture	Undecided
Major Group					
General Population	12.1% *N*=1606	5.8% *N*=866	5.7% *N*=846	3.4% *N*=458	73.2% *N*=10,846
Screened as Gifted	23.1% *N*=1,315	4.7% *N*=266	4.7% *N*=265	2.5% *N*=144	65.0% *N*=3,703
Screened as 2e	8.2% *N*=20	7.8% *N*=19	3.3% *N*=8	4.5% *N*=11	76.2% *N*=186
Subgroup					
Screened as Gifted in Reading	19.7% *N*=760	4.0% *N*=156	4.8% *N*=184	3.0% *N*=116	67.9% *N*=2,617
Screened as Gifted in Math	31.1% *N*=951	4.0% *N*=122	4.1% *N*=126	1.7% *N*=51	59.1% *N*=1,809
2e-Gifted in Reading	3.8% *N*=8	6.2% *N*=13	3.8% *N*=8	4.8% *N*=10	80.0% *N*=168
2e-Gifted in Math	35.3% *N*= 12	8.8% *N*=3	0.0% *N*=0	2.9% *N*=1	52.9% *N*=18

Table 10

Chi-square Values for Major Type Comparisons

Comparison Groups	STEM	B.A.	Business & Comm.	Agriculture	Undecided
Screened as 2e					
to Screened as Gifted	29.809***	4.966*	1.010	3.603	12.953***
to General Population	3.074	1.643	2.647	.033	1.149
Screened as 2e (Gifted in Reading, SLD in Math)					
to Gifted in Reading	32.849***	2.303	.409	2.042	13.619***
to General Population	12.912***	2.944	1.391	1.083	4.938*
Screened as 2e (Gifted in Math, SLD in Reading)					
to Gifted in Math	.277	2.027	1.460	.330	.534
to General Population	17.791***	.548	2.058	.025	7.059**

Note. *p< .05. **p < .01. ***p<.001

Table 11

Binary Logistic Regression Models to Predict First-Year Retention

	Model 1				Model 2			
Independent Variable	B	*SE*	Wald	*OR*	B	*SE*	Wald	*OR*
(Constant)	1.75***	.02	8018.8	5.75	1.89***	.03	3297.8	6.61
Discrepancy					-0.04***	.01	29.1	.97
Model Chi-Square (*df*)						28.57 (1)		
Block Chi-Square (*df*)						28.57 (1)		
% Correct Predictions		85.2				85.2		
Nagelkerke R^2						.002		

Note.*** $p < .001$.

Table 12

Binary Logistic Regression Models to Predict Six-Year Graduation

	Model 1				Model 2			
Independent Variable	B	*SE*	Wald	*OR*	B	*SE*	Wald	*OR*
(Constant)	0.75***	.03	485.0	2.11	.86***	.06	229.0	2.35
Discrepancy					-.03*	.01	5.82	0.97
Model Chi-Square (*df*)						5.79 (1)		
Block Chi-Square (*df*)						5.79 (1)		
% Correct Predictions		67.9				67.9		
Nagelkerke R^2						.002		

Note. Analysis limited to students in the 2007 cohort (*N*= 3,980). * *p*< .05. ****p*<.001

Table 13

ROC Curve Statistics When Discrepancy is used to Predict Retention and Graduation

Outcome Variable	[b]AUC	Cut Score	[c]PLR	[d]NLR	[e]PPV	[f]NPV	Classification Accuracy
Retention	.525***	8	1.04	76.2	18.6%	85.7%	77.4%
[a]Graduation	.519	8	1.04	77.8	36.2%	68.4%	64.5%

Note. Cut score for discrepancy size selected to reflect sensitivity level as close as possible to 90%. [a]Only students in the 2007 cohort were used for the graduation analysis (*N=3,980*). [b]Area Under the Curve. [c]Positive Likelihood Ratio. [d]Negative Likelihood Ratio. [e]Positive Predictive Value. [f]Negative Predictive Value. ****p*<.001

Table 14

Descriptive Statistics for Discrepancy Size by Retention and Graduation Status

Group	*N*	*M*	*SD*	Percentage
Student Retention Status				
Retained	17,687	3.84	2.909	85.2%
Not Retained	3,074	4.15	3.113	14.8%
[a]*Student Graduation Status*				
Graduated	2,709	3.78	2.859	67.9%
Did not Graduate	1,279	4.02	3.051	32.1%

Note. [a]Graduation information only available for 2007 cohort (*N*=3,980).

Table 15

Multivariate Binary Logistic Regression Models to Predict First-Year Retention

	Model 1				Model 2			
Independent Variable	B	*SE*	Wald	*OR*	B	*SE*	Wald	*OR*
(Constant)	-2.74***	.19	218.4	0.07	-2.71***	.19	211.8	0.67
High School GPA	0.97***	.05	4686.6	2.64	0.95***	.05	448.7	2.59
Composite ACT Score	0.04***	.01	218.4	1.04	0.04***	.01	31.3	1.04
[a]At-Risk (High Discrepancy)					-0.25***	.06	19.5	0.78
Model Chi-Square (*df*)	705.62 (2)				724.46 (3)			
Block Chi-Square (*df*)	705.62 (2)				18.84 (1)			
% Correct Predictions	85.2				85.2			
Nagelkerke R^2	.059				.061			

Note. [a]Classified as At-Risk if discrepancy between Reading and Math ACT is 8 points or higher. ***$p<.001$.

Table 16

Multivariate Binary Logistic Regression Models to Predict Six-Year Graduation

	Model 1				Model 2			
Independent Variable	B	*SEb*	Wald	*OR*	B	*SEb*	Wald	*OR*
(Constant)	-4.49***	.35	166.3	0.01	-4.47***	.35	164.2	0.01
High School GPA	1.08***	.09	150.9	2.95	1.07***	.09	146.3	2.91
Composite ACT Score	0.05***	.01	23.0	1.05	0.06***	.01	24.1	1.06
[a]At-Risk (High Discrepancy)					-0.14	.35	1.83	0.87
Model Chi-Square (*df*)	252.35 (2)				254.16 (3)			
Block Chi-Square (*df*)	252.35 (2)				1.81 (1)			
% Correct Predictions	68.3				68.3			
Nagelkerke R^2	.086				.087			

Note. Analysis limited to 2007 cohort of students (*N=3,980*). [a]Classified as At-Risk if discrepancy between Reading and Math ACT is 8 points or higher.*** $p < .001$.

Table 17

Comparison by Group of Correlations of High School GPA and Composite ACT Score with Academic Outcomes in College

Variables	General Population	Screened as Gifted	Screened as 2e
High School GPA with			
Retention	.153**	.210***	.071
Graduation[a]	.223**	.311**	-.124
College GPA[b]	.414***	.470***	.338*
Composite ACT Score with			
Retention	.079**	.113***	.055
Graduation	.106**	.178**	-.043
College GPA	.228***	.202***	.036

Note. [a]Graduation correlations based on 2007 cohort only (*N*=3,980). [b]College GPA correlations based on 2008 cohort only (*N*=4,171).*p< .05. **p < .01. ***p<.001

Figure

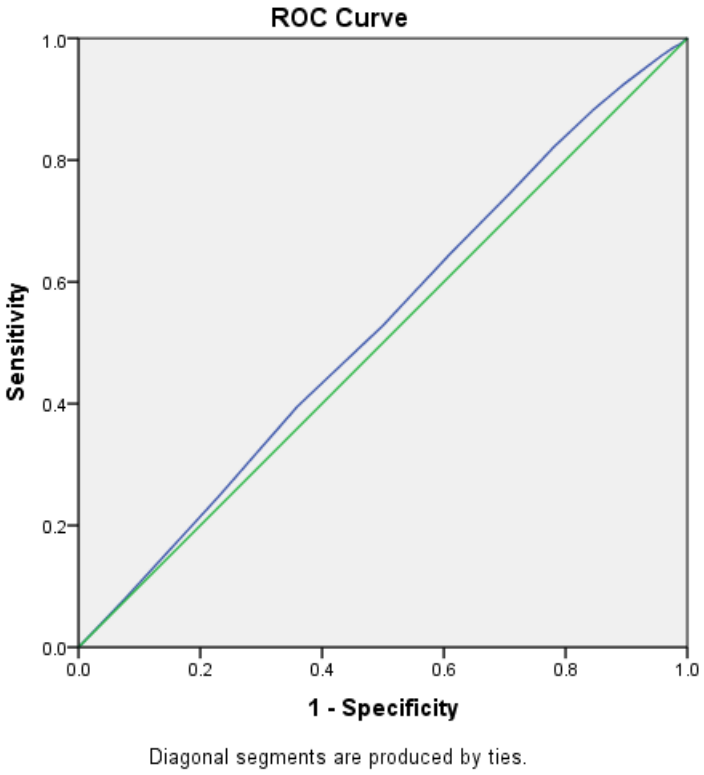

Figure 1. *ROC curve using discrepancy size to predict first-year retention.*

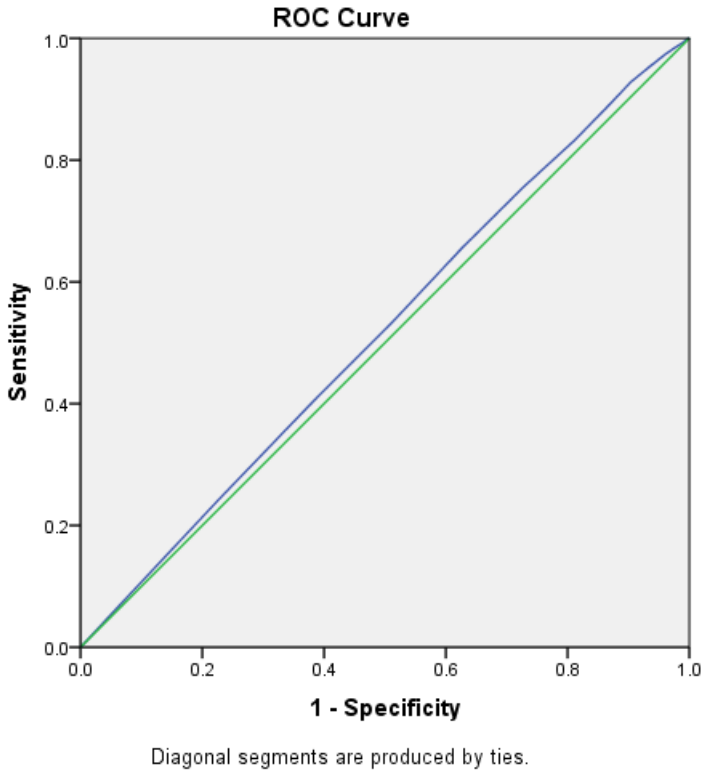

Figure 2. *ROC curve using discrepancy size to predict six-year graduation.*

Note. Analysis limited to students in 2007 cohort (*N*= 3,980).

National ACT Score Distributions

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Graduating Class 2014 Code 999999
National
Total Students in Report: 1,845,787

Table 2.1. ACT Score Distributions, Cumulative Percentages (CP[1]), and Score Averages

ACT Scale Score	English		Mathematics		Reading		Science		Composite		ACT Scale Score
	N	CP	N	CP	N	CP	N	CP	N	CP	
36	5,975	100	5,400	100	13,165	100	11,531	100	1,407	100	36
35	26,161	100	13,108	100	14,556	99	12,611	99	7,175	100	35
34	30,375	98	18,570	99	31,013	98	16,974	99	14,037	100	34
33	30,411	97	18,025	98	38,980	97	14,106	98	19,589	99	33
32	28,737	95	17,626	97	52,419	95	16,738	97	25,524	98	32
31	28,256	93	19,932	96	49,288	92	25,304	96	32,048	96	31
30	41,462	92	30,310	95	54,503	89	25,658	95	41,117	95	30
29	39,959	90	46,744	93	48,770	86	20,210	93	47,863	92	29
28	47,354	87	59,648	91	52,742	84	40,447	92	58,319	90	28
27	51,085	85	73,504	88	55,851	81	70,000	90	68,252	87	27
26	65,951	82	94,975	84	60,553	78	60,807	86	78,342	83	26
25	84,857	79	105,356	78	64,155	74	115,330	83	89,877	79	25
24	100,830	74	109,795	73	82,475	71	121,023	77	100,843	74	24
23	87,151	69	102,903	67	106,481	66	127,163	70	108,788	68	23
22	109,310	64	78,987	61	88,960	61	144,860	63	116,220	62	22
21	116,479	58	77,004	57	154,247	56	131,031	55	120,908	56	21
20	118,238	52	77,389	53	96,038	48	139,527	48	121,593	50	20
19	95,523	45	91,189	49	128,465	42	155,409	41	121,185	43	19
18	75,871	40	124,435	44	89,003	35	100,427	32	120,918	36	18
17	68,820	36	172,761	37	100,323	31	104,819	27	115,530	30	17
16	90,304	32	228,216	28	91,894	25	87,409	21	109,843	24	16
15	117,446	27	165,837	15	81,099	20	69,279	16	101,019	18	15
14	84,233	21	73,316	6	94,542	16	63,193	13	88,696	12	14
13	62,448	16	27,248	2	65,307	11	53,790	9	70,438	7	13
12	58,405	13	8,840	1	58,417	7	42,195	6	42,473	4	12
11	58,237	10	3,082	1	39,108	4	33,180	4	16,603	1	11
10	53,095	7	781	1	17,535	2	20,055	2	4,689	1	10
9	32,318	4	349	1	7,670	1	13,572	1	1,530	1	9
8	20,101	2	201	1	2,500	1	5,073	1	573	1	8
7	10,652	1	55	1	2,942	1	2,056	1	242	1	7
6	3,637	1	85	1	1,539	1	803	1	80	1	6
5	1,260	1	13	1	536	1	505	1	47	1	5
4	551	1	58	1	288	1	329	1	12	1	4
3	174	1	4	1	186	1	203	1	5	1	3
2	83	1	0	1	161	1	76	1	1	1	2
1	38	1	41	1	76	1	94	1	1	1	1
Avg (SD)	20.3 (6.6)		20.9 (5.3)		21.3 (6.3)		20.8 (5.5)		21.0 (5.4)		Avg (SD)

[1]CP is the cumulative percent of students at or below a score point.

Note: Shaded portions of columns identify the students who met/exceeded the ACT College Readiness Benchmark Scores.

VITA

Elizabeth Hays graduated from the University of Tennessee, Knoxville, in May 2011 with a Bachelor of Arts degree in Psychology, with a minor in Child and Family Studies. Subsequently, Elizabeth continued her studies at the University of Tennessee, earning her Master's of Science degree in Applied Educational Psychology in August 2014. Elizabeth will be completing her pre-doctoral internship with Cypress-Fairbanks Independent School District in Cypress, Texas. She will graduate from the University of Tennessee, Knoxville, with a Doctor of Philosophy degree in School Psychology in August 2016.