1-1-2005

Incremental Validity Of The Learning Behaviors Scale

Erin E. Willenborg
Eastern Illinois University

This research is a product of the graduate program in Psychology at Eastern Illinois University. Find out more about the program.

THESIS REPRODUCTION CERTIFICATE

TO: Graduate Degree Candidates (who have written formal theses)

SUBJECT: Permission to Reproduce Theses

The University Library is receiving a number of request from other institutions asking permission to reproduce dissertations for inclusion in their library holdings. Although no copyright laws are involved, we feel that professional courtesy demands that permission be obtained from the author before we allow these to be copied.

PLEASE SIGN ONE OF THE FOLLOWING STATEMENTS:

Booth Library of Eastern Illinois University has my permission to lend my thesis to a reputable college or university for the purpose of copying it for inclusion in that institution's library or research holdings.

Erin Willey ______ 8-9-05 ______

Author's Signature Date

I respectfully request Booth Library of Eastern Illinois University **NOT** allow my thesis to be reproduced because:

____

____

____

______________________________ ______________

Author's Signature Date

This form must be submitted in duplicate.

Incremental Validity of the Learning Behaviors Scale

(TITLE)

BY

Erin E. Willenborg

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Specialist in School Psychology

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

2005

YEAR

I HEREBY RECOMMEND THAT THIS THESIS BE ACCEPTED AS FULFILLING
THIS PART OF THE GRADUATE DEGREE CITED ABOVE

8/9/05
DATE

THESIS DIRECTOR

8/9/05
DATE

DEPARTMENT/SCHOOL HEAD

Running head: INCREMENTAL VALIDITY OF THE LBS

Incremental Validity of the Learning Behaviors Scale

Erin E. Willenborg

Eastern Illinois University

Abstract

Previous research on the incremental validity of the Learning Behaviors Scale (LBS; McDermott, Green, Francis, & Stott, 1999) has shown that good learning behaviors were associated with good academic achievement (Schaefer & McDermott, 1999; Yen, Konold, & McDermott, 2004). Additionally, research has indicated that learning behaviors account for appreciable variation in student grades and academic achievement test scores above and beyond the contribution of intelligence (Schaefer, 1996). The present study investigated the influence of cognitive ability and learning behaviors in the prediction of scores from standardized academic achievement tests. Learning behaviors were assessed with the LBS (McDermott et al., 1999) and cognitive ability was measured with the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2003a). This study used an independent sample of 57 students in grades kindergarten through 10. Multiple regression analyses were conducted to examine the relationships between ability, learning behaviors and academic achievement. The criterion variable was academic achievement scores and the predictor variables were cognitive ability (Full Scale IQ score and index scores) and learning behaviors (LBS Total scale score and subscale scores). Results showed that cognitive ability alone was a better predictor of academic achievement than interaction of ability and learning behaviors. Also, results indicated that learning behaviors did not aid in the prediction of academic achievement. For this sample, learning behaviors did not possess incremental validity.

Acknowledgments

I would like to thank my parents, family, friends, and colleagues for their support and encouragement throughout graduate school and the completion of this study. They knew I would be successful, even when I was unsure of myself. I would also like to thank my thesis chairperson, Dr. Gary Canivez, and my thesis committee members, Dr. Michael Havey and Dr. Assege HaileMariam. Without their guidance, support, time, and effort, I would not have been able to successfully complete this project.

This study would not have been possible without the support and effort from several colleagues. I would like to thank Blake Edwards, Joel Grafman, Nik Hoffman, Julie Koetters, Kim Miller, Ryan Mitchell, and Sarah Peterson for their assistance with data collection. It was with their cooperation and generosity that I was able to obtain data and, thus, complete this project.

A special thank you is extended to Mr. Kevin Dill and the school psychologists employed by Rural Champaign County Special Education Cooperative for the invaluable knowledge and experiences I gained during my internship.

Table of Contents

List of Tables

Introduction

Each year more than 5 million students, ages 6 to 21, in the United States receive special education services under the Individuals with Disabilities Education Act (IDEA; U. S. Department of Education, 2002). During the 2000-2001 school year, 11.5% of students enrolled in school received services under IDEA. Of those students receiving special education services, more than half received services under the disability category specific learning disability (SLD).

A SLD can be diagnosed if a child has been provided with appropriate learning opportunities; a discrepancy exists between the child's cognitive ability and academic achievement in one or more of the following areas: oral expression, listening comprehension, written expression, basic reading skill, reading comprehension, mathematics calculation, or mathematics reasoning; and the discrepancy is not a result of the following: visual, hearing, or motor impairments, mental retardation, emotional disturbance, or environmental, cultural or economic disadvantage (Office of Special Education and Rehabilitative Services [OSERS], 1997). As a result, utilizing intelligence tests and achievement tests during psychoeducational evaluations in order to diagnose learning disabilities has become common practice. However, this method of diagnosis does not necessarily lead to treatment or intervention targets. Research has indicated that cognitive ability measures are limited in their utility for the design and implementation of educational interventions (Ceci, 1991; McDermott, 1999; McDermott & Beitman, 1984; McDermott & Schaefer, 1996; Reschly, 1997; Schaefer & McDermott, 1999) because intelligence is a relatively stable construct (McDermott, Mordell, & Stoltzfus, 2001).

As an alternative, researchers have suggested identifying students' learning behaviors and using these as targets for educational interventions (Schaefer & McDermott, 1999). Learning behaviors refer to observable patterns of behavior that children exhibit during learning tasks (Yen, Konold, & McDermott, 2004) and include, but are not limited to, such constructs as motivation, strategy, flexibility, persistence, and response to correction or feedback (Buchanan, McDermott, & Schaefer, 1998). In contrast to cognitive ability, research indicates that learning behaviors are malleable and thus can be targets for interventions (Barnett, Bauer, Ehrhardt, Lentz, & Stollar, 1996; Buchanan, et al.; McDermott, 1999). The Learning Behaviors Scale (LBS; McDermott, Green, Francis, & Stott,

1999) is one of the few measures designed to aid in the development of interventions for children who have learning problems. Thus, the purpose of the present study was to investigate the validity of the LBS.

The LBS is a teacher report behavior rating scale that is used to assess different classroom behaviors of children between the ages of 5 and 17. It is composed of 29 items, each of which describes specific learning related behaviors. The scale is completed by a teacher, who has observed the student for at least 50 school days. The LBS was nationally standardized on a sample consisting of 1500 youths (750 male and 750 female) ages 5 to 17. The sampling methods utilized during national standardization included matrix blocking for gender, age, and grade level and stratified random sampling for race, social class, family structure, community size, and national region. The sample conformed to the 1992 U.S. Census (for further details, see McDermott, 1999).

Based on both exploratory and confirmatory factor analysis of the standardization sample, four factors, or dimensions emerged: Competence Motivation (CM), Attitude Toward Learning (AL), Attention/Persistence (AP), and Strategy/Flexibility (SF) (McDermott, 1999). The four factor structure was found to be invariant across age, gender, and race/ethnicity. Raw scores from 25 of the 29 items are used to compute the four dimension scores. An LBS total score can also be computed. Raw scores are converted into normalized *T* scores, with a *M* = 50 and *SD* = 10.

The LBS dimensions were labeled according to the items comprising each factor (McDermott, 1999). The Competence Motivation dimension is intended to measure the student's expectation of success (i.e., is reluctant to tackle a new task; sticks to a task with no more than minor distractions). Attitude Toward Learning items focus on the child's willingness to participate in learning activities (i.e., gets aggressive or hostile when frustrated or when work is corrected; cooperates in class activities sensibly). The Attention/Persistence items relate to the student's ability to complete tasks and distractibility (i.e., shows little determination to complete a task, gives up easily; is willing to be helped when a task proves too difficult). The Strategy/Flexibility dimension focuses on the child's approach to tasks (i.e., does not work well if in a bad mood; tries hard but concentration soon fades and performance deteriorates).

Reliability and validity evidence for LBS scores have been supportive. McDermott (1999) found average internal consistency estimates, ranging from .75 to .85 for the four scales (M_r = .82). Additionally, Worrell, Vandiver, and Watkins (2001) found high internal consistency estimates for the LBS total score across gender and grade subgroups with an independent sample of students (.88-.91). Also, Canivez, Willenborg, and Kearney (in press) used an independent sample to investigate the internal consistency of the LBS. For the total sample, internal consistency estimates of the four LBS subscales and the LBS total score ranged from .78 to .93 (Mdn_α = .88). Across gender and grade subgroups, internal consistency estimates of the subscale and total score ranged from .71 to .94 (Mdn_α = .87).

Two-week test-retest reliability was established with a sample of 77 students, and reliability coefficients ranged from .91 to .93 (McDermott, 1999). Interrater reliability was also established with a sample of 72 special education students. For each student, the teacher and teacher's aide each independently completed the LBS. Interrater reliability was good, with intraclass correlations ranging from .68 to .88 for the subscales and .91 for the LBS total score (Buchanan et al., 1998). These results suggested that observer qualities did not interfere with the observation and ratings of the student.

Additionally, construct (factorial) validity of the LBS has been partially supported. Worrell et al. (2001) conducted a study to investigate the factor structure of the LBS with an independent sample of 257 students in grades 1-5. Parallel analysis and computer software suggested that there were three factors, and a three factor solution was extracted. The three dimensions were labeled as Attention and Learning Attitudes, Competence Motivation, and Strategy/Flexibility. A four factor solution was also extracted based on theoretical considerations since the LBS is based on a four factor model. In the four factor solution, three of the four factors were supported. The three factors were named Competence Motivation, Strategy/Flexibility, and Attitude Toward Learning, because these factors contained items similar to the normative study (McDermott, 1999). However, the Attention/Persistence (AP) factor was not supported. When four factors were extracted, the items contained on the fourth factor consisted of three AP items and three non-AP items. Overall, the results supported three of the four LBS dimensions. However, the authors suggested that the results could have been due to sampling error and that further research was needed.

Canivez et al. (in press) conducted a study to further investigate the factor structure of the LBS with an independent sample of 241 students in grades 1-11. The scree test suggested a four factor solution and parallel analysis suggested a three factor solution. The results of this study supported the four factor model, as found by McDermott (1999). When four factors were extracted, many of the items loaded onto the same factors as in the normative study, providing support for the Attention and Persistence factor, which was not supported by Worrell et al. (2001). Only four items loaded onto factors that differed from their factor assignment from the normative data. When three factors were extracted, many of the items loaded onto factors that differed from those observed in the Worrell et al. study and from the normative data (McDermott, 1999). Coefficients of congruence comparing the fit or factorial invariance of these data to the standardization data resulted in good to excellent match for the four factor model. The four factor model was deemed most appropriate due to the coefficients of congruence.

McDermott (1999) summarized convergent and divergent validity of the LBS with the Differential Abilities Scales (DAS; Elliott, 1990) and the Adjustment Scales for Children and Adolescents (ASCA; McDermott, Stott, & Marston, 1993). Convergent validity was evidenced with the DAS. The LBS dimensions were positively correlated with the DAS achievement (canonical correlation [*Rc*] = .42) and ability scales (*Rc* = .43). Specifically, strong relationships were noted between the DAS ability and achievement measures and the LBS Competence Motivation, Attention/Persistence, and Attitude Toward Learning dimensions. Divergent validity was observed with the ASCA. The ASCA is a teacher rating scale that is designed to measure children's behavior pathologies that manifest across a variety of situations. McDermott found statistically significant negative correlations between the LBS dimensions and the ASCA syndrome scales. In general, good learning behaviors were associated with low levels of behavior pathologies, especially overactivity or externalizing behaviors.

Canivez, Willenborg, and Kearney (2004) further investigated the convergent and divergent validity of the LBS with the ASCA with an independent sample of 246 students. This research replicated the findings of McDermott (1999). Specifically, statistically significant negative relationships were observed between the LBS total score and the ASCA Overactivity score ($r = -.64$) and between the LBS total score and the ASCA Underactivity score ($r = -.43$). Moreover, overactive behavior problems (ASCA Overactivity) were more strongly associated with poor learning behaviors, as compared to underactive behavior problems (ASCA Underactivity). These results suggested that good learning behaviors are associated with low levels of psychopathology, including overactive and underactive behaviors.

Incremental validity of the LBS has also been investigated. During standardization, McDermott (1999) found that the LBS dimensions were correlated with intelligence, but the overlap was small (12.1%), indicating that approximately 85% of the variance of the LBS is not shared with intelligence. Schaefer and McDermott (1999) reported similar correlations between the LBS dimensions and intelligence. Other research has investigated the contribution of the LBS dimensions in the prediction of academic achievement over and above that of intelligence, which is referred to as incremental validity. Incremental validity examines the "extent to which a measure adds to the prediction of a criterion beyond what can be predicted with other data" (Hunsley, 2003, p. 443).

Schaefer (1996), using a cross-sample of the standardization sample, investigated the incremental validity of the LBS and the Differential Ability Scales (DAS; Elliott, 1990) in the prediction of academic achievement (teacher-assigned grades and standardized achievement test scores). When examining the contributions of the LBS dimensions, the LBS dimensions were able to account for 21.90% to 32.2% of the variance of teacher-assigned grades and 11.50% to 14.50% of standardized achievement test scores. When examining the interactions between LBS dimensions and intelligence, the interactions were able to account for 28.10% to 35.80% of teacher-assigned grades and 31.20% to 37.50% of standardized achievement. Similar results were reported by Schaefer and McDermott (1999).

Additionally, the LBS dimensions were able to account for 16.3% of grade variation over and above that explained by intelligence alone (Schaefer, 1996). Also, the LBS dimensions were able to account for 2.7% of the achievement test variation over and above that explained by cognitive ability only. In general, learning behaviors were better able to predict teacher-assigned grades than standardized test scores.

Schaefer and McDermott (1999) reported that students with good learning behaviors (i.e., academic engagement, willingness to attempt tasks) had better academic achievement. Specifically, standardized reading achievement was associated with positive attitudes towards learning, while reading grades were related to the use of appropriate strategies and managing frustration.

Weiss (1997) investigated the interactions between intelligence, learning behaviors, and achievement responsibility in the prediction of academic achievement with two independent samples. One sample consisted of 180 4^{th}, 5^{th}, and 6^{th} grade parochial school students. In this sample, the interactions between the three variables were able to predict 43.3% of achievement test scores and 49% of student grades. The second sample consisted of 185 public school students in similar grades. The interactions of the three variables were able to predict 61% of achievement scores and 60% of student grades. Overall, the interaction between intelligence and learning behaviors was found to be the best predictor of academic achievement.

Other researchers investigated the contribution of learning behaviors in the prediction of academic achievement over and above cognitive ability utilizing a stratified sample (Yen et al., 2004). The sample consisted of 1304 non-institutionalized students ages 6 to 17 and was collected as part of the national standardization of the LBS. Results indicated that students with positive learning behaviors were more likely to be academically successful. These relationships were found invariant across gender and race or ethnicity.

The previous studies investigating the incremental validity of the LBS have generally utilized subsamples or cross-samples obtained from the standardization data. These studies have indicated that good learning behaviors are associated with good academic achievement (Schaefer & McDermott, 1999; Yen et al., 2004). Additionally, Schaefer (1996) found that the LBS accounts for appreciable variation in student grades and achievement test scores above and beyond the contribution of intelligence. Given that intelligence is a stable construct, it is important to investigate and replicate the incremental validity of the LBS with independent samples, as research suggests that learning behaviors are teachable (Barnett et al., 1996; Buchanan, et al.; McDermott, 1999).

The purpose of the present study was to further investigate the incremental validity of the LBS; and particularly, the contributions of intelligence and learning behaviors in the prediction of standardized academic achievement test scores with an independent sample of students referred for special education services. It was hypothesized that learning behaviors would predict academic achievement variation beyond that accounted for by intelligence. Also, it was hypothesized that the interaction of learning behaviors and intelligence would be the best predictor of academic achievement.

Method

Participants

Data were collected by 8 school psychologists and school psychologist interns from 8 rural and suburban Illinois school districts. The sample consisted of 57 students ranging from kindergarten to 10th grade. Students ranged in age from 6 to 16 years (M = 10.92, SD = 2.96). Demographic characteristics are presented in Table 1. The majority of the students were male, Caucasian, and not disabled. Of those with disabilities, the majority were identified as Learning Disabled. The disability status was based on the outcome of the most recent evaluation.

The participants were students who were referred for evaluation to determine eligibility for special education services. Each student was administered the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV;

Wechsler, 2003a) and one of the following individually administered academic achievement tests: the Wechsler Individual Achievement Test-Second Edition (WIAT-II; The Psychological Corporation, 2001) or the Woodcock-Johnson Tests of Achievement-Third Edition (WJ-III; Woodcock, McGrew, & Mather, 2001). Of the total sample, approximately half of the students were administered the WIAT-II (50.9%) and half were administered the WJ-III (49.1%). The student's primary teacher completed the Learning Behaviors Scale (LBS; McDermott, Green, Francis, & Stott, 1999).

Consent for testing was obtained as part of the school's regular procedure for psychoeducational evaluation. Information on the student's age, grade, gender, race, and disability status was also obtained in order to more accurately describe the sample. No personally identifiable information was collected to protect the anonymity of the students.

Instruments

The Learning Behaviors Scale. The Learning Behaviors Scale (LBS; McDermott, Green, Francis, & Stott, 1999) was designed to measure classroom learning behaviors of children between the ages of 5 to 17. The LBS is comprised of 29 items, which the child's teacher indicates if the item "*Most* *often applies," "Sometimes applies,"* or *"Doesn't apply"* to the student (McDermott et al., 1999). The behavioral statements are both positively and negatively worded in order to reduce response sets, and the negatively worded items are reverse-scored (i.e., negative ratings are scored higher than positive ratings). Higher scores indicate good learning behaviors, whereas lower scores are indicative of problematic learning behaviors. In addition to a total scale score, four dimension scores are obtained, including: Competence Motivation, Attitude Toward Learning, Attention/Persistence, and Strategy/Flexibility.

Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2003a). The WISC-IV was designed to measure a child's cognitive ability. It can be used with children from age 6 to age 16. The test is composed of 10 core subtests and five supplemental subtests. The scores from these 10 subtests are utilized to obtain the Full Scale IQ score. Exploratory and confirmatory factor analysis of the standardization data suggested a four factor structure. The four factors were labeled Verbal Comprehension, Perceptual Reasoning, Working Memory, and Processing Speed index scores.

The WISC-IV was nationally standardized on a sample of 2,200 children between the ages of 6 and 16 (Wechsler, 2003b). The sample conformed to the 2000 U. S. Census in terms of parental education level, race or ethnicity, and geographic region. Reliability and validity estimates for WISC-IV scores have been supportive. Average reliability coefficients for the Full Scale IQ score and index scores ranged from .88 to .97, while the average reliability coefficients for the subtest scores ranged from .79 to .90. The average test-retest reliability coefficients (mean interval = 32 days) for composite scores were high (.86 to .93), and the average reliability coefficients for individual subtest scores were lower and ranged from .76 to .92. Interrater reliability estimates for subtests were high (.95-.99). Convergent validity was established with the Wechsler Intelligence Scale for Children-Third Edition (WISC-III; Wechsler, 1991) and with the Wechsler Preschool and Primary Scale of Intelligence-Third Edition (WPPSI-III; Wechsler, 2002). Correlations of the WISC-IV and WISC-III index scores ranged from .72 to .88, and the correlation between the Full Scale IQ scores was .89. Correlations between similar subtest were somewhat lower (.62 to .83). Correlations between the WPPSI-III and WISC-IV index and

Full Scale scores ranged from .65 to .89, while correlations between similar subtests ranged from .44 to .74.

Wechsler Individual Achievement Test-Second Edition. The Wechsler Individual Achievement Test-Second Edition (WIAT-II; Psychological Corporation, 2001) is a test that was designed to assess achievement skills, to assist in the diagnosis of learning disabilities and special education placement, and to aid in curriculum planning (Psychological Corporation, 2001). The WIAT-II can be used with individuals between the ages of 4 to 85. The test is comprised of nine subtests, including: Word Reading, Pseudoword Decoding, Reading Comprehension, Math Reasoning, Numerical Operations, Listening Comprehension, Oral Expression, Spelling, and Written Expression. From these subtests, four composite scores can be obtained, including Reading, Written Language, Mathematics, and Oral Language composite scores. A Total Composite score can also be obtained. Individual subtest scores and composite scores can be reported as standard scores, percentile ranks, age or grade equivalents, normal curve equivalents, stanines, quartile scores, or decile scores (Psychological Corporation, 2001).

Normative data for the WIAT-II was collected for school-age populations, college students, and adults

(Psychological Corporation, 2001). Reliability and validity estimates reported here are only for the school-aged population. Internal consistency estimates for the WIAT-II Composite scores were high (above .90), with the exception of the Oral Language Composite score (above .85). The internal consistency estimates for individual subtest scores were also high (above .85). However, reliability estimates for Written Expression and Listening Comprehension subtests were somewhat lower (above .70). Test-retest reliability coefficients were generally high, with coefficients above .85 for the subtests and above .90 for the Composite scores. Correlations between the subtest scores on the WIAT-II and the previous version, the Wechsler Individual Achievement Test (WIAT), were high (above .80). However, correlations between the WIAT-II and the DAS (Elliott, 1990) were lower (.32-.64).

Woodcock-Johnson Tests of Achievement-Third Edition. The Woodcock-Johnson Tests of Achievement (WJ-III; Woodcock, McGrew, & Mather, 2001) was designed to "determine and describe the present status of an individual's academic strengths and weaknesses" (Mather & Woodcock, 2001, p. 6). It can be used with individuals from age 2 to above age 90. The WJ-III includes parallel forms of the test, designated as Form A and Form B, and it consists of 22 subtests. The first 12 subtests are considered the standard battery of the test, and 10 additional tests are included to supplement the standard battery. These 10 supplemental subtests are referred to as the extended battery. For the purposes of the current research, scores obtained from the standard battery subtests were utilized.

The following subtests are included in the standard battery: letter-word identification, reading fluency, story recall, understanding directions, calculation, math fluency, spelling, writing fluency, passage comprehension, applied problems, and writing samples. From these subtests, cluster scores can be obtained from combinations of the standard battery subtests: Broad Reading, Oral Language-Standard, Broad Math, Math Calculation Skills, Broad Written Language, Written Expression, Academic Skills, Academic Fluency, Academic Applications, and Total Achievement.

Overall, the reliability estimates for the WJ-III were high, with most estimates falling above .70 (Mather & Woodcock, 2001). On the speeded subtests, test-retest reliability estimates for one-day intervals ranged from .69 to .96. On the non-speeded subtests, one-year test-retest reliability estimates were similar. Interrater reliability was established for the writing subtests, and correlations were above .90. Construct validity was also established. Scores on the WJ-III subtests are moderately to highly correlated with scores on similar subtests from the WIAT and the Kaufman Test of Educational Achievement (KTEA; Kaufman & Kaufman, 1985).

Procedure

School psychologists and school psychologist interns were recruited to participate in this study. Information detailing the purpose and method of this study was provided to school psychologists via email and word-of-mouth. The school psychologists who agreed to participate in this study were given forms on which to record the student's demographic characteristics (i.e., age, grade, race, sex, disability, etc.) and test scores. Parental consent for each student was obtained prior to evaluation as a part of the school district's standard procedure for psychoeducational evaluation.

The participating school psychologists were also provided the Learning Behaviors Scale (LBS; McDermott, Green, Francis, & Stott, 1999) rating forms. The school psychologists were given instructions on how to have the teachers complete the LBS, and the LBS rating forms were returned to this researcher for scoring. Upon the participating psychologist's request, the student's scores on the LBS and interpretation of these scores were provided.

Data Analyses

Data were analyzed using multiple regression analysis. Multiple regression analysis permitted the prediction of one criterion, or dependent variable, from several predictor variables, or independent variables (Tabachnick & Fidell, 2001). Table 2 presents the criterion and predictor variables used in the multiple regression analyses. In the present study, the criterion was the standardized academic achievement test scores: basic reading skills, reading comprehension, mathematical calculation, mathematical reasoning, and written expression obtained from the WIAT-II or WJ-III academic achievement tests. The predictor variables were estimates of cognitive ability and learning behaviors. Partial correlations were also calculated to determine the correlation between learning behaviors and academic achievement after controlling for cognitive ability.

In the first set of analyses, the WISC-IV Full Scale IQ score and the LBS Total scale score were utilized as the predictor variables. Partial correlations were calculated between the LBS Total Scale score and standardized academic achievement scores after controlling for Full Scale IQ.

In the second set of analyses, WISC-IV index scores (Verbal Comprehension [VCI], Perceptual Reasoning [PRI], Working Memory [WMI], and Processing Speed [PSI] scores) and the LBS subscale scores (including Competence Motivation [CM], Attitude toward Learning [AL], Attention/Persistence [AP], and Strategy/Flexibility [SF] scores) were used as the predictor variables. Partial correlations were again calculated between standardized academic achievement scores and the LBS subscale scores (CM, AL, AP, and SF). The control variables were the WISC-IV index scores (VCI, PRI, WMI, and PSI).

Results

Global Predictors

A series of multiple regression analyses were conducted to examine how global intelligence scores and overall learning behavior scores predicted academic achievement in the areas of basic reading skills, reading comprehension, math calculation skills, math reasoning, and written expression. The predictor variables were the WISC-IV Full Scale IQ score and the LBS Total scale score. These variables are presented in Table 2. Partial correlations were examined between overall learning behaviors and academic achievement test scores, while controlling for global cognitive ability.

Basic Reading Skills. Multiple regression analysis was conducted to examine how cognitive ability (Full Scale IQ) and learning behaviors (LBS Total Scale score) predicted basic reading skills. Results showed that this set of predictors accounted for 23.20% (adjusted) of the variance in basic reading skills, $F(2, 54) = 9.47$; $p < .05$. Cognitive ability accounted for all of the predicted achievement variance, while the contribution of learning behaviors was not significant. In fact, cognitive ability alone accounted for slightly more variance (24.80%; $p < .05$) in basic reading skills than the interaction of cognitive ability and learning behaviors (23.20% [adjusted]; $p < .05$). After controlling for Full Scale IQ, the partial correlation between the LBS Total Scale score and basic reading skills (.08) was not statistically significant, as shown in Table 3.

Reading Comprehension. Another multiple regression analysis was conducted to determine how this set of variables (Full Scale IQ and LBS Total Scale score) predicted reading comprehension. Cognitive ability and learning behaviors accounted for 24.80% (adjusted) of the variance in reading comprehension, $F(2, 53) = 10.06$; $p < .05$. Similar to the results for basic reading skills, cognitive ability alone was able to account for slightly more variance in reading comprehension (25.30%; $p < .05$) than the interaction of cognitive ability and learning behaviors (24.80% [adjusted]; $p < .05$). As shown in Table 3, the partial correlation between reading comprehension and the LBS Total Scale (.11) score was not significant.

Math Calculation Skills. Multiple regression analysis was performed to investigate how the WISC-IV Full Scale IQ and the LBS Total Scale score predicted math calculation skills. This set of predictors accounted for 40.70% (adjusted) of the variance in math calculation skills, $F(2, 53) = 19.90$; $p < .05$. When controlling for learning behaviors, cognitive ability alone accounted for more of the variance in math calculation skills (43.03%; $p < .05$) than the set of predictors. Again, the partial correlation between math calculation skills and the LBS Total Scale score (-.08) was not statistically significant, as seen in Table 3.

Math Reasoning. Multiple regression analysis was conducted to study how cognitive ability (Full Scale IQ) and learning behaviors (LBS Total Scale score) predicted math reasoning. This set of predictors accounted for 60.50% (adjusted) of the variance in math reasoning, $F(2, 54) = 43.96$; $p < .05$. Moreover, cognitive ability alone accounted for slightly more (62.09%; $p < .05$) of the variance in math reasoning, an increase of 1.59%. As shown in Table 3, the partial correlation revealed that the LBS Total Scale score and math reasoning (.00) was not significantly correlated after controlling for cognitive ability.

Written Expression. Multiple regression analysis was conducted to examine how the Full Scale IQ score and the LBS Total Scale score predicted written expression. This set of predictors accounted for 9.60% (adjusted) of the variance in written expression, $F(2, 50) = 3.78$; $p < .05$. Cognitive ability alone accounted for 11.76% of the variance in written expression ($p < .05$). Partial correlation results showed that learning behaviors and written expression scores (.14) were not significantly correlated (see Table 3).

Index/Subscale Predictors

A series of multiple regression analyses were conducted to examine how cognitive ability index scores and learning behavior subscale scores predicted academic achievement. As shown in Table 2, the predictor variables included the WISC-

IV index scores of Verbal Comprehension (VCI), Perceptual Reasoning (PSI), Working Memory (WMI), and Processing Speed (PSI) and the LBS subscale scores of Competence Motivation (CM), Attitude toward Learning (AL), Attention/Persistence (AP), and Strategy/Flexibility (SF). Again, academic achievement test scores served as the criteria and included: basic reading skills, reading comprehension, math calculation skills, math reasoning, and written expression (see Table 2). Partial correlations were calculated between the LBS subscale scores and academic achievement test scores. The control variables included the WISC-IV index scores (VCI, PRI, WMI, PSI).

Basic Reading Skills. Multiple regression analysis examined how the cognitive ability index scores and learning behavior subscale scores predicted basic reading skills. Results showed that this set of predictors accounted for 23.90% of the variance in basic reading skills, $F(4, 52) = 5.40$; $p < .05$. Additionally, the best predictor set included the cognitive ability index scores only. After controlling for WISC-IV index scores, the partial correlations between the learning behavior subscale scores and basic reading skills were not statistically significant. Partial correlations are presented in Table 4.

Reading Comprehension. Multiple regression analysis was conducted to investigate how learning behaviors (LBS subscale scores) and cognitive ability (WISC-IV index scores) predicted reading comprehension scores. Results indicated that this set of predictors accounted for 30.20% of the variance in reading comprehension scores, $F(4, 51) = 6.95$, $p < .05$. Again, the best predictor set was the WISC-IV index scores. When factoring out the influence of WISC-IV index scores, the partial correlations between the LBS subscale scores and reading comprehension scores were not statistically significant (see Table 4).

Math Calculation Skills. Multiple regression analysis was performed to determine how the LBS subscale scores and the WISC-IV index scores predicted math calculation skills. Results showed that this set of predictors accounted for 46.50% of the variance in math calculation skills, $F(4, 51) = 12.95$, $p < .05$. Also, the best set of predictors included the WISC-IV index scores. Partial correlations were calculated on LBS subscale scores and math calculation skills, with the WISC-IV index scores as the control variables. As shown in Table 4, the partial correlations were not statistically significant.

Math Reasoning. Multiple regression analysis was conducted on LBS subscale scores and WISC-IV index scores in the prediction of math reasoning scores. Results showed that these predictors accounted for 64.40% of the variance of math reasoning scores, $F(4, 52) = 26.37$, $p < .05$. As in the previous analyses, the best set of predictors was the WISC-IV index scores only. After controlling for the influence of cognitive ability (WISC-IV index scores), the partial correlations between learning behaviors and math reasoning scores were not statistically significant, as seen in Table 4.

Written Expression. Multiple regression analysis was conducted to determine how WISC-IV index scores and LBS subscale scores predicted written expression scores. Results indicated that these variables accounted for 11.40% of the variance in written expression scores, $F(4, 48) = 2.68$, $p < .05$. Additionally, the best set of predictors included the cognitive ability scores. When examining the partial correlations between learning behaviors and written expression scores (controlling for WISC-IV index scores), the correlations between these variables were not significant (see Table 4).

Discussion

The present study was conducted to further investigate the incremental validity of the LBS with an independent sample. The results of the present study did not support the incremental validity of the LBS in the prediction of standardized academic achievement test scores. Specifically, the results did not support the hypothesis that learning behaviors add to the prediction of academic achievement test scores over cognitive ability. Additionally, the results did not support the hypothesis that the interaction of cognitive ability and learning behaviors is a better predictor of academic achievement than cognitive ability alone. When examining the interaction of learning behaviors and cognitive ability, ability was demonstrated to account for a majority of the variance in academic achievement. In fact, when examining the effect of cognitive ability in the prediction of academic achievement, ability alone tended to account for more variance in academic achievement than the interaction of the set of predictors.

The results of the present study were not consistent with other research completed on the incremental validity of the LBS. Using a cross-sample of the standardization data, Schaefer (1996) investigated the incremental validity of the

LBS and the DAS (Elliot, 1990) in the prediction of achievement. Results indicated that the LBS dimensions were able to account for an average of 13.3% of standardized achievement test scores. Additionally, when factoring out the influence of ability, Schaefer found that the LBS dimensions were able to account for 2.7% of the achievement test score variation over and above that explained by cognitive ability.

However, in the present study, only cognitive ability scores accounted for significant portions of achievement test score variability. Also, when partial correlations were calculated between learning behaviors and achievement (factoring out the influence of cognitive ability), the correlations were not statistically significant (see Table 3 and Table 4), suggesting that learning behaviors did not aid in the prediction of achievement test scores. However, research has found that learning behaviors only account for a small portion of the variance in standardized academic achievement scores, when controlling for the influence of cognitive ability (Schaefer, 1996).

Additionally, previous research has investigated the incremental validity of learning behaviors, intelligence, and achievement responsibility in the prediction of achievement (Weiss, 1997). Academic achievement was measured through teacher-assigned grades and standardized achievement test scores. Results suggested that the interaction of cognitive ability and learning behaviors was the best predictor of academic achievement, including both teacher-assigned grades *and* standardized achievement test scores. In contrast, the results of the present study indicated that the best predictor was cognitive ability alone. However, in the present study student academic achievement was assessed using standardized achievement test scores only and did not include teacher-assigned grades.

There are several significant limitations in this study which may have impacted the results. The fundamental limitation is the size and the lack of representativeness of the sample. First, the sample consisted of only 57 participants. A larger sample size would have allowed for better validity estimates. Also, the sample was limited with respect to the demographic characteristics of the participants. As shown in Table 1, the majority of participants were male, Caucasian, and from rural Midwest communities. Given the demographic and geographic limitations of the study, the results should not be generalized to the larger population.

Other limitations are related to the design and procedure of the study. First, all of the participants had been referred for evaluation to determine the need for special education services. The fact that all of the students had been referred for evaluation suggests that each of the students had been struggling in school. When examining the sample's performance on the WISC-IV, the LBS, and the achievement tests, the mean test scores were approximately one standard deviation below population means based on the standardization samples for the respective tests (see Table 5). Also, two separate standardized achievement tests were utilized to assess academic achievement. Although, the WIAT-II and the WJ-III were both designed to assess academic achievement, subtests measuring the same constructs (i.e., reading comprehension; written expression) are different. Another limitation involved the variability in administration of the tests used in this study. Eight school psychologists and school psychologist interns assisted in data collection for this study. Although the school psychologists and interns were trained in standardized test administration, there may have been variability in test administration or scoring procedures, but there was no way to assess this.

Future research studies should include participants from rural, suburban, and urban areas as well as individuals with diverse racial or ethnic backgrounds (i.e., African American, Hispanic/Latino American, Asian American, and Native American). In addition, future research investigating the incremental validity of the LBS in terms of predicting academic achievement should utilize various indices of academic achievement, including standardized tests *and* teacher grades.

References

Barnett, D. W., Bauer, A. M., Ehrhardt, K. E., Lentz, F. E., & Stollar, S. A. (1996). Keystone targets for changes: Planning for widespread positive consequences. *School Psychology Quarterly, 11,* 95-117.

Buchanan, H. H., McDermott, P. A., & Schaefer, B. A. (1998). Agreement among classroom observers of children's Stylistic learning behaviors. *Psychology in the Schools, 35,* 355-361.

Canivez, G. L., Willenborg, E. E., & Kearney, A. (in press). Replication of the Learning Behaviors Scale factor structure with an independent sample. *Journal of Psychoeducational Assessment.*

Canivez, G. L., Willenborg, E. E., and Kearney, A. (2004, April). *Construct validity of the Learning Behaviors Scale and the Adjustment Scales for Children and Adolescents.* Paper presented at the 2004 Annual Convention of the National Association of School Psychologists, Dallas, TX.

Ceci, S. J. (1991). How much does schooling influence general intelligence and its cognitive components?: A reassessment of the evidence. *Developmental Psychology, 27,* 703-722.

Elliott, C. D. (1990). *Differential Ability Scales: Introductory and technical handbook*. San Antonio, TX: Psychological Corporation.

Hunsley, J. (2003). Introduction to the special section on incremental validity and utility in clinical assessment. *Psychological Assessment, 15*, 443-445.

Kaufman, A. S., & Kaufman, N. L. (1985). *Kaufman Test of Educational Achievement*. Circle Pines, MN: AGS Publishing.

Mather, N., & Woodcock, R. W. (2001). *Examiner's manual: Woodcock-Johnson-III Tests of Achievement*. Itasca, IL: Riverside.

McDermott, P. A. (1999). National scales of differential learning behaviors among American children and adolescents. *School Psychology Review, 28,* 280-291.

McDermott, P. A., & Beitman, B. S. (1984). Standardization of a scale for the study of children's learning styles: Structure stability, and criterion validity. *Psychology in the Schools, 21,* 5-14.

McDermott, P. A., Green, L. F., Francis, J. M., & Stott, D. H. (1999). *Learning Behaviors Scale*. Philadelphia: Edumetric and Clinical Science.

McDermott, P. A., Mordell, M., & Stoltzfus, J. C. (2001). The organization of student performance in American schools: Discipline, motivation, verbal learning, and nonverbal learning. *Journal of Educational Psychology, 93,* 65-76.

McDermott, P. A., Stott, D. H., & Marston, N. C. (1993). *Adjustment Scales for Children and Adolescents.* Philadelphia: Edumetric and Clinical Science.

Office of Special Education and Rehabilitative Services. (1997). *Individuals with Disabilities Education Act amendments of 1997* (Public Law 105-17). Retrieved August 11, 2004, from: http://www.ed.gov/policy/speced/leg/idea/idea.pdf

The Psychological Corporation. (2001). *Wechsler Individual Achievement Test-Second Edition.* San Antonio, TX: The Psychological Corporation.

Reschly, D. J. (1997). Diagnostic and treatment utility of intelligence tests. In D. P. Flanagan, J. L. Genshaft, P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 437-456). New York: Guilford.

Schaefer, B. A. (1996). Relationship between learning behavior and academic achievement among school-aged American children and adolescents. (Doctoral dissertation, University of Pennsylvania, 1996). *Dissertation Abstracts International, 57(04),* 1490.

Schaefer, B. A., & McDermott, P. A. (1999). Learning behavior and intelligence as explanations for children's scholastic achievement. *Journal of School Psychology, 37,* 299-313.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using Multivariate Statistics* (4th ed.). Boston: Allyn and Bacon.

U. S. Department of Education. (2002). *24th annual report to Congress on the implementation of the Individuals with Disabilities Act*. Retrieved August 2, 2004, from http://www.ed.gov/about/reports/annual/osep/2002/section-ii.pdf

Wechsler, D. (1991). *Wechsler Intelligence Scale for Children-Third Edition.* San Antonio, TX: The Psychological Corporation.

Wechsler, D. (2002). *Wechsler Preschool and Primary Scale of Intelligence-Third Edition.* San Antonio, TX: The Psychological Corporation.

Wechsler, D. (2003a). *Wechsler Intelligence Scale for Children-Fourth Edition.* San Antonio, TX: The Psychological Corporation.

Wechsler, D. (2003b). *Wechsler Intelligence Scale for Children-Fourth Edition: Technical and interpretive manual.* San Antonio, TX: The Psychological Corporation.

Weiss, R. V. (1997). Cognitive ability, classroom learning behavior, and achievement responsibility as predictors of concurrent academic performance. (Doctoral dissertation, University of Pennsylvania, 1997). *Dissertation Abstracts International, 58(03),* 839.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson Tests of Achievement-Third Edition.* Itasca, IL: Riverside.

Worrell, F. C., Vandiver, B. J., & Watkins, M. W. (2001). Construct validity of the learning behavior scale with an independent sample of students. *Psychology in the Schools, 38,* 207-215.

Yen, C.-J., Konold, T. R., & McDermott, P. A. (2004). Does learning behaviors augment cognitive ability as an indicator of academic achievement? *Journal of School Psychology, 42*, 157-169.

Table 1

Sample Demographic Characteristics (*N* = 57)

Variable	*n*	%
Sex		
Male	41	71.9
Female	16	28.1
Race/Ethnicity		
Caucasian	46	80.7
Black/African American	7	12.3
Hispanic/Latino	2	3.5
Asian American	1	1.8
Other	1	1.8
Grade		
K	1	1.8
1	10	17.5
2	3	5.3
3	7	12.3
4	14	24.6
5	2	3.5
6	4	7.0
7	3	5.3
8	3	5.3
9	7	12.3
10	3	5.3
Disability Status		
Not Disabled	18	31.6
Learning Disabled (LD)	14	24.6
Emotionally Disabled (ED)	5	8.8
Mentally Retarded (MR)	5	8.8
Other Health Impaired (OHI)	6	10.5
Speech/Language Impaired (S/L)	2	3.5
Orthopedically Impaired	1	1.8
Visual/Motor Integration (VMI)	2	3.5
LD/ S/L	1	1.8
OHI/ LD	1	1.8
OHI/ ED	1	1.8
OHI/ S/L	1	1.8

Table 2

Criterion and Predictor Variables for Multiple Regression Analyses

Criterion	Predictor
Global Analyses	
Basic Reading Skills	WISC-IV Full Scale IQ
Reading Comprehension	LBS Scale Score
Math Calculation Skills	
Math Reasoning	
Written Expression	
Index/Subscale Analyses	
Basic Reading Skills	WISC-IV Verbal Comprehension Index
Reading Comprehension	WISC-IV Perceptual Reasoning Index
Math Calculation Skills	WISC-IV Working Memory Index
Math Reasoning	WISC-IV Processing Speed Index
Written Expression	LBS Competence/Motivation
	LBS Attitude Toward Learning
	LBS Attention/Persistence
	LBS Strategy/Flexibilty

Note. WISC-IV = Wechsler Intelligence Scale for Children-Fourth Edition; LBS = Learning Behaviors Scale.

Table 3

Partial Correlations of Learning Behaviors Scale Total Scale Score with Achievement Scores after Controlling for WISC-IV Full Scale IQ

Criterion	Predictor LBS Total Scale Score
Basic Reading Skills	.08
Reading Comprehension	.11
Math Calculation Skills	-.08
Math Reasoning	.00
Written Expression	.14

Note. N = 57. df = 49 for all comparisons.
All correlations not significant, $p > .05$.

Table 4

Partial Correlations of Learning Behaviors Subscale Scores with Achievement Scores after Controlling for WISC-IV Index Scores (VCI, PRI, WMI, PSI)

	Predictor			
Criterion	CM	AL	AP	SF
Basic Reading	.23	-.05	.12	.03
Reading Comprehension	.20	.01	.01	-.02
Math Calculation	-.10	-.12	-.11	-.03
Math Reasoning	-.05	-.07	-.08	-.13
Written Expression	.05	.11	.22	.12

Note. $N = 57$. $df = 46$ for all comparisons. VIC = Verbal Comprehension Index; PRI = Perceptual Reasoning Index; WMI = Working Memory Index; PSI = Processing Speed Index; CM = Competence Motivation; AL = Attitude toward Learning; AP = Attention/Persistence; SF = Strategy/Flexibility.
All correlations not significant, $p > .05$.

Table 5

Mean Cognitive Ability, Learning Behaviors, and Achievement Scores for the Sample

Test score	*N*	*M*	*SD*
Wechsler Intelligence Scale for Children-Fourth Edition[a]			
WISC-IV Full Scale IQ	57	84.33	12.26
Verbal Comprehension Index	57	85.67	12.07
Perceptual Reasoning Index	57	89.42	14.50
Working Memory Index	57	85.86	12.90
Processing Speed Index	57	89.16	13.85
Learning Behaviors Scale[b]			
LBS Total Scale	57	40.56	7.03
Competence Motivation	57	38.61	11.09
Attitude toward Learning	57	42.47	9.75
Attention/Persistence	57	41.33	8.94
Strategy/Flexibility	57	43.74	10.77
Academic Achievement Test Scores[a]			
Basic Reading Skills	57	88.35	11.01
Reading Comprehension	56	83.23	13.31
Math Calculation Skills	56	86.20	12.73
Math Reasoning	57	85.26	12.30
Written Expression	53	83.64	13.20

[a]Scores are standard scores (*M* = 100, *SD* = 15). [b]Scores are *T* scores (*M* = 50, *SD* = 10).

Appendix

Data Collection Form

Student ID # _______ Race/Ethnicity _____ Age____ Grade ___ Gender ___ Zip _____

Please fill in the information where the (*) is. Supplemental subtests on the WISC-IV are not necessary, but if you have them, please record them. Please specify the achievement test that you used beside Achievement. Thank you.

WISC-IV	**Scaled Score**	**Standard Score**
▪ Block Design	*	
▪ Similarities	*	
▪ Digit Span	*	
▪ Picture Concepts	*	
▪ Coding	*	
▪ Vocabulary	*	
▪ Letter-Num. Seq.	*	
▪ Matrix Reasoning	*	
▪ Comprehension	*	
▪ Symbol Search	*	
▪ (Picture Comp.)	*	
▪ (Cancellation)	*	
▪ (Information)	*	
▪ (Arithmetic)	*	
▪ (Word Reasoning)	*	
▪ Verbal Comp. Ind.		*
▪ Percept. Reas. Ind.		*
▪ Work. Mem. Ind.		*
▪ Process. Speed Ind.		*
▪ Full Scale IQ		*
Achievement:		
▪ Basic Reading		*
▪ Reading Comp.		*
▪ Math Calculation		*
▪ Math Reasoning		*
▪ Written Expression		*
▪ Oral Expression		*
▪ Listening Comp.		*

Disability:	
LD Basic Reading Skills	
LD Reading Comp.	
LD Math Calculation	
LD Math Reasoning	
LD Written Expression	
LD Oral Expression	
LD Listening Comp.	

Please place a check mark (√) in the box next to the LD classification for this student if applicable. If the student has any other disabilities, please write them beside Disability.