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Validity And Diagnostic Utility Of The Learning Behaviors Scale

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Validity and Diagnostic Utility of the Learning Behaviors Scale

(TITLE)

BY

Cassandra N. Ledvina

THESIS

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Abstract

Psychological assessment is a critical component in educational decision making and planning; therefore it is important to investigate the validity and diagnostic utility of the tools that we use. The current study examined the construct validity and diagnostic utility of the Learning Behaviors Scale (LBS; McDermott, Green, Francis, & Stott, 1999). Two hundred and seventy-three third grade students were rated by their classroom teacher using the LBS. LBS data were analyzed along with TerraNova achievement scores and InView Cognitive Skills Index. Overall, statistically significant distinct group differences were found for the LBS between the Gifted and Typical groups, as well as the Gifted Referred (students screened, but not identified as gifted) and Typical groups supporting construct validity. However, no statistically significant results were found between the Gifted and Gifted Referred groups. Moderate support was found for the incremental predictive validity for LBS scores. The LBS Total score captured statistically significant variance (1.5% to 5.3%) in academic achievement above and beyond that of the Cognitive Skills Index. Similarly, the LBS factor scores added 3.1% to 6.5% of variance in achievement scores beyond the Cognitive Skills Index. Finally, LBS scores were unable to correctly classify individual group membership for the Gifted and Gifted Referred groups. However, a critical limitation was proposed as a potential reason for the limited support and lack of discriminant validity for the use of the LBS with above average students. A ceiling effect was observed for the LBS Total and factor scores among the Gifted Referred and Gifted groups, which likely limited the range of scores and impacted correlations and variability.

Validity and Diagnostic Utility of the Learning Behaviors Scale

Introduction

Psychological Assessment

Psychological assessment is a multidimensional process aimed at identifying characteristics of individuals with various disabilities and/or giftedness. The process often includes measures of intelligence, achievement, behavior, speech, language, and other factors that influence school performance. Information gathered is used to inform others about how a person is currently functioning, is often linked to interventions, and may be used to predict functioning and behavior in the future. Because psychological assessment is often so vital in decision making and planning, it is important to investigate the validity and diagnostic utility of these tools. The current study proposed to examine construct validity and diagnostic utility of the Learning Behaviors Scale (LBS; McDermott, Green, Francis, & Stott, 1999). Specifically, in differentiating distinct group differences (i.e.; Gifted and Typical students), examining LBS variance accounted for in academic achievement above and beyond that of cognitive ability, and diagnostic accuracy in correctly identifying individual students.

Learning Styles

Many psychological theories have been developed describing individual differences in learning related to the concept of learning styles. The concept of individual differences dates back to the ancient writings of religion and philosophy (Jarvis, Holford, & Griffin, 2003). In 334 BC, Aristotle noticed individual differences and stated "each child possessed specific talents and skills" (Reiff, 1992, p.7). In the 1950's the term "learning style" first appeared in the research literature, and in the 1970's learning styles became a prominent focus in education and research. There is great acceptance and interest in learning styles within all levels of the education system, including parents, teachers, and other professional educators. However the push for use of learning styles is in large part the result of commercial activity and beliefs rather than empirically supported evidence for its use (Pashler, McDaniel, Rohrer, & Bjork, 2009).

Although there are those with beliefs in the efficacy of learning styles and their influence on school performance, the lack of empirical support suggested learning style scales should not be used for individual decision-making. Much of the research has shown substantial weaknesses in the reliability and validity of learning style measures (Curry, 1990). In addition to the lack of supportive psychometric properties of learning style measures, there was no empirical support for matching students' hypothesized learning styles to the teaching style of the teacher.

Teacher guidebooks have emphasized the pedagogy of learning styles. Dunn (1990) proposed a learning-styles model, which focused on individual preferences across physiological, sociological, psychological, emotional, and environmental elements. Dunn and Dunn also developed assessments to identify patterns among learners across the elements and promote teaching through methods that match learning styles (Dunn & Dunn, 1979). However, evidence did not support use of teaching according to students' learning style preference (Pashler, McDaniel, Rohrer, & Bjork, 2009).

Stahl (1999) reported that researchers found matching a students learning style to the instruction style had no relation to actual learning. A review of 13 studies by Tarver and Dawson (1978) found that matching visual learners to sight words and auditory learners to phonics showed no significant interaction. Similarly, Kavale and Forness

(1987) conducted a meta-analysis of 39 studies and found that matching children by reading styles had no effect on achievement.

Measures of Individual Differences/Learning Styles

Field dependence-field independence. Witkin, Moore, Cox, and Goodenough (1977) developed a theory of individual differences based on the variations in how people perceived their environment. Witkin's experiments required subjects to locate vertical in space using orientation tasks such as the body-adjustment test, the rod-and-frame test, and the rotating-room test. These experiments led to Witkin's discovery of individual differences as subjects completed the task in varying ways. He concluded that subjects had preferred ways of integrating the information around them when solving problems. Witkin described the cognitive styles as field-dependence and field-independence. Field dependent individuals used an external frame of reference to solve a task, whereas field-independent individuals used an internal frame of reference to complete a task (Witkin & Goodenough, 1977).

Canfield's learning styles inventory. The Learning Styles Inventory (LSI-C; Canfield & Lafferty, 1974) was developed to assess learning styles from the following perspectives: preferred conditions for learning (peer, organization, goal setting, competition, instructor detail independence, authority), areas of interest (numeric, qualitative, inanimate, people), mode of learning (listening, readings, iconic, direct experience), and expectation for course grade. Canfield moved away from the dichotomous structures of the prior learning style assessments to a multidimensional approach. The LSI-C consists of 16 scales divided into three domains: conditions of learning, areas of interest, and modes of learning (Gruber & Carriuolo, 1991).

Kolb's learning styles inventory. Kolb's model of experiential learning (Kolb, 1984) sparked an interest in exploring learning styles beyond Witkin's contributions to individual differences. Kolb's theory described four, cyclical stages of experiences that guide learning. Through each stage, the learner applied experiences to understand and guide problem solving. Much variation existed in how effective people were with each stage of Kolb's model, which resulted in developed preferences and habits in learning. Kolb's four predominant learning style preferences included divergers, assimilators, convergers, and accommodators. Each of these styles was described through the stages: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE). The four stages represented four quadrants based on individuals' differences in perceiving and processing information (Platsidou & Metallidou, 2009).

Kolb's learning styles have also been termed imaginative learners, analytic learners, common sense learners, and dynamic learners. The imaginative learners fell into the CE and RO categories, and the analytic learners fell into the AC and RO categories. The common sense learners fell into the AC and AE categories, and the dynamic learners fell into the CE and AE categories (American Association of School Administrators, 1991).

Kolb's (1984) theory was based on Lewin's (1936) work in social psychology, Piaget's (1952) model of learning and cognitive development, and Dewey's (2009) model of experiential learning. Kolb's theory combined behavior, experience, cognition, and development to conceptualize the four types of learners. Kolb developed the Learning Styles Inventory (LSI; Kolb, 1976) to test this theory. The LSI measured individual's strengths and weaknesses as learners through a self-report and self-scoring questionnaire (Sugarman, 1985). Adequate internal reliabilities ($r = .78$ - $.88$) were reported for the LSI scales (Marshall & Merritt, 1986). However, the ipsative-ranking format of the LSI, as well as revised versions, made it unsuitable for most psychometric evaluation due to the inability to conduct between-subject analyses (Merritt & Marshall, 1984).

Platsidou & Metallidou (2009) investigated the reliability, construct validity, and discriminant validity of the LSI with a Greek sample ($N = 340$) of primary school teachers and university students from three different departments. Cronbach's alpha coefficients, ranging from .72 to .81, were satisfactory for research purposes for the four constructs. Results of the principal component analysis with varimax rotation supported a two-factor structure of the LSI. Factor 1 consisted of items loading on the CE/RO dimension, and factor 2 consisted of items loading on the AE/AC dimension. However, the structure did not match that proposed by Kolb. The LSI must be robust and portray significant differences between the different groups of participants and the different learning modes to have adequate construct validity. However, Platsidou and Metallidou (2009) did not find significant differences across the different groups. Given the insufficient reliability for individual decision-making ($r \geq .90$) and lack of validity of the LSI, it should not be used in making important decisions for individuals (Pickworth, Glynis, & Schoeman, 2000; Platsidou & Metallidou, 2009).

Merritt & marshall's learning style questionnaire. The Learning Style Questionnaire (LSQ-MM; Merritt & Marshall, 1984; Marshall & Merritt, 1986), a normative rather than ipsative scale, was created to improve upon the poor reliability evaluation of the LSI. The LSQ-MM described the learning cycle through the same four-stages (CE, RO, AC, and AE) described in Kolb's theory. The LSQ-MM was found to have internal consistency reliabilities with alpha coefficients ranging from .78 to .90 for the four scales (CE, RO, AC, & AE). Marshall and Merritt (1986) also conducted least squares factor analysis of all items to examine the construct validity and concluded that all items loaded on the factors as proposed by Kolb's experiential learning model. The two-factor solution accounted for 78.41% of the LSQ variance with 100% item congruence into the hypothesized scales. The four-factor solution accounted for 91.79% of the LSQ variance.

Gregorc style delineator. Gregorc (1982) developed the mind styles model to categorize approaches to learning in which the mind receives and expresses information through distinct channels. His channel theory included four types of learners: concrete sequential, abstract sequential, abstract random, and concrete random (American Association of School Administrators, 1991). The Gregorc Style Delineator (GSD; Gregorc, 1982) was developed to measure these four types of learners using 40 words divided into 10 groups of 4 words. The participant ranked the words in each group from least descriptive (1) to most descriptive (4). A score greater than 26 on a scale was considered a dominant learning style for the individual. The ipsative format of the GSD was also problematic, resulting in questionable reliability and validity estimates (Reio & Wiswell; 2006).

Reio and Wiswell (2006) cautiously investigated the internal consistency and factor structure of the GSD with 467 adult college students. Test-retest reliabilities ranged from .54 to .68 on the scales, which showed inadequate reliability. Confirmatory factor analyses found the factor structure of the GSD did not support Gregorc's four-factor model. The two-factor model consisted of two bipolar dimensions (concrete – abstract and sequential – random). In addition, post hoc exploratory factor analyses found several of the factor structure coefficients loaded on two or more of the four scales (cross-loading). Similar to previously discussed instruments, there was little support for the theoretical structure and use of the GSD to measure individual differences in learning styles (Reio & Wiswell; 2006).

Honey & mumford's learning styles questionnaire. Honey and Mumford (1986, 1992) developed the Learning Styles Questionnaire (LSQ-HM) as an attempt to improve upon measuring Kolb's theoretical learning styles. The LSQ-HM maintained the intended bi-polar structure to measure an individual's preference for each of the four styles to indicate learning style preference. Honey and Mumford used different terminology from the LSI, but the scales correspond to Kolb's learning cycles: Activist was CE, Reflector was RO, Theorist was AC, and Pragmatist was AE. However, as investigated by Swailes and Senior (1999), the factor structure of the LSQ-HM did not reflect Kolb's learning cycle with a two-factor structure consisting of two uncorrelated bipolar constructs (activist – theorist and reflector – pragmatist). Instead, exploratory factor analysis revealed two factor structures that were correlated. The first factor, the Activist scale, contrasts with the Reflector and Theorist scales. The second factor, the Pragmatist scale, moderately loaded on the Theorist scale indicating that this factor was not bipolar. Results of this study suggested that the scale items are not distinct between the Reflector and Theorist scales.

Furthermore, a study conducted by Kappe, Boekholt, den Rooyen, and Van der Flier (2009) investigated the use of LSQ-HM scores in predicting student achievement.

The study found moderate test-retest reliability (Activists $r = .70$, Reflectors $r = .63$, Theorists $r = .50$, and Pragmatists $r = .46$) over a two-year period. According to Duff (2000), overall reliability estimates were found to be $r = .74$ for a one year period. Taking this into account and that reliabilities $r = .50$ and above are considered acceptable, the values ranging from $r = .46$ to .70 may be reported. No significant correlations were found between the predictors (learning styles) and the criterion measures (classroom lectures, skills training, group projects, on-the-job training, and written thesis). Results suggested the instrument should not be used in individual decision-making, as learning styles matching with presentation of material did not predict assessment scores. Due to the lack of predictive validity, Kappe et al. (2009) investigated group differences with predictors combined with criterions that were not hypothesized to match (Activists and Pragmatist on the classroom lecture criterion) compared to the hypothesized match (Reflector group on the classroom lecture criterion) and also found no significant differences (i.e., the Activists did not score higher than a combined Reflector/Theorist group on the criteria of on-the-job training nor did they score higher on the skills training criterion). The lack of empirical support for Honey and Mumford's LSQ make it an inappropriate tool for measuring individual differences in learning styles.

Overall, the measurement of learning styles has resulted in questionable or insufficient empirical support. Research on the LSI found low reliability and that the factor structure did not match Kolb's proposed structure (Marshall & Merritt, 1986; Platsidou & Metallidou, 2009). Gregorc's Style Delineator showed inadequate test-retest internal reliability, and confirmatory factor analyses found the factor structure of the GSD did not support Gregorc's model (Reio & Wiswell, 2006). Research on Honey and

Mumford's Learning Style Questionnaire indicated moderate test-retest reliability; however, there was no support for the predictive validity of the scale (Kappe et al, 2009). Although the reliability and validity of learning style scales are inadequate, many of the scales continue to be used.

The lack of empirical support for the use and interpretation of scales developed to measure individual differences in learning style led to the development of scales that focused on learning behaviors and tactics rather than learning styles. These behaviors and tactics were specific, observable activities of the learner in specific learning situations (Curry, 1990). More recently, the Learning Behavior Scale (LBS; McDermott, Green, Francis, & Stott, 1999), the Academic Competence Evaluation Scales (ACES; DiPerna & Elliott, 2000) and the School Motivation and Learning Strategies Inventory (SMALSI; Stroud & Reynolds, 2006) were developed as methods to quantify characteristics of learning behaviors rather than learning styles. These scales attempt to measure skills, attitudes, and behaviors that are important for academic success. The shift has moved to developing scales that quantify learning behaviors or academic enablers to supplement intelligence and achievement scales for diagnosing disabilities and giftedness.

Alternative Measures of Learning Characteristics

Learning behaviors scale. The Learning Behaviors Scale (LBS) predated the ACES and SMALSI and was developed as an alternative method to measuring learning styles due to the lack of empirical support of learning style measures. The LBS is a teacher report rating scale that quantifies behavioral characteristics of children reflecting efficient and effective learning and is gaining empirical support. McDermott, Green, Francis, and Stott (1999) recognized the influences of "learning behaviors" and argued that a "behaviorally" oriented approach was more appropriate to measure the constructs. The LBS was developed out of the need for an unobtrusive, time efficient teacher rating scale of children's learning behaviors in the classroom (McDermott, 1999). Unlike many previous attempts to measure learning characteristics, the LBS only assesses observable behaviors rather than having teachers make inferences about a child's thoughts or feelings (McDermott, 1999; Schaefer & McDermott, 1999). Knowledge of these behaviors gives insight for the development of interventions, as students portraying positive learning behaviors, such as attention, motivation, and persistence, are academically more successful (Sattler, 1992; Stott, 1985).

The nationally normed LBS is composed of twenty-nine questions that are rated after observing the child for at least 40 school days. The items are rated on a 3-point scale (0 = does not apply, 1 = sometimes applies, 2 = most often applies) and are worded both positively and negatively to reduce response sets. Twenty-five of the 29 items are scored along 4 dimensions of learning behaviors: Competence Motivation, Attitude Toward Learning, Attention/Persistence, and Strategy/Flexibility. The subscale/factor and Total scores are converted to normalized *T* scores ($M = 50$, $SD = 10$; McDermott, 1999).

Academic competence evaluation scales. The ACES is a standardized, group administered scale for kindergarten through 12th grade. The scale measures academic skills (Reading/Language Arts, Mathematics, and Critical Thinking) and academic enablers (motivation, study skills, engagement, and interpersonal skills). There is a teacher report form for kindergarten through 12th grade, a youth self-report form for grades 6 through 12, and a college self-report form. Reviews of the ACES in the Buros Mental Measurements Yearbook (Hambleton, 2010; Sabers & Bonner, 2010) reported high score internal consistency reliability for all scores ($r > .90$). Also, both teacher and student test-retest reliabilities ($r \geq .88$) were acceptable for individual decision-making on the nine scales and subscales. Evidence for construct validity was also demonstrated through factor analysis that matched the hypothesized factor structure. Preliminary evidence suggests the ACES may be useful in differentiating groups with further research needed (Hambleton, 2010; Sabers & Bonner, 2010).

School motivation and learning strategies inventory. The SMALSI purports to be a self-report diagnostic tool that measures strategies actively used by students in learning. The scale seeks to determine performance represented by learning strategies, academic motivation, and test-taking behaviors. Child (ages 8-12) and teen (ages 13-18) self-report forms were developed. A disadvantage to the SMALSI is that it takes approximately 20 to 30 minutes to complete the 147 child form items and 170 teen form items. According to Novak (2005) and Wright (2005), the lack of stability information is problematic in using the SMALSI to assess change over time. The internal-consistency reliability coefficients were acceptable, ranging from .69 to .89. However, reliability coefficients for the 8 to 9 year olds on the Writing construct indicated inconsistencies in reporting at this level. Factor analyses were not reported, but would be helpful, as many of the scales showed high levels of shared variance. A sample of Gifted and Talented children and teens obtained higher scores on the scales compared to the standardization sample. The effect sizes were moderate to large for both the Child Form (.59 - .70) and the Teen Form (.60 - .94). Although the authors provided resources for interventions linked to the SMALSI and some promises for group differentiation, further research needs to be conducted to determine the validity and effectiveness of the SMALSI in individual decision-making (Novak, 2005; Wright, 2005).

Group differences in Learning Behaviors

Academic achievement is positively linked to learning behaviors (McDermott, Mordell, & Stoltzfus, 2001; Schaefer & McDermott, 1999). Children with specific learning disability (SLD) often lack adaptive learning behaviors that are associated with higher academic achievement. Children with SLD, when compared to non-SLD peers, were less task-oriented; described as more distractible and inattentive; and showed less persistence, concentration, and effort when rated by their classroom teachers. These children were also found to have more off-task behavior than non-SLD peers. This suggested that students with learning disability show maladaptive behaviors during instructional activities when compared to non-SLD peers (McKinney, McClure, & Feagans, 1982).

On the other end of the spectrum, gifted children portrayed superior adaptive learning behaviors in the classroom (Burney, 2008). Measuring these learning behaviors may help in the identification of gifted children. The identification of giftedness typically involves an intelligence assessment cut off score as the main indicator (Jensen, 1998). However, intelligence scores predict about half of the variance in achievement with the other 50% left to other variables such as learning behaviors. In addition, due to measurement error in intelligence test scores, cutoff scores will lead to false positives and false negatives in identifying giftedness. Other commonly used criteria for admission into a gifted program include school grades and teacher recommendation, which are highly influenced by the student's motivation, intelligence, and classroom behavior (Davis, 2006).

Knowing a student's cognitive abilities provides a large piece of information for individual decision-making. However, it is not the only component. If other factors or dimensions assist in identifying gifted students, it may be important to include reliable and valid measures of these other dimensions, such as learning behaviors.

Gifted children have been found to portray more positive learning behaviors than comparison peers (Burney, 2008). These children are characterized by an interest in mastery, curiosity, persistence, task completion, and interest in learning new and challenging tasks. Gifted children also demonstrated significantly greater attention span and goal directedness when compared to typical children (Gottfried & Gottfried, 2004). Therefore if gifted children portrayed superior learning behaviors compared to typical, non-gifted children, their scores should be higher on scales, such as the LBS, that measure these characteristics.

Methods to Assess Construct Validity of Tests

Various methods to investigate the construct validity of tests, such as distinct group differences and incremental predictive validity, must be conducted for confidence in their use. More importantly for a test to be used in clinical practice, research must support the diagnostic efficiency of a test. Diagnostic efficiency examines the ability for a measure to correctly identify the group an individual belongs to (i.e., SLD, gifted, typical).

The LBS may be useful in the psychological assessment of gifted children. However, additional studies focusing on the reliability and validity of the LBS with gifted children need to be conducted. It is important to continue validating the LBS, as one study does not validate or fail to validate the score(s) from a test. Studies using various approaches, samples, and populations may be necessary (Benson, 1998). The ability to differentiate distinct groups and provide incremental predictive validity is necessary for the use of tests in psychological assessment. More importantly, diagnostic utility is required for school and clinical psychologists to have confidence in the individual clinical application of the LBS. The purpose of the present thesis was to further investigate the validity and diagnostic utility of the LBS in the context of gifted evaluations. With significant results, the LBS may better aid in identifying gifted children as the LBS measures many of the behaviors identified in the gifted population.

Literature Review

Giftedness

The definition and criteria of giftedness has historically ranged from very conservative to liberal. Terman's definition (1925) identified the top 1% of general intellectual ability as gifted compared to the more liberal conceptualization of giftedness as a consistent, remarkable performance in specific areas (Gagné, 2004). Many of the conceptualizations of giftedness included psychological aspects, while others focused on social contexts in which cultures foster the development of giftedness (Robinson & Clinkenbeard, 1998). Renzulli (2011) proposed giftedness as a combination of above-average general or specific abilities, task commitment, and creativity. Gifted students possess these traits and are able to apply them to various areas of performance. Gifted children require educational programs and services above and beyond those of the regular education curriculum. Acceleration and enrichment programs allow gifted children to realize their contribution to self and society (Robinson & Clinkenbeard, 1998).

Gottfried and Gottfried (2004) defined gifted as "those individuals who are superior in their strivings and determination pertaining to an endeavor" (p. 122). A longitudinal study concluded that children with giftedness showed higher academic intrinsic motivation than typical comparison peers according to the Children's Academic Intrinsic Motivation Inventory (CAIMI; Gottfried, 1986). Academic intrinsic motivation was defined as the enjoyment of learning. This enjoyment of learning was characterized by an individual's interest in mastery, curiosity, persistence, task completion, and interest in learning new and challenging tasks. Gottfried and Gottfried (2004) also found that children identified as gifted showed significantly greater attention span and goal directedness. In addition, hierarchical regression analyses were conducted using intelligence and academic intrinsic motivation to predict academic achievement. It was concluded that academic intrinsic motivation was a significant positive predictor of achievement beyond the variance attributed by intelligence alone (Gottfried & Gottfried, 2004).

Although the terms giftedness and talented are often used interchangeably, the concepts have been defined separately. Giftedness refers to above-average competence in human ability, whereas talent is above-average performance in a specific field. For example, giftedness includes intellectual or creative abilities and talent involves performance in areas such as mathematics or music (Robinson & Clinkenbeard, 1998).

There is much controversy in identifying students for differentiated programs and services. State and federal definitions include the importance of using multiple criteria for identification; however, most often giftedness refers to general intelligence (Davis, 2006). Typically an intelligence test cutoff score of two standard deviations above the mean on individual and group cognitive tests (130 and above on Wechsler scales) are used to determine giftedness (Worrell & Schaefer, 2004). More conservatively, Terman (1925) operationally defined giftedness as an IQ score of 140 or above on the Stanford-Binet Intelligence Scales (Roid, 2003). While intelligence scores predict about half of the variance in achievement (Jensen, 1998), this leaves the other 50% of achievement variance to be associated with other variables, including learning behaviors. Research indicated those who portray motivation, task commitment, attention, and independence had higher academic success (McKinney, Mason, Perkerson, & Clifford, 1975; Subotnik, Olszewski-Kubilius, & Worrell, 2011). Some also believe that qualification for gifted ability should not be solely based on intelligence scores and that a student with an intelligence score of 130 can be admitted into a gifted program if he or she meets other educational criteria (Special Education for Gifted Students, 2000).

Also, like in all tests, there is measurement error in intelligence test scores so any cut score will contribute to various false positive and false negative rates when identifying giftedness. False positive and false negatives can be reduced with better measurement in individual scales and through the use of combinations of scales in making decisions. Therefore, it is important to gather information on other commonly used variables for admission into a gifted program. School grades and teacher recommendation, which are highly influenced by the student's motivation, intelligence, and classroom behavior (Davis, 2006), are often used. It is important to have reliable and valid measures of other variables beyond intelligence that might define or measure giftedness.

Characteristics that Influence Learning

Self-efficacy. One common link to achievement is self-efficacy. Self-efficacy is defined as an individual's belief about their performance capabilities in a particular context or a specific task or domain (Bandura, 1997). Self-efficacy is the foundation for how people feel, what they think, how they make choices for themselves, and also how they motivate themselves (Burney, 2008). Students with higher self-efficacy were more likely to set higher goals and have stronger cognitive strategies (Burney, 2008). Students with positive self-efficacy beliefs were more likely to work hard and be more persistent which ultimately led to higher levels of achievement (Linnenbrink & Pintrich, 2002). In the academic world, self-efficacy is an important predictor of a student's academic performance. Self-efficacy influences behaviors such as effort and persistence through difficult tasks (Linnenbrink & Pintrich, 2002). Therefore, the observable effort and persistent behaviors can be measured to capture the self-efficacy construct. Also, these academic behaviors of students play an important role in their achievement levels as these students set higher goals for themselves and develop strategies for acquiring skills and knowledge (Bandura, 1977).

Bandura's self-efficacy theory suggested that the development of a sense of efficacy is based primarily on past performance in specific situations (Bandura, 1977). In accordance with Bandura's theory, students who struggled and experienced failure often had lower self-efficacy beliefs. Students who were academically successful had stronger beliefs that they had the skills to be confident and therefore were more confident in completing schoolwork (Linnenbrink & Pintrich, 2002). These successes often led to positive reinforcement, in which the student would continue to strive for success to continue to receive positive reinforcement. In the educational setting, efficacy beliefs influenced how much effort a student would expend on an activity, how long they would persevere when confronted with challenges, and how resilient they were when faced with adverse situations (Pajares, 1996).

Self-efficacy varied across groups of children and raters. A sample of mildly disabled (n = 49), gifted (n = 30), and nonhandicapped students (n = 257) were rated using the Academic and Social Self-Efficacy Scale (ASSESS; Gresham, Evans, & Elliott, 1988a). The ASSESS is a 28 item rating scale modified from the Walker Problem Behavior Identification Checklist (Walker, 1976) and the Social Skills Rating Scales (Gresham & Elliott, 1990). Teachers rated mildly disabled students as having significantly lower academic and social self-efficacy than non-handicapped and gifted students. However, no significant differences were found on teacher ratings of academic and social self-efficacy between non-handicapped and gifted students. The same was found when students rated themselves, with the exception that gifted students self-ratings showed significantly lower social self-efficacy than non-handicapped students. Effect size estimates (Cohen's d = .40) indicated a small to moderate effect size. Mildly handicapped children often were presented with academic and social tasks that resulted in failure, which suggested that these students may have had lowered perceptions of academic and social self-efficacy. A possible explanation of the lower social self-ratings for the gifted sample may have been that they compared themselves to other gifted students rather than peers in the general education classroom. No significant differences between parent ratings of mildly handicapped, non-handicapped, and gifted children were found (Gresham, Evans, & Elliott, 1988b).

Research has shown that students who believe they are capable of performing academic tasks use more cognitive and metacognitive strategies, as well as persist longer than those who do not (Pajares, 1996). Zimmerman, Bandura, and Martinez-Pons (1992) found academic self-efficacy mediated the influence of self-efficacy for self-regulated learning on academic achievement. High school students ($N = 102$) completed self-efficacy and goal-setting scales at the beginning of the school year in their social studies class. Academic achievement was measured by obtaining the students' final grades in the social studies class. Using path analysis, a significant causal path was found between students' perceived efficacy for self-regulated learning and their efficacy for academic achievement ($P = .51$). Academic self-efficacy directly influenced achievement ($\beta = .21$) and indirectly raised students' grade goals ($\beta = .36$).

Attention/on-task/distractibility. Self-efficacy is a mediator of academic performance and behavioral variables including attention, persistence, motivation, and strategy. These desired behavioral variables positively influenced self-efficacy which then in turn led to stronger academic performance (Bandura, 1977). Bryan (1974) found that during certain academic activities, children categorized as learning disabled (LD) showed less attention than normally achieving children during the same activity. Also, studies using the Schedule for Classroom Activity Norms (SCAN; McKinney, Mason, Perkerson, & Clifford, 1975) found distractibility was significantly higher for the LD group compared to typical peers.

In addition, McKinney, McClure, and Feagans (1982) used multivariate analysis of variance on the Classroom Behavior Inventory (CBI; Schaefer & Aronson, 1965) teacher rating scale and SCAN observation system for 22 pairs of LD and non-LD second and fourth graders. It was found that both methods discriminated the groups. Children with LD, when compared to non-LD peers, were less task-oriented; described as more distractible and inattentive; and showed less persistence, concentration, and effort. They were also found to have more off-task behavior than non-LD peers. This suggested that students with learning disability showed maladaptive behaviors during instructional activities when compared to non-LD peers.

Motivation. Motivation also plays a key role in academic achievement. According to Bandura's (1986) social learning theory, those with higher motivation typically showed higher achievement. Student motivation was "conceived as being inherently changeable" (Linnenbrink & Pintrich, 2002, p. 314). As students believed they could be successful, they showed stronger motivation (Burney, 2008). Gifted children often had more academic success and higher levels of motivation to continue to succeed.

Another theory, attribution theory, explained that students attribute the cause of their success or failure along a dimension of internal–external control (Weiner, 1986). The causes were internal/external, controllable/uncontrollable, or stable/unstable. Self-efficacy developed out of the beliefs behind successes or failures in a specific area. Students who attributed success to intrinsic characteristics tended to put forth more effort and achieved more. Olszewski-Kubilius, Kulieke, and Krasney (1988) conducted a meta-analysis and found elementary gifted students scored significantly higher on internal locus of control compared to non-gifted students. These children assumed more responsibility for past events and expressed greater feelings of competence to affect future events.

Dweck's theory also involved persistent and effortful behavior patterns. Children who believed their intelligence is an entity or fixed, set goals for themselves based on performance; the goal was to gain positive judgments from others and avoid the negative judgments of incompetence. Individuals of the entity mindset, who perceived their current ability as high, sought challenges and portrayed high persistence. However when individuals of the entity mindset perceived their current ability as low, their behavior pattern indicated they avoided challenges and showed low persistence. Children who believed their intelligence was incremental or malleable, set goals for themselves based on learning; the goal was to increase competence through learning. Individuals of the incremental mindset, whether they perceived their present ability as high or low, sought challenges and portrayed high persistence (Dweck, 1986; Dweck & Leggett, 1988).

Learning Behaviors Predicting Achievement

According to McDermott, Mordell, and Stoltzfus (2001) learning behaviors were defined as observable behaviors displayed by a child as they approach and undertake learning tasks and have been found to be useful in predicting achievement along with cognitive abilities. Schaefer and McDermott (1999) found students who demonstrated desire and willingness to try tasks and engage in learning activities showed higher achievement based on both teacher-assigned grades and the standardized achievement tests. In addition, positive attitudes toward learning added to achievement measured by standardized tests, and using appropriate strategies and coping with frustration added to teacher-assigned grades. Also, students who were attentive and persisted during learning tasks showed higher achievement and grades.

McKinney, Mason, Perkerson, and Clifford (1975) examined the relationship between classroom behavior and academic achievement with 90 second graders. The SCAN system was used to collect data on behaviors during the fall and spring for each student. Achievement was measured using five subtests of the California Achievement Test (CAT; Christian Liberty Press, 1970), and abilities were measured using the Primary Mental Abilities Test (PMA; Thurstone & Thurstone, 1948). No significant differences were found in behavior patterns between boys and girls. Multiple regression analyses indicated that the fall behaviors accounted for 33% of the variance in fall achievement and spring behaviors accounted for 25% of spring achievement. The fall behaviors also accounted for 31% of the spring achievement scores. Most importantly when fall behavior patterns were included with IQ in the multiple regression analyses, the behaviors added significantly more variance (total $R^2 = .76$) in predicting achievement. This was an increase from the variance of IQ alone ($R^2 = .49$) in predicting achievement. Similar results were found when spring behaviors were used with IQ to predict achievement ($R^2 = .83$). Overall, it was found that children who were attentive, independent, and task-oriented were more likely to succeed academically than children who were distractible, dependent, and passive in interactions with peers. Also, the behaviors had incremental validity in the achievement assessment above and beyond IQ alone.

DiPerna and Elliott (2000) described academic enablers as attitudes and behaviors that allow a student to benefit from classroom instruction. Elliott, DiPerna, Mroch, and

Lang (2004) used the Academic Competence Evaluation Scales (ACES; DiPerna & Elliott, 2000) to explore group differences between general education students, academically at-risk students, and students with learning disability on ratings of academic enablers. Both self-report and teacher report ratings were examined. The first sample consisted of 2,060 teacher ratings of kindergarten through 12^{th} graders, and the second sample consisted of 534 self-reports of 6^{th} through 12^{th} grade students. The previous two samples were combined to create a third sample, which included both self-ratings and teacher ratings. The four Academic Enabler subscales were examined (Interpersonal Skills, Motivation, Engagement, and Study Skills). The general education students were rated significantly higher on all academic enablers compared to students with LD, with a very large effect size (Cohen's $d = 1.18$) for the Total Academic Enabler score. The general education students also were rated significantly higher than at-risk students on all academic enablers, with a very large effect size (Cohen's $d = 1.62$) for the Total Academic Enabler score. An educational status main effect was also found to be statistically significant on self-report ratings. General education ratings were also significantly higher than those of students with LD on all academic enablers, with a large effect size (Cohen's $d = .93$) for the Total Enabler score. Medium to large correlations (.40 - .60) were found between teacher and student ratings in the third sample. This study provided insight on differences between groups with regard to academic enablers. The information may also assist in assessment and development in learning behavior research.

Yen, Konold, and McDermott (2004) investigated the structural relationship between learning behavior and student achievement, beyond what cognitive abilities accounted for. Data were collected as a part of the national standardization sample for the

LBS, Differential Ability Scale (DAS; Elliott, 1990), and the Adjustment Scales for Children and Adolescents (ASCA; McDermott, Marston, & Stott, 1993). Structural Model I examined learning behavior, cognitive ability, and achievement constructs specifying that all constructs were correlated. Model II examined the direct relationship between cognitive ability and achievement by freeing learning behavior from the path. Models I and II were examined as the foundation for Model III, and results were as expected for Models I and II. Model I evidenced acceptable fit indices as learning behaviors, cognitive abilities, and academic achievement were all correlated. Model II demonstrated the direct relationship between cognitive ability and achievement. Model III was an addition to model II in which the direct path from learning behavior to academic achievement was estimated. The study found that model III was statistically better than model II, Δx^2 (1, $N = 1304$) = 22.040, $p < .01$. This indicated that learning behaviors accounted for a unique relationship on academic achievement beyond that attributed by cognitive ability.

Teachers Assessment of Learning Behaviors

Several methods, such as rating scales and checklists, have been used to assess classroom behavior of children. Myklebust, Boshes, Olson, and Cole (1969) reviewed teacher's perceptions of children with learning problems and found behavior ratings on a multitude of tests and instruments were one of the best predictors of a child's identification as LD. These children were often rated as less task-oriented, less organized, and less responsible with schoolwork. Results established the importance of including behavioral measures along with IQ and achievement level when classifying children, as well as using teacher input.

Generally speaking, many global teacher-rating scales have been found to predict achievement, as well as differentiate LD and typical students (McKinney & Feagans, 1983). Unfortunately not many scales with good standardized normative data have been developed for assessment of learning behaviors. Often lengthy individually administered assessments or classroom observations have been used. The vast research on teachers as accurate, reliable, unobtrusive, and relatively cost efficient raters aids the importance of using a teacher rating scale for learning behaviors (McDermott, 1999).

Learning Behaviors Scale (LBS) Research

The purpose of the LBS is to identify targeted behaviors in a rather unobtrusive manner and the behaviors are those that can be influenced through intervention. The LBS was developed over a period of about 15 years. Orthogonal and oblique factoring revealed the 4 dimensions of learning behavior: Competence Motivation, Attitude Toward Learning, Attention/Persistence, and Strategy/Flexibility. The current form was standardized on 1,500 students ages 5-17 and nationally normed to match the 1992 U.S. Census (U.S. Department of Commerce, 1992) with matrix blocking for age, gender, academic level, ethnicity, family structure, disabling condition, national region, community size, and parent education. The norm sample included 67.7% White students, 15.9% Hispanic students, 12.1% African-American students, and 4.3% students from other ethnic groups (McDermott, 1999).

The standardization sample included 154 public school districts and 47 private schools with diverse enrollments. Consent forms and demographic information were obtained from parents. Participants among those with parent permission were randomly selected to meet stratification quotas. Also, the same classroom teacher rated no more than two participants. All teachers received financial or service compensation for participating (McDermott, 1999).

Psychologists and graduate students administered the Differential Ability Scales (Elliott, 1990) to 1,366 of the 1,500 participants to assess cognitive abilities in co-norming by the Psychological Corporation. The Adjustment Scales for Children and Adolescents (McDermott, Marston, & Stott, 1993) was also administered to teachers of 1,252 participants of the LBS norm sample in co-norming by the Psychological Corporation. The LBS norm sample was found to be reasonably representative in terms of general intellectual ability, achievement, and social-emotional functioning (McDermott, 1999).

LBS reliability. Internal consistency coefficients all met the alpha $\geq .70$ criterion for the overall standardization sample and pertinent subsamples. The average internal consistency estimates for the standardization sample were .82 for the Total score, .85 for the Competence Motivation subscale, .84 for the Attitude Toward Learning subscale, .85 for the Attention/Persistence subscale, and .75 for the Strategy/Flexibility subscale. A two-week test-retest reliability study was also reported ($N = 77$, ages 7-12 years). Statistically significant and substantial stability coefficients (.91 - .93) were found (McDermott, 1999).

Buchanan, McDermott, and Schaefer (1998) investigated interrater agreement of the LBS with students in self-contained special education classrooms. Pairs of special education teachers and special education aides independently completed the LBS on a total of 72 students in Philadelphia, PA. Significant interrater agreement was found across independent teachers and teacher aides. Pearson product-moment, interclass coefficients, ranged from .68 to .88 on the subscales, and the coefficient was higher for the Total scale ($r = .91$). The Shrout-Fleiss (1979), intraclass coefficients, illustrated the same agreement coefficients for each subscale/factor and the Total score. No statistically significant differences were found in mean scores between the observers. This indicated that overall the special education class was viewed as having comparable levels of learning behaviors by two independent raters. In addition, the class mean *T* score fell nearly one standard deviation below the population mean, indicating that special education teachers generally reported their students as having less effective learning behaviors. Interclass alpha coefficients ranged from .68 to .88 for the subscales and .91 on the LBS Total score. The intraclass correlation approach was used and indicated a consistent and adequate coefficient range. Therefore, the LBS ratings were comparable across observers in terms of level (severity), rank ordering, and pattern.

LBS validity. Convergent and discriminant validity research supported the LBS scores in comparisons with the Differential Ability Scale (DAS; Elliott, 1990), the Basic Achievement Skills Individual Screener (The Psychological Corporation, 1983), teacher-assigned grades, and the Adjustment Scales for Children and Adolescents (ASCA; McDermott, Marston, & Stott, 1993). Strong positive relationships were found between all ability and achievement criteria and the LBS Competence Motivation (CM), Attention/Persistence (AP), and Attitude Toward Learning (AL) dimensions. A secondary relationship was also found between poor reading performance and LBS learning inflexibility and over-vigilance as measured by the LBS Strategy/Flexibility (SF) and AP subscales. The LBS accounted for 12.1% of the variability in DAS verbal, nonverbal, and spatial ability. Statistically significant negative bivariate correlations were found between the LBS and ASCA syndromes. Therefore, generally less behavior pathology was observed as learning behavior improves (McDermott, 1999).

Incremental validity of LBS scores was established with the normative sample by demonstrating that learning behavior significantly improved the prediction of teacher assigned grades above that of cognitive ability alone. Schaefer and McDermott (1999) examined a representative cross-sample of students ages 6-17 drawn from the national standardization samples of the LBS and the DAS. A secondary sample from the LBS and DAS with teacher-assigned grades was included. Hierarchical setwise regression models were used for the achievement criterion, and the independent variables: demographics, intelligence, and learning behavior. All independent variables were simultaneously entered into the regression models. Preliminary analyses using zero-order correlations found intelligence and learning behaviors to be nonredundant constructs with only 15.2% overlap. This indicated that about 85% of the variance between intelligence and learning behaviors was unique. The LBS predicted variation in teacher-assigned grades beyond demographics and contributed to student's grades in addition to IQ. While 15.8% of grade variation was accounted for by demographics and 16.9% was accounted for by test variation, learning behavior accounted for a larger proportion of variance, 21.6%, of grade variation and 7.9% of test variation.

Learning behaviors and intelligence together accounted for 32% of variability in teacher-assigned grades and 34.8% variability in test scores. Learning behaviors accounted for 27.1% of the variability in teacher-assigned grades and 12% in achievement test scores. The intelligence variable however accounted for 15.7% of teacher-assigned grades and 32.1% of achievement test scores. This indicated that learning behaviors were able to account for a large part of teacher-assigned grades, as intelligence was able to account for a large portion of standardized testing variance. However when learning behaviors and intelligence were combined, academic achievement was better predicted (Schaefer & McDermott, 1999).

Worrell, Vandiver, and Watkins (2001) investigated the factor structure and internal reliability of the LBS with 10 participating teachers. A total of 257 elementary students were included in the study. Worrell et al. reported the internal consistency of the Total score as highly consistent across all subgroups and the total sample (.88 - .91). They suggested that the LBS Total score and two subscales/factors (Competence Motivation and Attitude Toward Learning) could be used for individual decision-making. The Attention/Persistence and Strategy/Flexibility factors were good only for screening purposes as internal consistency estimates were lower than .70 indicating only moderate reliability. However, these estimates were based on small subgroups of 52 or less students.

In the same study, exploratory factor analysis was performed using principal axis extractions for both three-factor and four-factor models. Both were used, because a parallel analysis indicated a three-factor model while the LBS was based on a four-factor model. Principal axis with equamax rotation for a four-factor solution accounted for 51.1% of the variance in scores, and 23 of the 25 items loaded on one factor with a structure coefficient loading of at least .40. The communality estimates ranged from .07 to .66 with majority being at least .40. Results were similar to the normative sample (McDermott, 1999), except three items cross-loaded on two factors and four items loaded onto different factors. Two of the items from CM cross-loaded onto the AL factor, and an

AL factor item cross-loaded onto the CM factor. An item from the AP factor loaded on both the CM and SF factors. Overall, the CM, AL, and SF factors were generally consistent with the normative sample with construct reliabilities ranging from $r = .77$ - .82. It was suggested that more research needed to be conducted to investigate the AP factor (Worrell, Vandiver, & Watkins, 2001).

The three-factor solution was also examined and accounted for 47.4% of the variance in scores. Similar to the four-factor structure, the AP items varied the most from the normative sample. Factor I was named Attention and Learning Attitudes as 11 of the 14 AL and AP items and one CM item loaded on it. Seven of the CM items, two AL items, and one AP item loaded on Factor II, Competence/Motivation. The third factor was named Strategy/Flexibility as seven of the SF items and one of the AP items loaded on it. One SF item did not have a salient loading on any factor; however, it had the highest loading on the SF factor compared to the other two factors. Overall, the construct reliability estimates were all above .8, but this may indicate overfactoring as the pattern shifted loadings. Therefore, a four-factor solution consistent with the normative sample may be the best fit for the LBS data (Worrell, Vandiver, & Watkins, 2001).

Canivez, Willenborg, and Kearney (2006) found good internal consistency and support for the four-factor structure using a second independent sample of 241 students in grades 1 through 8. Internal consistency estimates for the total sample ranged from .77 to .93 ($M = .88$). These estimates met the requirements for individual decision making for Total score and the CM and AL factors. These results were also consistent to those found by McDermott (1999) and Worrell et al. (2001). Principal axis analysis with equamax rotation examined both a three and four-factor model as was conducted in the Worrell et al. (2001) study. For the four-factor model, communality estimates ranged from .24 to .87 with 21 items exceeding .40. The four-factor model accounted for 50.94% of the variance in LBS scores. Four of the items loaded on factors different from the standardization sample (McDermott, 1999). Canivez et al. (2006) found the coefficients of congruence with the standardization sample ranged from .93 to .98 indicating a “good” to “excellent” match (MacCallum, Widaman, Zhang, & Hong, 1999, p. 93).

The three-factor model accounted for 46.78% of the variance in scores with communality estimates ranged from .21 to .89. However, only 16 of the 25 items exceeded .40. Seven of the 25 items loaded on factors different from that found in the three-factor model with the Worrell at al. (2001) sample. Coefficients of congruence with the Worrell et al. (2001) sample were only .85 - .95 indicating only a “borderline” to “good” match (MacCallum et al. 1999, p. 93). Overall, exploratory factor analyses supported the four-factor model and extended Worrell et al. (2001) results by supporting the inclusion of the AP factor.

Canivez and Beran (2011) investigated the factor structure of the LBS with a Canadian sample of 393 youths. Principal axis exploratory factor analysis with equamax rotations produced a four-factor structure in congruence with the standardization sample and the Canivez et al. (2006) study. Communality estimates ranged from .28 to .68, and the variance in the LBS scores on the factors ranged from 10.48% to 14.19%. Coefficients of congruence were found to be “good” or “excellent” (MacCallum et al. 1999, p. 93). In addition, LBS raw scores did not meaningfully differ from the U.S. standardization sample raw scores indicated the ability for the LBS to be used for research and clinical practice in Canada.

Worrell and Schaefer (2004) examined the reliability, structural validity, and predictive validity of the LBS scores of two independent, academically talented student cohorts ($N = 674$) enrolled in a university summer camp. Admission to the camp was highly competitive and included evaluating grade point average, achievement test scores, teacher recommendations, an academic sample, and an interest inventory. Independent *t*-tests were conducted to compare the academically talented subgroup to the normative sample and a gifted-talented subgroup. The study found that academically talented students had scores significantly higher ($p < .002$) than the normative sample (McDermott, 1999) and not significantly different from the gifted talented subgroup of the normative sample.

In the same study, internal consistency reliability for the LBS subscales and Total were moderate ranging from .67 to .86. Exploratory factor analyses were comparable to that found in the normative sample for Cohort 1. The four-factor model accounted for 40.2% of the variance in LBS scores. All 25 of the items loaded on at least one factor ($r \geq .35$), and construct reliabilities ranged from .64 to .76. Because eight items loaded on factors different from the normative sample, a three-factor model was also examined. This model accounted for 35.9% of the variance, and 24 of the 25 items loaded on at least one factor ($r \geq .35$). However, the three-factor structure had five items that cross-loaded on two or more factors and five items that loaded on factors differing from the normative sample. Construct reliabilities ranged from .67 to .83. Similar exploratory factor analyses results were found with Cohort 2 for the four-factor structure. Coefficients of congruence between the two cohorts were in the .9 range, and the four-factor model was found to be the best fit for LBS scores (Worrell & Schaefer, 2004).

Worrell and Schaefer (2004) also found predictive validity of the LBS scores in achievement, which was measured using teacher-assigned grades. Multiple regression analyses indicated that the LBS scores accounted for 38% of the variance in teacher-assigned grades for Cohort 1 and 22% of the variance in Cohort 2. Although, there are very few behaviorally based rating scales available for use in identifying students that are gifted. This provided evidence that the LBS may be useful in rating gifted children. Worrell and Schaefer (2004) suggested further research to examine LBS scores with samples of nonidentified, referred, and identified students to see if the LBS could aid in the identification of academically talented and gifted students for school-based programs.

Research conducted on the LBS has found good internal reliability and support for the factor structure. Convergent and divergent validity were established for the LBS, as well as some support for the predictive validity. The LBS added a unique component to predicting achievement above and beyond that of cognitive abilities alone. Learning behaviors were easily observed and readily linked to interventions, which added to the benefit of assessing learning behaviors (McDermott, Mordell, & Stoltzfus, 2001). As suggested by Worrell and Schaefer (2004), more research needs to be conducted with the LBS in assisting with the identification of gifted students.

Purpose and Hypotheses

Although the current research supports use of the LBS, it is important to continue validating the instrument as one study does not validate or fail to validate the score(s) from a test. Studies using various approaches, samples, and populations may be necessary (Benson, 1998). The current study proposed to examine the capability of the LBS in differentiating students classified as gifted. It is necessary to provide construct validity evidence through investigating distinct group differences. The following research question was developed for the current study: would students identified as Gifted according to district criteria show statistically significant and meaningful differences from the Typical and Gifted Referred students on LBS Total score and factor scores. It was hypothesized that the mean LBS Total score and factor scores would be highest for the Gifted group compared to the Typical group. It was also hypothesized that the Gifted Referred group would have higher LBS scores than the Typical group (Burney, 2008; Gottfried & Gottfried, 2004; Worrell & Schaefer, 2004).

The incremental predictive validity of the LBS was also investigated. The following research question was developed: would the LBS Total and factor scores provide incremental prediction of academic achievement beyond intelligence. Incremental predictive validity investigates a measures ability to add to the prediction of a criterion above and beyond what is predicted by other sources (Haynes & Lench, 2003; Hunsley & Meyer, 2003). It was hypothesized that the LBS Total and factor scores would predict academic achievement above and beyond that of cognitive abilities alone (Schaefer & McDermott, 1999; Worrell & Schaefer, 2004).

The LBS may be very useful with a combination of other diagnostic tools. With significant results, it may become an important addition in identifying gifted children. Differences between groups are necessary for the use of the test, but are not sufficient. However, the diagnostic utility of the test must also be supported for the test to be used in clinical practice. The following research question was developed: would the LBS Total and factor scores correctly identify students classified as Gifted, Gifted Referred, and Typical. It was hypothesized that the LBS would correctly identify students classified as

Gifted, Gifted Referred, and Typical, alone and in addition to cognitive ability (Worrell & Schaefer, 2004).

Additional studies focusing on the reliability and validity of the LBS need to be conducted to increase the confidence in use of the scale. It is important that the ability to diagnostically differentiate different groups, as well as evidence of incremental predictive validity, continue to be assessed with clinical instruments. In addition, diagnostic utility is required for school and clinical psychologists to have confidence in the clinical application of the LBS.

Method

Participants

A sample of 273 students from a south suburban Chicago, Illinois school district was obtained. All third grade students from two elementary schools within the same district were included in the sample. All students were 8 or 9 years old (*M* = 8.29 years, *SD* = .45). Table 1 presents demographic information for the total sample, as well as the Typical, Gifted Referred, and the Gifted groups. Classroom teachers (*N* = 11) who provided LBS ratings were all Caucasian and female. Teacher ages ranged from 29 to 54 years (*M* = 40 years, *SD* = 7.73) and teaching experience ranged from 5 to 23 years (*M* = 13, *SD* = 5.71).

Instruments

Learning behaviors scale (LBS). The Learning Behaviors Scale (LBS; McDermott, Green, Francis, and Stott, 1999) is nationally normed and composed of 29 questions that are recorded by teachers after observing the child for at least 40 school days. The items are rated on a 3-point scale (0 = does not apply, 1 = sometimes applies, 2

= most often applies) and are worded both positively and negatively to reduce response sets. Twenty-five of the 29 items are scored revealing 4 dimensions of learning behaviors: Competence Motivation, Attitude Toward Learning, Attention/Persistence, and Strategy/Flexibility.

The LBS subscales show acceptable levels of internal consistency reliability (Canivez & Beran, 2011; Canivez, Willenborg, & Kearney, 2006; McDermott, 1999). Worrell, Vandiver, and Watkins (2001) reported that the internal consistency of the LBS Total score and two subscales (Competence Motivation and Attitude Toward Learning) could be used for individual decision-making, and the other factors (Attention/Persistence and Strategy/Flexibility) were good for screening purposes. McDermott (1999) reported an acceptable level of test-retest reliability, and Buchanan, McDermott, and Schaefer (1998) found support for the interrater reliability of the LBS with teachers and teacher aides.

Convergent and discriminant validity research support the LBS scores compared to the Differential Ability Scale (Elliott, 1990), the Basic Achievement Skills Individual Screener (The Psychological Corporation, 1983), teacher-assigned grades, and the Adjustment Scales for Children and Adolescents (McDermott, Marston, & Stott, 1993). The four-factor structure of the LBS was supported by several independent studies (Canivez & Beran, 2011; Canivez, Willenborg, & Kearney, 2006; Worrell & Schaefer, 2004). Worrell and Schaefer (2004) provided evidence of predictive validity for the potential use of the LBS with gifted children.

TerraNova, third edition. The TerraNova, Third Edition (CTB/McGraw-Hill, 2011) is a standardized, group-administered test of achievement developed for use in state and district-wide testing. The TerraNova is claimed to align with the Common Core State Standards in Reading, Math, English Language Arts, Science, and Social Studies. The TerraNova, Third Edition includes three tests: Survey, Complete Battery, and Multiple Assessments. The TerraNova provides the following scores: national percentiles, normal curve equivalents, stanines, and grade equivalent scores. A Total Score is derived from the Reading, Language, and Mathematics composites. Within the Reading and Language composites, there are two subtests in each, reading and vocabulary, and language and language mechanics, respectively. The Mathematics composite also contains two subtests, Mathematics and Mathematics Computation.

Item development for the TerraNova began with item tryout pools in 2004 and a tryout study in 2005. The TerraNova was then co-normed with the InView, a group administered intelligence test, (CTB McGraw-Hill, 2007) in 2007. A sample of approximately 15,000 students was included for each level, for a total of about 200,000 U.S. students. In addition, the sample was stratified by region, community type, socioeconomic status, ethnicity, and special needs (Anderson, 2010). The technical bulletin (CTB McGraw-Hill, 2008) reported that the TerraNova, Third Edition and InView were co-normed.

Item difficulties ranged from .14 to .98, which allow for a variety of item difficulties in the group administered format. According to the review by Anderson (2010), moderately positive correlations existed between the Reading, Language, Mathematics, and Science tests. On the constructed-response items, interrater agreement was strong and generally exceeded .90 for the content areas. According to a review by Harwell (2010), adequate reliability was evidenced through item difficulties, internal consistency values, and standard errors of measurement. Internal consistencies for each test consistently fell in the .80-.90's.

According to the review by Harwell (2010), construct validity evidence of the TerraNova was provided through correlations with the InView scores. Moderate to high correlations were found for the TerraNova, Third Edition and InView across various grade levels. The technical bulletin reported the following: "CTB will conduct several research studies" to assess criterion-related validity with other assessments and intercorrelations will be reported to demonstrate convergent and divergent validity (CTB/McGraw-Hill, 2008, p. 43-44). The technical bulletin also reported that content validity was supported through "editorial attention" to minimize bias (CTB/McGraw-Hill, 2008, p. 22). In regard to an empirical approach to reduce bias, there were low to no differential item functioning for ethnicity or gender. However, further evidence needs to be provided to continue to demonstrate reliability and validity of the TerraNova, third edition assessment (Cizek, 2005; Harwell, 2010).

InView. The InView (CTB McGraw-Hill, 2007) was designed to assess cognitive abilities and anticipated academic achievement for students in grades 2 through 12 in a standardized, group-administered format. The InView consists of three subtests comprising the Nonverbal abilities score (Sequences, Analogies, Quantitative Reasoning) and two subtests comprising the Verbal abilities score (Verbal Reasoning-Words, Verbal Reasoning-Context). Each subtest contains 20 scored items and the entire administration takes a maximum of 95 to 105 minutes depending on grade level. The InView also provides a composite general cognitive ability score, the Cognitive Skills Index (CSI), which has a mean of 100 and a standard deviation of 16. Grade equivalents, national percentiles, and normal curve equivalent scores are also available normative scores (Thompson, 2005).

The InView was standardized with the TerraNova, Second Edition (CTB/Mc-Graw-Hill, 2000). The standardization of the InView included a national sample of over 100,000 students in grades 2 through 12. The sample closely matched the 1999 U.S. Census population and included the following stratification variables: geographic region, community type, socioeconomic status, and special needs. A wide range of item difficulty values (p = .30 to .95) were incorporated in the InView allowing for items for various ability levels (Thompson, 2005). The InView norms were updated with the TerraNova, Third Edition national norms in 2007 (see TerraNova description above).

According to the review by Carney (2005), no estimates of test-retest reliability were included in the technical bulletin. Internal consistency was estimated for the subtests, Nonverbal composite, Verbal composite, and total score using the Kuder-Richardson Formula 20 (KR-20) resulting in values in the low to mid .80s. The KR-20 scores on the total score were consistently in the mid .90s (Carney, 2005).

In regard to the validity of the InView, discriminant and convergent validity evidence was demonstrated through intercorrelations and correlations between the InView and the TerraNova, second edition. Correlations ranged from .4 to .7, and subtests were correlated as expected (i.e.; verbal scores on both TerraNova and InView; Thompson, 2005).

The overall general ability, as well as the nonverbal and verbal traits, were supported by confirmatory factor analyses reported in the technical manual (Carney, 2005). Currently, no published empirical studies that investigated the reliability and validity of the InView with other assessments of cognitive ability were found or included in the technical manual. More research in this area must be conducted.

Procedure

Administrators in a south suburban Chicago, Illinois school district were informed of the opportunity to participate in the study in September of 2012. Permission was granted by the school district to examine the LBS for possible use in the district's gifted evaluation. Approval was also granted by the Institutional Review Board to conduct the current study. Third grade teachers at two elementary schools completed the LBS on all students in their classroom in November of 2012 for later examination of validity and diagnostic utility. As the LBS was completed for each student *before* the teachers were aware of the decision on gifted referral and later gifted classification, the teachers were blind to the giftedness selection when rating students. All data were collected anonymously to protect the identity of the students as students were assigned random identification numbers.

TerraNova and InView assessments were administered in January of 2013 to all students. After district wide testing, students were selected for gifted screening based on TerraNova and InView scores. Students that earned a score at or above the 90th percentile on at least one of the TerraNova composites (Reading, Language, or Math) or a Cognitive Skills Index (CSI) of 125 on the InView were screened using the gifted matrix. The gifted matrix included a combination of required points based on the TerraNova composite scores and CSI (see matrix criteria in Appendix). A third, subjective variable was also included in the matrix. This variable was based on standards-based report cards; however, no set criteria were included for the report card variable. Students who earned a CSI at or above 135 were automatically identified as the Gifted group (n = 5).

Those who were not screened, because they did not meet the criteria to be included in the matrix, (n = 179) were identified as the Typical group in the current study. Those who were screened but did not meet the gifted criteria within the matrix (n = 71) were identified as the Gifted Referred group for the current study. Finally, those who were screened and met the criteria within the matrix, or automatically qualified with a CSI of 135 or higher, (n = 23) were identified as the Gifted group in the current study.

Analyses

All LBS and InView scores were converted into Normal Curve Equivalents (NCE) to obtain a consistent metric across all assessments as TerraNova scores were already reported as NCE's. NCE scores have a mean of 50 and a standard deviation of 20.06.

Zero order Pearson product-moment correlations were calculated for all TerraNova achievement scores, LBS scores, and the InView CSI score. MANOVA and ANOVA for distinct group differences were used to assess hypothesized differences between groups (typical, gifted referred, and gifted students) on the LBS Total and LBS factor scores with Tukey HSD post hoc comparisons. Cohen's d effect size estimates (Cohen, 1988) were calculated for mean differences and evaluated using the following criteria: small effect size d = .20, medium effect size d = .50, and large effect size d = .80.

Hierarchical multiple regression analyses were conducted to assess the incremental validity of the LBS Total and factor scores in predicting achievement (TerraNova scores) beyond the InView CSI. Hierarchical multiple regression analyses were conducted to assess the LBS in predicting achievement above and beyond CSI. The CSI was included in the first block of the regression analyses as research has shown consistent evidence of a strong, positive relationship between CSI and academic achievement. The CSI was then controlled for in the second block of regression analyses with the addition of the LBS Total or factor scores, in an effort to determine if the LBS contributed to TerraNova achievement score prediction above and beyond that of the CSI. Cohen's (1988) criteria for effect sizes for R^2 (small effect $R^2 = .03$, [3%], medium effect $R^2 = .10$ [10%], large effect $R^2 = .30$[30%]) were used to evaluate regression effect sizes.

To examine the diagnostic accuracy of the LBS and the InView CSI, direct discriminant function analyses (DFA; Tabachnick & Fidell, 2007) were used. All statistical analyses were conducted with SPSS version 19.0 for Mac.

Results

Zero Order Correlations.

Pearson product-moment correlation coefficients were calculated to determine the relationship between the variables. Pearson product-moment correlation coefficients between the InView Cognitive Skills Index (CSI) and LBS scores with TerraNova achievement scores (see Table 2) and Pearson product-moment correlations between CSI and LBS scores (see Table 3) were all found to be statistically significant ($p < .05$).

As expected, the CSI and TerraNova subtests, composites, and total score had the highest correlations (ranging from .50 to .76). Correlations were statistically significant between the LBS and TerraNova scores (ranging from .13 to .45), but were much lower than those of the CSI and TerraNova. Also as expected, were low correlations among the

LBS scores and CSI scores (ranging from .19 to .37). These statistically significant yet low correlations support divergent validity as cognitive abilities and learning behaviors are different constructs. See Tables 2 and 3 for correlations, means, and standard deviations. These scores were as expected, which suggests predictive validity of the LBS, as well as the CSI.

Distinct Group Differences.

Distinct group differences were used to examine the construct validity of the LBS. It was hypothesized that the Gifted group would have a higher group mean than the Gifted Referred and Typical groups on the LBS Total and factors scores, as well as the CSI. It was also hypothesized that the Gifted Referred group would have a higher group mean than the Typical groups on the LBS Total and factors scores, as well as the CSI.

InView CSI. ANOVA for differences between the Typical group, Gifted Referred group, and Gifted group on the CSI was statistically significant, $F(2, 270) = 113.50, p < .001$, partial $\eta^2 = .46$. Results of Tukey's HSD post hoc analyses indicated that children in the Gifted group ($M = 87.61$, $SD = 8.86$) had significantly higher CSI than the Typical group ($M = 54.24$, $SD = 12.43$), $p < .001$ with a large effect size ($d = 2.76$) and the Gifted Referred group ($M = 70.24$, $SD = 10.04$), $p < .001$ with a large effect size ($d = 1.78$). Children in the Gifted Referred group had significantly higher CSI than the Typical group, $p < .001$ with a large effect size ($d = 1.36$).

LBS total. ANOVA for differences between the Typical group, Gifted Referred group, and Gifted group on the LBS Total score was statistically significant, $F(2, 270) = 13.16, p < .001$ with a small effect size ($\eta^2 = .09$). Results of Tukey's HSD post hoc analyses indicated that children in the Gifted group ($M = 77.57$, $SD = 14.36$) had significantly higher LBS Total scores than the Typical group (M = 58.26, SD = 24.99), p < .001 with a large effect size (d = .80). In addition, children in the Gifted Referred group (M = 70.38, SD = 14.74) had significantly higher LBS Total scores than the Typical group, p < .001 with a medium effect size (d = .54). However, no statistically significant difference was found between Gifted Referred group and the Gifted group (p = .363, d = .49), but a small effect size was observed.

LBS factors. MANOVA for differences between the Typical group, Gifted Referred, and Gifted group with the four LBS factors (CM, AL, AP, SF) serving as dependent variables was statistically significant, Wilks' Λ = .913, $F(2, 270) = 3.12$, p = .002 with a small effect size ($\eta^2 = .05$). Univariate ANOVAs were also statistically significant for all LBS factors (see Table 4). Means and standard deviations are presented in Table 5. Tukey HSD post hoc analyses found statistically significant mean differences between the Typical and Gifted groups with small to medium effect sizes (*d's* ranging from .48 to .68) on all LBS factor scales. Mean differences between the Typical and Gifted Referred groups also had small to medium effect sizes (*d's* ranging from .39 to .54). No statistically significant LBS factor score differences were found between the Gifted Referred group and the Gifted group with trivial to small effect sizes (*d's* ranging from .14 to .43).

Incremental Predictive Validity.

Incremental predictive validity was investigated to determine the ability of the LBS to predict academic achievement over and above the CSI.

LBS total. Hierarchical multiple regression analyses were conducted to assess incremental contribution of the LBS Total score in the prediction of TerraNova achievement scores beyond that predicted by the CSI and are presented in Table 6. In the first block, CSI was used as the predictor. The CSI accounted for statistically significant ($p < .001$) portions of the TerraNova scores (ranging from 24.6% to 57.7%) that represented large effect sizes (ranging from .33 to 1.36).

In the second block, the LBS Total score was added to determine if it could predict achievement over and above the previous CSI. Statistically significant ($p \leq .01$) portions of the subtest scores (1.7% to 4.6%), composite scores (1.5% to 5.3%), and total achievement score (4.1%) variance was incrementally accounted for by the LBS Total score that represented small to medium effect sizes (.03 to .10). The Vocabulary subtest was not statistically significant ($p = .095$, 0.8%).

LBS factors. Hierarchical multiple regression analyses were also conducted to assess incremental contribution of the four LBS factors in the prediction of TerraNova achievement scores beyond that predicted by the CSI and are presented in Table 7. In the first block, CSI was used as the predictor. The CSI accounted for statistically significant ($p < .001$) portions of the TerraNova scores (ranging from 24.6% to 57.7%) that represented large effect sizes (ranging from .33 to 1.36).

In the second block, the LBS factor scores (CM, AL, AP, and SF) were added to determine if they could jointly predict achievement over and above the previous CSI. Statistically significant ($p \leq .01$) portions of the subtest scores (3.3% to 6.0%), composite scores (3.1% to 6.5%), and total achievement score (4.6%) variance was incrementally accounted for by the combined LBS factor scores that represented small to medium effect sizes (ranging from .03 to .12). The Vocabulary subtest was not statistically significant ($p = .096$, 2.2%). Refer to Table 7 for incremental variance accounted by each LBS factor.

Discriminative Validity.

Discriminant function analyses (DFA) were conducted to determine if *individuals* within the Typical, Gifted Referred, and Gifted groups could be significantly differentiated and correctly classified by the CSI and LBS scores. First, the CSI scores were investigated for their ability to discriminate and correctly identify individuals followed by adding the LBS Total score to the CSI in the DFA. Then, LBS scores alone were investigated for their ability to significantly discriminate and correctly identify individuals. Finally, DFA were conducted with only the Gifted Referred and Gifted groups in order to determine if Gifted students could be correctly identified from Gifted Referred students.

Statistical cross-validation was also used in an effort to provide an unbiased assessment of discriminative effects of InView CSI and LBS scores. In cross-validation, the jackknife, or leave one out, procedure was used to eliminate bias of using individual cases to both create the discriminant classification equations and then to statistically assign the cases to groups based on those classifications equations (Tabachnick & Fidell, 2007).

CSI NCE: typical, referred, and gifted. The direct discriminant function analysis for CSI (predictor variable) was statistically significant; Wilks' $\Lambda = .543$, $\chi^2(2) = 164.74$, $p < .001$. The overall correct classification of 77% illustrated a moderate degree of diagnostic accuracy between the Typical, Gifted Referred, and Gifted groups based only on the CSI variable. The cross-validation procedure correctly classified 75% of the cases. As typically observed in cross-validation, there was a slight shrinkage in the overall correct classification from the original reclassification. See Table 8 for classification results.

CSI NCE & LBS total NCE: typical, referred, and gifted. The direct discriminant function analysis for CSI and LBS Total score (predictor variables) was statistically significant; Wilks' $\Lambda = .538$, $\chi^2(4) = 167.15$, $p < .001$. The overall correct classification of 77% illustrated a moderate degree of diagnostic accuracy between the Typical, Gifted Referred, and Gifted groups. The cross-validation procedure correctly classified 76% of the cases. As typically observed in cross-validation, there was a slight shrinkage in the overall correct classification from the original reclassification. See Table 9 for classification results. The overall correct classifications were nearly identical to those in the previous analyses using only CSI, indicating that the LBS Total score, when added to the CSI, did not improve the classification accurately beyond the CSI.

CSI NCE & LBS factors NCE: typical, referred, and gifted. The direct discriminant function analysis for CSI and LBS factor scores (predictor variables) was statistically significant; Wilks' $\Lambda = .531$, $\chi^2(10) = 169.85$, $p < .001$. The overall correct classification of 66.7% illustrated a moderate degree of diagnostic accuracy between the Typical, Gifted Referred, and Gifted groups. The cross-validation procedure correctly classified 66.3% of the cases. As typically observed in cross-validation, there was a slight shrinkage in the overall correct classification from the original reclassification. See Table 10 for classification results. The overall correct classifications were lower than those in the previous analyses using only CSI, indicating that the LBS factor scores, when added to the CSI, did not improve the classification accurately beyond the CSI.

LBS total NCE: typical, referred, and gifted. The direct discriminant function analysis for LBS Total score (predictor variable) was statistically significant; Wilks' Λ= .911, $\chi^2(2) = 25.12, p < .001$. The overall correct classification of 65.6% illustrated a moderate degree of diagnostic accuracy between the Typical, Gifted Referred, and Gifted groups. The cross-validation procedure also correctly classified 65.6% of the cases. See Table 11 for classification results. The overall correct classifications were lower than those in the previous analyses using the CSI, indicating that the LBS Total score alone was not as accurate as that of the CSI. Further, it is important to note that all of the typical children were correctly classified; however, *none* of the Gifted Referred or Gifted students were classified as Gifted Referred or Gifted. Instead, individuals within these groups were classified into the Typical group.

LBS factors: typical, referred, and gifted. The direct discriminant function analysis for LBS factor scores (predictor variable) was statistically significant; Wilks' Λ= .913, $\chi^2(8) = 24.50, p = .002$. The overall correct classification of 65.6% illustrated a moderate degree of diagnostic accuracy between the Typical, Gifted Referred, and Gifted groups. The cross-validation procedure also correctly classified 65.6% of the cases. See Table 12 for classification results. The overall correct classifications were similar to those of the LBS Total score, indicating that the LBS factor scores alone (like Total score alone) were not as accurate as that of the CSI. Again, it is important to note that all of the Typical children were correctly classified; however, *none* of the Gifted Referred or Gifted students were classified as Gifted Referred or Gifted. Instead, individuals within these groups were classified into the Typical group.

CSI NCE: referred and gifted. The direct discriminant function analysis for CSI (predictor variable) differentiation of referred and gifted students was statistically significant; Wilks' $\Lambda = .626$, $\chi^2(1) = 42.82$, $p < .001$. The overall correct classification of 84% illustrated a moderate degree of diagnostic accuracy between the Typical, Gifted Referred, and Gifted groups. The cross-validation procedure also correctly classified 84% of the cases. See Table 13 for classification results.

CSI NCE & LBS total NCE: referred and gifted. The direct discriminant function analysis for CSI and LBS Total (predictor variables) was statistically significant; Wilks' $\Lambda = .621$, $\chi^2(2) = 43.32$, $p < .001$. The overall correct classification of 84% illustrated a moderate degree of diagnostic accuracy of individuals in Gifted Referred and Gifted groups. The cross-validation procedure correctly classified 83% of the cases. As typically observed in cross-validation, there was a slight decrease in the overall correct classification from the original reclassification. See Table 14 for classification results. The overall correct classifications were nearly identical to those in the previous analyses using only the CSI, indicating that the LBS Total score did not improve the correct classification when added to the CSI.

CSI NCE & LBS NCE factors: referred and gifted. The direct discriminant function analysis for CSI and LBS factors (predictor variables) was statistically significant; Wilks' $\Lambda = .611$, $\chi^2(5) = 44.09$, $p < .001$. The overall correct classification of 85% illustrated a moderate degree of diagnostic accuracy of individuals in Gifted Referred and Gifted groups. The cross-validation procedure correctly classified 83% of the cases. As typically observed in cross-validation, there was a decrease in the overall correct classification from the original reclassification. See Table 15 for classification results. The overall correct classifications were also nearly identical to those in the previous analyses only using the CSI, indicating that the LBS factor scores did not improve the correct classification when added to the CSI.

Discussion

Additional studies focusing on the reliability and validity of the LBS need to be conducted to increase the confidence in use of the scale. It is important that the construct validity and diagnostic utility are supported through empirical evidence for school and clinical psychologists to have confidence in the clinical application of the LBS. The current study examined the construct validity and diagnostic utility of the Learning Behaviors Scale (LBS; McDermott, Green, Francis, and Stott, 1999). Specifically, distinct group differences (construct validity), incremental validity (construct validity), and diagnostic accuracy in correctly identifying individual students (diagnostic utility) were methods used to examine the LBS.

Zero order correlation coefficients indicated low to moderate correlations between the LBS Total and factor scores with the TerraNova achievement scores. As expected, high and positive correlations were found between the InView CSI and TerraNova achievement scores. Low correlations were found between the LBS scores and InView CSI scores. Correlations were all significant suggesting predictive validity of the CSI and LBS. This was consistent with the strong positive correlations previously found between the Differential Ability Scale (DAS; Elliott, 1990) and the LBS (McDermott, 1999; Yen, Konold, & McDermott, 2004) in the standardization sample.

Distinct group differences. ANOVA and MANOVA analyses were conducted to investigate the LBS differences between groups (Typical, Gifted Referred, and Gifted).

It was hypothesized that the mean LBS Total score, factor scores, and CSI score would be highest for the Gifted group, followed by the Gifted Referred group and Typical group, respectively.

Statistically significant differences between the Gifted group, Gifted Referred group, and the Typical group were found for the CSI. The Gifted group had a significantly higher CSI than the Typical group and the Gifted Referred group. The Gifted Referred group also had significantly higher scores than the Typical group. Large effect sizes were found among all post hoc tests. The significant differences with large effect sizes indicate that the three groups were appropriately configured based on cognitive ability. The Gifted group mean CSI was nearly two standard deviations above the normative mean as would be expected (Worrell & Schaefer, 2004). Additionally, the mean of the Typical group for the current study fell near the mean NCE score of 50.

Overall, a significant difference on the LBS Total score was found between the groups. Post hoc analyses revealed that the Gifted group had a significantly higher LBS Total score than the Typical group with a large effect size. The Gifted Referred group also had a significantly higher LBS Total score than the Typical group with a medium effect size. No statistically significant LBS Total score difference was found between the Gifted group and the Gifted Referred group as they had similar mean LBS Total scores on the LBS overall. Similar results were found for the LBS factor scores between the three groups.

These results were consistent with those of Worrell and Schaefer (2004) who found academically talented students (M = 55.3, and SD = 7.3 for the 1997 sample, M = 56.5, SD = 7.3 for the 1998 sample) had LBS Total T scores significantly higher than the normative sample (McDermott, 1999), but not significantly different from the gifted and talented subgroup of the normative sample.

The group means for the current study were higher than the normative and cohort means reported in the Worrell and Schaefer (2004) study. For the total sample in the current study ($N = 273$), the LBS Total T score mean of 56.13 ($SD = 10.87$) was 6 points higher than the normative sample mean of 50 ($SD = 10$). In addition, the current study Gifted group had an LBS Total T score mean of 62.96 and standard deviation of 6.79, which is approximately 7 points higher than that of the gifted group in the normative sample ($M = 55.2$, $SD = 7.6$). Also, the Gifted Referred group ($M = 59.61$, $SD = 6.95$) in the current study was also higher than the gifted group in the normative sample. The total sample mean in the current study was similar to that of the academically talented group means across both cohorts ($M = 55.3$, $SD = 7.3$ and $M = 56.5$, $SD = 7.3$). It is important to note that comparing the results from the current study with previous studies may be challenging as the criteria used to determine giftedness varies. In addition, the comparative sample across the studies differed. Teachers rating gifted children within a gifted camp may rate the children differently than teachers rating a wide range of abilities within the classroom like in the current study.

Incremental predictive validity. Hierarchical multiple regression analyses were conducted to investigate if the LBS could account for significant and meaningful portions of TerraNova achievement score variance above and beyond that of the InView CSI. It was hypothesized that the LBS would account for significant achievement variance above and beyond that of the CSI.

In regard to the hierarchical multiple regression analyses, the CSI score was used as the first predictor as there is a well-established relationship between cognitive ability and academic achievement (Jensen, 1998; Naglieri & Bornstein, 2003; Watkins, Lei, & Canivez, 2007). The CSI consistently accounted for large portions of TerraNova subtest, composite, and total score variance as expected (ranging from 24.6% to 57.7%) and similar to other studies (Canivez, 2013; Canivez, in press; Glutting, Watkins, Konold, & McDermott, 2006).

In the second step, the LBS Total score was added to the CSI score to account for incremental portions of achievement test variance. Statistically significant increments in variance accounted for were found for all TerraNova subtests, composites, and total score (except the Vocabulary subtest) and the effect sizes were small to medium. These results were the same when the four LBS factor scores were added in the second block. Results of hierarchical regression analyses moderately support the incremental predictive validity of the LBS. However, several limitations later discussed likely impacted these results.

In comparing these results to previous research, Worrell and Schaefer (2004) found that previous achievement (as measured by GPA and standard achievement test scores in reading and math) and socioeconomic status (SES) predictors accounted for less than 11% of the variance in summer GPA. The LBS Total score, when added to previous achievement and SES added 15% and 25% of the variance to the prediction of summer GPA for the 1997 and 1998 cohorts, respectively. The LBS factor scores added more than 30% and 14% of the variance when added to previous achievement and SES in predicting summer GPA for the 1997 and 1998 cohorts, respectively. The hierarchical multiple regression analyses were also conducted with reversing the predictor variables. First, the

LBS scores alone accounted for 38% and 22% of the variance in summer GPA. Second, previous achievement and SES added only 3% and 1% of the variance across the cohorts.

Although results of Worrell and Schaefer (2004) suggested that LBS scores contributed significantly and meaningfully to the prediction of teacher-assigned grades above the contributions of previous achievement and SES, there were many differences in the methods compared to the current study, as well as limitations. Teachers may rate children differently based on the context and comparison peers (i.e.; gifted camp versus entire classroom). In the current study variance was predicted in standardized achievement scores rather than teacher assigned grades, which hold more subjectivity. Also, bias in teacher assigned grades was problematic as teacher assigned grades and the LBS have much shared variance (Schaefer & McDermott, 1999).

Furthermore, a study by Schaefer and McDermott (1999) concluded that LBS incremental prediction was better for teacher grades than for standardized achievement test scores. As class grades are unlikely to be based solely on academic performance, grades often include effort, persistence, and motivation, as well as other learning behaviors (Davis, 2006). Therefore, the LBS could represent a method effect for teacher's inclusion of learning behaviors in assigning grades.

In addition, the LBS scores in the current study were added to cognitive abilities, which consistently account for a high amount of variance (24.6% to 57.7% in the current study) in academic achievement (Canivez, 2013; Canivez, in press; Glutting, Watkins, Konold, & McDermott, 2006) compared to previous achievement and SES, which accounted for less than 11%.

Discriminative validity. Discriminant function analyses (DFA) were conducted to investigate the ability of the LBS scores to correctly classify individual students into the groups based on the school district gifted criteria. It was hypothesized that the LBS, alone and in addition to the InView CSI, would correctly identify students classified as Gifted and those who were Typical.

Discriminant function analyses revealed that the LBS Total score and factor scores did not improve the correct classification of the Gifted Referred and Gifted groups when added to the InView CSI. The correct classification rates for the LBS Total and factor scores were lower than correct classification rates for the CSI. Additionally, the classification rates did not change appreciably to the LBS scores when added with the InView CSI.

Overall DFA was statistically significant whether using the LBS Total score or the LBS factor scores, however; the classification tables illustrated that students in the Gifted Referred group and the Gifted group were reclassified into the Typical group. This resulted in students originally classified as Typical to be correctly classified in that group but those in the Gifted Referred groups and Gifted were incorrectly classified as Typical.

A critical problem was observed in the current study. A ceiling effect was observed for the LBS Total and factor scores among the Gifted Referred and Gifted groups. As the LBS raw scores can range from 0 to 16 for the CM factor, 0 to 18 for the AL factor, 0 to 14 for both the AP and SF factors, and 0 to 50 for the Total score; the mean LBS raw scores for the Gifted Referred and Gifted groups were all near the maximum scores. The LBS mean raw scores for the two groups were as follows: Gifted Referred (CM = 15.17, AP = 17.37, AL = 13.00, SF = 13.63, Total = 47.58) and Gifted

(CM = 15.61, AP = 17.74, AL = 13.17, SF = 13.17, Total = 48.61). This indicated that there were too few items or not a large enough range of item scores to adequately measure those students significantly above average who are likely to be members of a gifted referred and gifted population. Due to the restriction in range, the ceiling effect reduced the variability, which reduced correlation coefficients and statistical power. Therefore, statistical significance was also impacted. This critical issue impacted all analyses and is discussed further in the limitations section.

Implications

The current study contributes to the research in psychological assessment in several ways. First, the results obtained for the CSI support the well-established principle of a strong, positive relationship between cognitive ability and academic achievement. The CSI consistently accounted for large portions of variance in TerraNova achievement scores as would be expected. Therefore, the InView may be a useful tool for decision-making and educational planning. However, further research of the InView must be conducted.

Second, construct validity for the LBS was supported with the district group differences. The Gifted Referred and Gifted groups had higher LBS Total and factor scores than the Typical group. The LBS may be a useful tool for identifying those that are above average from those that are typical.

Third, due to the ceiling effect observed in the current sample of Gifted Referred and Gifted groups, the LBS may be a less than adequate tool for differentiating among the significantly above average. When learning behavior reaches above average levels, these small differences are unable to be detected by the LBS Total and factor scores as discovered in the current study. As statistically significant differences were found between the Gifted Referred group and the Typical group, as well as between the Gifted and Typical group, the LBS may be more useful as a screening tool to assist with identifying the Gifted Referred group for further gifted evaluation. More research in this area must be conducted.

Finally, the LBS may be better for differentiating those with problematic learning behaviors rather than those with above average academic achievement and cognitive ability. There is some evidence supporting the use of the LBS in early identification of problem learners and in developing individualized interventions (McDermott, 1999; McDermott & Watkins, 1987; Stott, McDermott, Green, & Francis, 1988). However, more research similar to the current study should be conducted to further investigate the diagnostic utility of the LBS in identifying those who are below average.

Limitations

Several limitations should be noted for the current study. Most importantly, a ceiling effect played a major role in the results of the analyses conducted. Conducting research with gifted populations is often challenging due to the lack of instruments with a sufficient range to measure the upper extreme of abilities (McBee, 2010). When a ceiling effect is present, only partial information is revealed for those scoring at the upper limit of the instrument.

In the current study, it was difficult to differentiate the Gifted Referred and Gifted groups as both groups had LBS scores near the maximum. The range of scores was minimized for above average students who were identified for the Gifted Referred and Gifted groups, which resulted in statistically non-significant differences between the group means. Also, the effect sizes were likely impacted, as the spread of scores of the two groups was limited due to the maximum points available. The effect size for the LBS Total score was small, and effect sizes for the factor scores ranged from small to medium. It appears that both groups may have similar learning behaviors, but their actual learning behaviors may differ. However, the LBS may not have been rated as having enough items or a large enough range of item scores to adequately measure the learning behaviors at the upper extreme.

In the hierarchical regression analyses, the parameters of the regression model were likely impacted by the restriction of range produced by ceiling effects of LBS scores. The insufficient range of scores may limit the estimation of learning behaviors of the Gifted group. As the intercept and slope of the regression model is estimated by ordinary least squares regression, the distribution of the means is inappropriate due to lack of true measurement of the Gifted group. Therefore, the model of the equation in which the analysis relied on was limited.

In the discriminant function analyses, the ceiling effect did not impact the Typical group as individuals were appropriately classified. However, the ceiling effect likely impacted the individual classification the Gifted Referred and Gifted groups. The decreased variability in the scores among the two groups made it impossible to correctly differentiate the two groups based on LBS scores.

Another limitation in the study related to the gifted matrix used to classify students as gifted. Due to the inclusion of the third, subjective variable, it is difficult to compare results across previous studies with this gifted sample. In addition, students in this particular sample could be identified as gifted according to the district criteria regardless of cognitive ability. Students that earned a TerraNova achievement composite score at or above the 90th percentile were screened for gifted. A student could then meet the gifted identification requirements of the matrix by meeting the 97th percentile on the TerraNova achievement composite if the student also earned the maximum points based on the more subjective standards-based report card criteria. This leads to problems in differentiating the truly gifted students from those that are academically talented and may have been another cause to the lack of significant group differences between the Gifted Referred group and the identified as Gifted groups. However, it is important to note that overall significant differences in cognitive ability *were* found across the groups.

In addition, as the TerraNova and InView assessments were administered in a group format it is difficult to determine whether or not the scores are reflective of the child's true abilities. Also, disabled students with an Individualized Education Plan (IEP) were administered the TerraNova and InView assessment with accommodations listed in their IEP. As a result, students' scores may be inflated from those of the normative sample.

Another critical limitation of the present study relates to the characteristics of the sample. The sample is not representative of the national population based on the U.S. census. This particular school district also has overall higher socioeconomic status compared to the average for the state of Illinois. The 2012 Illinois District Report Card indicated 12.3% of students were of low income compared to the average for the state of Illinois at 49% of students identified as low income. In addition, the size of the Gifted sample limits the power in statistical significance findings. A further limitation relates to students in this particular school district who have historically obtained high achievement on standardized testing (i.e.; 85% of students meet or exceed on state achievement testing). The mean LBS scores observed to be higher than those from the normative sample could be related to characteristics of this particular district. The LBS norm sample was found to be reasonably representative in terms of general intellectual ability, achievement, and social-emotional functioning (McDermott, 1999).

Further Research

Further research in this area should continue to focus on including the LBS in gifted evaluations in more diverse school districts. As school districts implement varying methods to identify gifted students, as well as academically talented students, it will be important to investigate the usefulness of the LBS within the various evaluation methods (Benson, 1998). The current study used group administered cognitive and academic assessments, in addition to a matrix with a subjective component. Some schools chose to use individually administered assessments with specific cut-off scores for gifted identification, as well as using various instruments for the screening versus identification process. As school districts also use different assessment tools for assessing cognitive and academic skills, LBS research should be conducted in conjunction with the alternate assessments used. Additionally, research should be conducted with more diverse samples that more closely represent that of the U.S. population.

The importance of investigating the validity and diagnostic utility of the tools we use is a vital process that must continue. Psychological assessment is aimed at identifying characteristics of individuals with various disabilities and/or giftedness for decision making and planning. Continuous research must be conducted in this area, as a single study is insufficient to validate or fail to validate the score(s) from a test.

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Table 1

Demographic Characteristics of Total sample, Typical, Referred, and Gifted Groups

Demographic Variable	*n*	%
Total sample *(N = 273)*		
Sex		
Male	143	52.4
Female	130	47.6
Race/Ethnicity		
White/Caucasian	248	91.9
Black/African American	0	0
Hispanic	14	5.2
Asian American	4	1.5
Native American/Alaskan native	2	.7
Multiracial	2	.7
Typical Group *(N = 179)*		
Sex		
Male	99	55.3
Female	80	44.7
Race/Ethnicity		
White/Caucasian	161	89.9
Black/African American	0	0
Hispanic	11	6.1
Asian American	2	1.1
Native American/Alaskan native	2	1.1
Multiracial	0	0
Gifted Referred group *(N = 71)*		
Sex		
Male	35	49.3
Female	36	50.7
Race/Ethnicity		
White/Caucasian	66	93.0
Black/African American	0	0
Hispanic	3	4.2
Asian American	0	0
Native American/Alaskan native	0	0
Multiracial	2	2.8
Gifted group *(N = 23)*		
Sex		
Male	9	39.1
Female	14	60.9
Race/Ethnicity		
White/Caucasian	21	91.3
Black/African American	0	0
Hispanic	0	0
Asian American	2	8.7
Native American/Alaskan native	0	0
Multiracial	0	0

Table 2

Pearson Product-Moment Correlations between LBS and InView CSI with TerraNova Subtest, Composite, and Total Scores and Descriptive Statistics

Subtest/	Learning Behaviors Scale					InView		
Composite	Total	CM	AL	AP	SF	CSI	*M*	*SD*
Reading	.35	.37	.33	.29	.17	.65	60.22	17.53
Vocabulary	.26	.27	.21	.24	.13	.50	59.37	15.60
Reading Composite	.33	.35	.30	.29	.17	.64	61.18	16.71
Language	.43	.40	.33	.40	.28	.65	56.68	17.59
Language Mechanics	.38	.40	.33	.34	.24	.53	61.01	16.46
Language Composite	.44	.44	.36	.41	.29	.66	59.53	16.55
Math	.43	.44	.35	.35	.26	.73	62.81	17.29
Computation	.36	.36	.25	.34	.24	.54	59.81	15.90
Math Composite	.43	.44	.33	.38	.27	.70	62.90	16.46
Total Achievement	.45	.45	.38	.39	.27	.76	60.98	17.17

Note. CM = Competence Motivation, AL = Attitude Toward Learning, AP = Attention/Persistence, SF = Strategy/Flexibility, CSI = Cognitive Skills Index. All correlations statistically significant ($p < .05$).

Table 3

Pearson Product-Moment Correlations and Descriptive Statistics for LBS and CSI

	Learning Behaviors Scale						
	Total	CM	AL	AP	SF	*M*	*SD*
CSI	.35	.37	.31	.28	.19	61.21	15.67
M	63.04	61.78	59.37	56.74	63.30		
SD	22.98	23.92	19.01	22.28	18.45		

Note. CSI mean = 61.21, SD = 15.67. CM = Competence Motivation, AL = Attitude Toward Learning, AP = Attention/Persistence, SF = Strategy/Flexibility, CSI = Cognitive Skills Index. All correlation statistically significant ($p < .01$).

Table 4

MANOVA and ANOVA Results for LBS Scores (Typical, Referred, and Gifted)

	SS	*SS Error*	*MS*	*MS Error*	*F*	*p*	η^2
CM	12024.16	143580.66	6012.08	531.78	11.31	.001	.08
AL	6593.92	91649.71	3296.96	339.44	9.71	.001	.07
AP	8371.24	126672.81	4185.62	469.16	8.92	.001	.06
SF	3844.37	88697.00	1922.18	328.51	5.85	.003	.04

Note. CM = Competence/Motivation, AL = Attitudes Toward Learning, AP = Attention/Persistence, SF = Strategy/Flexibility. η^2 = partial eta squared. MANOVA for LBS factors: Wilks' $\Lambda = .913$, $F(2, 270) = 3.12$, $p = .002$. Multivariate Effect Size = .05, Power = .965. LBS factor ANOVA *df* (2, 270).

Table 5

Descriptive Statistics for LBS Factors Between Typical, Referred, and Gifted Groups

	Typical		Referred		Gifted	
	M	*SD*	*M*	*SD*	*M*	*SD*
LBS						
Competence/Motivation	57.02[a]	26.76	69.90[b]	13.92	73.74[b]	10.83
Attitude Towards Learning	55.93[a]	21.09	64.70[b]	12.34	69.70[b]	9.19
Attention/Persistence	52.75[a]	24.51	63.85[b]	14.47	65.91[b]	15.17
Strategy/Flexibility	60.61[a]	20.69	67.85[b]	12.15	70.17[b]	9.99

Note. LBS = Learning Behaviors Scale. Means with different superscripts differ significantly ($p < .05$) based on Tukey HSD.

Table 6

Incremental Contribution of LBS Total score in Predicting TerraNova Achievement Scores Beyond InView CSI

	Reading		Vocabulary		Reading Composite	
Predictor	Variance (%)	Increment[a] (%)	Variance (%)	Increment[a] (%)	Variance (%)	Increment[a] (%)
CSI	42.5	42.5***	24.6	24.6***	40.6	40.6***
LBS Total(df = 1)[b]	44.2	1.7**	25.4	0.8	42.1	1.5**

	Language		Language Mechanics		Language Composite	
Predictor	Variance (%)	Increment[a] (%)	Variance (%)	Increment[a] (%)	Variance (%)	Increment[a] (%)
CSI	42.5	42.5***	27.8	27.8***	43.0	43.0***
LBS Total (df = 1)[b]	47.0	4.6***	32.4	4.6***	48.4	5.3***

	Math		Computation		Math Composite	
Predictor	Variance (%)	Increment[a] (%)	Variance (%)	Increment[a] (%)	Variance (%)	Increment[a] (%)
CSI	53.4	53.4***	28.9	28.9***	48.3	48.3***
LBS Total (df = 1)[b]	56.9	3.6***	32.5	3.6***	52.6	4.2***

	Total Achievement	
Predictor	Variance (%)	Increment[a] (%)
CSI	57.7	57.7***
LBS Total (df = 1)[b]	61.7	4.1***

Note. CSI = Cognitive Skills Index, LBS = Learning Behaviors Scale Total score. Variance percentages are R^2*100.

[a]Unless otherwise indicated, all unique contributions are squared part correlations equivalent to changes in R^2 if this variable was entered last in block entry regression procedure.

[b]Partialing out CSI.

*p < .05, **p < .01, ***p < .001.

Table 7

Incremental Contribution of LBS Factor Scores in Predicting TerraNova Achievement Scores Beyond InView CSI

Predictor	Reading		Vocabulary		Reading Composite	
	Variance (%)	Increment[a] (%)	Variance (%)	Increment[a] (%)	Variance (%)	Increment[a] (%)
CSI	42.5	42.5***	24.6	24.6***	40.6	40.6***
LBS Factor Scores (*df* = 4)[b]	45.8	3.3**	26.8	2.2	43.7	3.1**
CM		0.3		0.2		0.3
AL		0.3		0.0		0.0
AP		0.4		1.2*		1.0*
SF		1.0*		1.0		1.3*

Predictor	Language		Language Mechanics		Language Composite	
	Variance (%)	Increment[a] (%)	Variance (%)	Increment[a] (%)	Variance (%)	Increment[a] (%)
CSI	42.5	42.5***	27.8	27.8***	43.0	43.0***
LBS Factor Scores (*df* = 4)[b]	48.4	6.0***	33.4	5.6***	49.5	6.5***
CM		0.0		1.0*		0.4
AL		0.1		0.0		0.1
AP		2.6***		0.7		1.9**
SF		0.4		0.3		0.5

Predictor	Math		Computation		Math Composite	
	Variance (%)	Increment[a] (%)	Variance (%)	Increment[a] (%)	Variance (%)	Increment[a] (%)
CSI	53.4	53.4***	28.9	28.9***	48.3	48.3***
LBS Factor Scores (*df* = 4)[b]	56.9	3.5***	34.4	5.5***	53.2	4.9***
CM		0.8*		1.0*		1.1*
AL		0.0		1.3*		0.4
AP		0.2		1.6*		0.8*
SF		0.1		0.1		0.1

Predictor	Total Achievement	
	Variance (%)	Increment[a] (%)
CSI	57.7	57.7***
LBS Factor Scores (*df* = 4)[b]	62.2	4.6***
CM		0.4
AL		0.0
AP		1.0**
SF		0.5

Note. CSI = Cognitive Skills Index, LBS = Learning Behaviors Scale, CM = Competence Motivation, AL = Attitude Toward Learning, AP = Attention/Persistence, SF = Strategy/Flexibility. Variance percentages are R^2*100. *p < .05, **p < .01, ***p < .001.

[a]Unless otherwise indicated, all unique contributions are squared part correlations equivalent to changes in R^2 if this variable was entered last in block entry regression procedure.

[b]Partialing out CSI.

Table 8

Classification Results for Typical, Referred, and Gifted Groups Based on CSI

	Predicted Group Membership		
Original Group[a]	Typical	Referred	Gifted
Typical	166	13	0
Referred	36	34	1
Gifted	0	13	10

	Predicted Group Membership		
Original Group[b]	Typical	Referred	Gifted
Typical	160	19	0
Referred	36	34	1
Gifted	0	13	10

Note. In cross validation, each case is classified by the functions derived from all cases other than that case.

[a]76.9% of original grouped cases correctly classified.

[b]74.7% of cross-validated grouped cases correctly classified.

Table 9

Classification Results for Typical, Referred, and Gifted Groups Based CSI and LBS Total Score Combined

	Predicted Group Membership		
Original Group[a]	Typical	Referred	Gifted
Typical	165	14	0
Referred	36	34	1
Gifted	0	13	10

	Predicted Group Membership		
Original Group[b]	Typical	Referred	Gifted
Typical	162	17	0
Referred	36	34	1
Gifted	0	13	10

Note. In cross validation, each case is classified by the functions derived from all cases other than that case.

[a]76.7% of original grouped cases correctly classified.

[b]75.5% of cross-validated grouped cases correctly classified.

Table 10

Classification Results for Typical, Referred, and Gifted Groups Based CSI and LBS Factor Scores Combined

	Predicted Group Membership		
Original Group[a]	Typical	Referred	Gifted
Typical	122	55	2
Referred	13	42	16
Gifted	0	5	18

	Predicted Group Membership		
Original Group[b]	Typical	Referred	Gifted
Typical	122	55	2
Referred	14	41	16
Gifted	0	5	18

Note. In cross validation, each case is classified by the functions derived from all cases other than that case.

[a]66.7% of original grouped cases correctly classified.

[b]66.3% of cross-validated grouped cases correctly classified.

Table 11

Classification Results for Typical, Referred, and Gifted Groups Based on LBS Total Score

	Predicted Group Membership		
Original Group[a]	Typical	Referred	Gifted
Typical	179	0	0
Referred	71	0	0
Gifted	23	0	0

	Predicted Group Membership		
Original Group[b]	Typical	Referred	Gifted
Typical	179	0	0
Referred	71	0	0
Gifted	23	0	0

Note. In cross validation, each case is classified by the functions derived from all cases other than that case.

[a]65.6% of original grouped cases correctly classified.

[b]65.6% of cross-validated grouped cases correctly classified.

Table 12
Classification Results for Typical, Referred, and Gifted Groups Based on LBS Factor Score (CM, AL, AP, SF)

	Predicted Group Membership		
Original Group[a]	Typical	Referred	Gifted
Typical	179	0	0
Referred	71	0	0
Gifted	23	0	0

	Predicted Group Membership		
Original Group[b]	Typical	Referred	Gifted
Typical	179	0	0
Referred	71	0	0
Gifted	23	0	0

Note. In cross validation, each case is classified by the functions derived from all cases other than that case.
[a]65.6% of original grouped cases correctly classified.
[b]65.6% of cross-validated grouped cases correctly classified.

Table 13

Classification Results for Referred and Gifted Groups Based on CSI

	Predicted Group Membership	
Original Groups[a]	Referred	Gifted
Referred	11	12
Gifted	67	4
	Predicted Group Membership	
Original Group[b]	Referred	Gifted
Referred	11	12
Gifted	67	4

Note. In cross validation, each case is classified by the functions derived from all cases other than that case.

[a]84.0% of original grouped cases correctly classified.

[b]84.0% of cross-validated grouped cases correctly classified.

Table 14

Classification Results for Referred and Gifted Groups Based on CSI and LBS Total Score Combined

Original Groups[a]	Predicted Group Membership	
	Referred	Gifted
Referred	11	12
Gifted	67	4
Original Group[b]	**Predicted Group Membership**	
	Referred	Gifted
Referred	11	12
Gifted	66	5

Note. In cross validation, each case is classified by the functions derived from all cases other than that case.

[a]84.0% of original grouped cases correctly classified.

[b]83.0% of cross-validated grouped cases correctly classified.

Table 15

Classification Results for Referred and Gifted Groups Based on CSI and LBS Factor Scores (CM, AL, AP, SF) Combined

	Predicted Group Membership	
Original Groups[a]	Referred	Gifted
Referred	10	13
Gifted	67	4
	Predicted Group Membership	
Original Group[b]	Referred	Gifted
Referred	11	12
Gifted	66	5

Note. In cross validation, each case is classified by the functions derived from all cases other than that case.

[a]85.1% of original grouped cases correctly classified.

[b]83.0% of cross-validated grouped cases correctly classified.

Appendix A

Must meet one matrix for gifted qualification.

CSI Score	**135**	**134-130**	**129-128**	**127-126**	**125**
TerraNova Reading Composite	99-97 percentile	X	96-94 percentile	X	93-90 percentile
TerraNova Language Composite	99-97 percentile	X	96-94 percentile	X	93-90 percentile
Standards based Report Card	All Exceeds	X	Some Exceeds, Some Meets	X	All Meets
Weight	X5	X4	X3	X2	X1
Each Column's Total					
**A total matrix score of 7 or a CSI of 135 or higher is needed for qualification into the gifted program.					
Matrix Total Score:					

CSI Score	**135**	**134-130**	**129-128**	**127-126**	**125**
TerraNova Math Composite	99-97 percentile	X	96-94 percentile	X	93-90 percentile
Standards based Report Card	All Exceeds	X	Some Exceeds, Some Meets	X	All Meets
Weight	X5	X4	X3	X2	X1
Each Column's Total					
**A total matrix score of 13 or a CSI of 135 or higher is needed for qualification into the gifted program.					
Matrix Total Score:					