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Replication of the Learning Behaviors Scale Factor Structure With an Independent Sample

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This study reports on the replication of the four-factor structure and the internal consistency of the Learning Behaviors Scale (LBS) with an independent sample of 241 students in Grades 1 through 7. Internal consistency estimates were as high or higher than those obtained with the standardization sample. Substantial replication of the four LBS factors (Competence Motivation, Attitude Toward Learning, Attention/Persistence, and Strategy/Flexibility) was found. Most items in the study were associated with the identical factor found with the standardization sample. Coefficients of congruence tested the factorial invariance and resulted in "good" to "excellent" matches to the exploratory factor analysis results based on the LBS standardization sample. Furthermore, three of the five LBS items that cross-loaded in this study were also items that cross-loaded in the standardization sample and did so on the same factors. Substantial evidence was found for the internal consistency and construct (factorial) validity of the LBS.

Keywords: *factor structure; Learning Behaviors Scale; teacher rater methods; elementary school students*

School psychologists devote significant time and attention to assisting teachers in understanding student behavioral and academic difficulties and recommending educational interventions for those difficulties. Often, evaluations to determine the nature of the difficulty and the presence of disability include standardized measures of intelligence, academic achievement, and psychopathology. Although measures of intelligence provide the best predictors of academic achievement (Neisser et al., 1996; Sattler, 2001) and such prediction is important, information from traditional intelligence tests does not appear relevant to designing effective cognitive or educational interventions (i.e., treatment validity; Brown & Campione, 1982; Ceci, 1990, 1991; Glutting & McDermott, 1990a, 1990b; Macmann &

Authors' Note: Data were obtained as part of undergraduate research projects conducted by Erin Willenborg and Amanda Kearney while undergraduate psychology students at Eastern Illinois University under the direction and supervision of the lead author. Special thanks to Paul A. McDermott for providing Learning Behavior Scale standardization data for comparison purposes. Correspondence regarding this article should be addressed to Gary L. Canivez, Ph.D., Department of Psychology, 600 Lincoln Avenue, Charleston, IL 61920-3099l; e-mail: glcanivez@eiu.edu; Web: http://www.ux1.eiu.edu/~glcanivez.

Barnett, 1994; Neisworth & Bagnato, 1992; Reschly, 1988, 1997; Scarr, 1981; Schaefer & McDermott, 1999; Scarr, 1981; Spitz, 1986; Ysseldyke & Christenson, 1988).

Although intelligence tests can account for as much as 50% of the variability in students' academic achievement test performance, other important factors may account for some of the remaining portion and need to be considered. A construct that has been examined for its potential in providing incremental validity in predicting achievement beyond intelligence as well as treatment validity is learning behavior. McDermott (1999), Schaefer and McDermott (1999), and Schaefer (2004) described theoretical rationales for the importance of considering learning behaviors in assessing children's educational difficulties. They pointed out that learning behaviors identified by developmental and learning experts (Anderson & Messick, 1974; Stipek, 1998) that facilitate the academic development include attention to tasks, positive attitudes about academics and school, competence motivation, problem-solving skills, and flexibility in information processing. Characteristics such as these that facilitate academic success are what DiPerna and Elliott (2002) referred to as "academic enablers" (p. 293). Research has suggested that various learning-related behaviors such as attention to task, active participation, reflective responding, accepting correction and feedback, developing and using effective strategies, and appreciation of novelty facilitate success in students' learning and educational achievement (Carter & Swanson, 1995; Finn & Cox, 1992; Jussim, 1989; Schuck, Oehler-Stinnett, & Stinnett, 1995; Wentzel, 1991). It has been suggested that learning behaviors can be taught and thus can have a direct impact on students' learning (Barnett, Bauer, Ehrhardt, Lentz, & Stollar, 1996; Engelmann, Granzin, & Severson, 1979; Stott, 1978, 1981; Stott & Albin, 1975; Weinberg, 1979). Assessment of such learning behaviors may provide additional insights into student learning difficulties and further aid in remediation of learning problems due to their responsiveness to interventions.

Attempts to measure learning-related constructs have been made, but McDermott (1999) pointed out that various approaches such as psycholinguistic modalities and perceptual and cognitive styles have eluded acceptable measurement and intervention. He also pointed out the hypothetical nature of constructs such as temperament, competence, effectiveness motivation, cognitive styles, and reflectivity that were based on inferences about the child's "internal, mediating, psychological processes" (p. 280). McDermott (1999) acknowledged the influence of these earlier approaches on the construct "learning behaviors" but believed that a more "behaviorally" oriented approach to measuring and studying such constructs was necessary.

McDermott (1999) cogently reported that efforts to measure learning behaviors were often hampered by expensive and time-consuming individual experimental procedures and a lack of standardized measures and national norms. The development of the Learning Behaviors Scale (LBS; McDermott, Green, Francis, & Stott, 1999) was driven by the need to create a standardized measure that would be cost- and time-effective, provide national norms, and provide for the unobtrusive observation of key learning behaviors that influence student learning.

Over the past 20 years, earlier editions and the present version of the LBS has achieved empirical support (Birrell, Phillips, & Stott, 1985; Canivez, Willenborg, & Kearney, 2003; Green & Francis, 1988; Green, Francis, & Stott, 1984; McDermott, 1984; McDermott & Beitman, 1984; Phillips, Stott, & Birrell, 1987; Pies, 1988; Stott, 1985; Stott, Green, & Francis, 1983; Stott, McDermott, Green, & Francis, 1988; Worrell, Vandiver, and Watkins, 2001). Investigation of the factor structure of the LBS standardization data suggested a four-factor model orthogonally rotated to equamax simple structure. The equamax rotation method (a combination of varimax and quartimax criteria to evenly spread out variance across the factorial dimensions) was used as it provided the most stable results for the standardization data (McDermott, 1999). This four-factor model was shown to be invariant across sex, age, and race/ethnicity. The four factors were defined and named based on the behaviors measured by the items: Competence Motivation (CM), Attitude Toward Learning (AL), Attention/Persistence (AP), and Strategy/Flexibility (SF) (McDermott, 1999).

McDermott (1999) summarized the psychometric properties of the LBS. Average internal consistency estimates ranged from .75 to .83 across various demographic subgroups and ranged from .75 to .85 for the four subscales ($M_r = .82$). Two-week test-retest stability for 77 students was substantial with coefficients ranging from .91 to .93 ($M_r = .92$). Interrater agreement with a sample of 72 students was also good with intraclass correlations ranging from .68 to .88 ($M_r = .82$) for the subscales and equaled .91 for the LBS Total (Buchanan, McDermott, & Schaefer, 1998). Furthermore, no differences in mean ratings were observed between the raters on the LBS scales. Worrell et al. (2001) replicated the substantial internal consistency estimates of the LBS scales and total score in an independent sample of 257 first- through fifth-grade students with coefficients for the total sample ranging from .76 to .91. Internal consistency estimates were also generally high across sex and grade subgroups.

Validity studies summarized by McDermott (1999) provided support for the convergent and divergent validity of the LBS in comparisons with the Differential Abilities Scales (DAS; Elliott, 1990) and the Adjustment Scales for Children and Adolescents (ASCA; McDermott, Marston, & Stott 1993). Additionally, the LBS demonstrated incremental validity by predicting significant portions of achievement beyond that of cognitive abilities (DAS). Schaefer and McDermott (1999) found that LBS scores were able to account for significant variability in teacher-assigned grades beyond that of intelligence and demographic variables.

In comparing the LBS and ASCA, McDermott (1999) found that statistically significant negative correlations typified the relations between subscales and composite scores and cononical redundancy analysis indicated a 30% overlap between learning behaviors (LBS) and psychopathology (ASCA). Several characteristics were noted among the results including positive learning behaviors being associated with an absence of hyperactivity and low levels of other psychopathologies; low levels of competence motivation and persistence and inflexible learning linked with avoidant and diffident characteristics; low motivation and poor attitudes toward learning were associated with oppositional behaviors and avoidance; and motivational problems and poor strategy were associated with higher levels of diffident and oppositional behaviors (McDermott, 1999). Canivez et al. (2003) found similar results in comparing the LBS and ASCA with an independent sample.

Worrell et al. (2001) also provided support of the construct (factorial) validity for three of the four LBS subscales in an independent sample of 257 students in Grades 1 through 5. Support for three of the four LBS factors (CM, SF, and AL) was reported, but further study of the AP factor was suggested. The fourth factor (AP) contained as many non-AP items as AP items, and one item loaded on the SF and CM factors but not the AP factor. Worrell et al. suggested the possibility of a three-factor solution (Attention & Learning Attitudes, Competence Motivation, and Strategy/Flexibility) based on parallel analysis, which is usually more accurate in determining the number of factors to retain than the eigenvalue rule or scree test (Thompson & Daniel, 1996). Items from the AP factor were most discrepant from the McDermott (1999) results of the factor analysis of the LBS standardization data. Worrell et al. suggested the shifted factor structure coefficients in the three-factor model may have been the result of overfactoring (Gorsuch, 1997), and the four-factor model might be the best solution for these data. Worrell et al. went on to point out that replication would help to determine the viability of the AP factor and determine if their results were the result of error.

This study was conducted to further investigate the factor structure of the LBS with another independent sample. The viability of the four-factor model of the LBS requires independent verification, and this study was conducted to test the exploratory factor analytic results of the present sample to those obtained with the LBS standardization sample and with the Worrell et al. (2001) data by investigating factorial invariance through coefficients of congruence (Gorsuch, 1983; Harman, 1976). As with the Worrell et al. study, this study also examined the internal consistency of scores from the LBS scales. It was hypothesized that a four-factor model similar to the McDermott (1999) and Worrell et al. studies would be found and that high internal consistency estimates would also be found.

Method

Participants

Data were provided by 27 teachers from nine different schools. A total of 241 students ranging from Grade 1 through 7 in three rural Illinois school districts were rated on the LBS by their classroom teacher. Students ranged in age from 6 to 14 years ($M = 9.48$, $SD = 2.24$). Table 1 presents the demographic characteristics for the sample. The majority of students were Caucasian and not disabled. Of the disabled group, most were identified as learning disabled. Males and females were sampled in approximately equal proportions.

Instrument

LBS. This is a teacher report questionnaire designed and found to measure student behaviors related to effective learning. It is composed of 29 positively and negatively worded items (behaviors) to reduce response sets and is rated on a 3-point scale (0 = *does not apply*, 1 = *sometimes applies*, 2 = *most often applies*; McDermott, 1999). Of the 29 items, 25 are used to produce a total score and the four subscales include CM, AL, AP, and SF. Five items cross-loaded and are included on multiple (two) LBS scales. Items 6, 11, 15, 18, and 26 are scored on multiple (two) scales. CM and AL share two items; and CM and AP, AL and AP, and AP and SF pairs each share one item. Total and subscale raw scores are converted to normalized *T* scores ($M = 50$, $SD = 10$) based on the nationally representative standardization sample of 1,500 students aged 5 to 17. The standardization sample was randomly selected and stratified by race, social class, family structure, community size, and geographic region and blocked for approximately equal numbers of participants within sex, age, and grade. As previously reviewed, McDermott (1999) has presented supportive psychometric evidence for the LBS.

Procedure

Classroom teachers from three rural school districts in Illinois volunteered to participate in this study by providing LBS ratings on students randomly selected from their classroom. The purpose, need, and details of data collection were explained to each teacher. The teachers were asked (and instructed how) to randomly select and rate a minimum of four male and four

Table 1
Sample Demographic Characteristics (*N* = 241)

Variable	*n*	%
Sex		
Male	120	49.8
Female	121	50.2
Race/ethnicity		
Caucasian	167	69.3
Black/African American	27	11.2
Hispanic/Latino	14	5.8
Asian American	1	0.4
Native American	2	0.8
Missing data	30	12.4
Grade		
1	35	14.5
2	53	22.0
3	52	21.6
4	12	5.0
5	11	4.6
6	28	11.6
7	50	20.7
Disability/exceptionality		
Not disabled	160	66.4
Learning disabled	36	14.9
Seriously emotionally disabled	5	2.1
Mentally retarded	2	0.8
Speech/language disabled	3	1.2
Attention deficit disorder	3	1.2
Pervasive developmental disorder	1	0.4
Other health impaired	4	1.7
Traumatic brain injury	1	0.4
Remedial reading	1	0.4
Missing data	25	10.4

female students that they had observed for at least 40 days prior to the completion of the LBS. The teachers then rated the selected students according to the standard instructions on the rating forms and returned the forms to the second and third authors who scored them according to the test manuals. No personally identifiable information was collected to protect the anonymity of the students.

Results

Item Statistics

Descriptive statistics for LBS item raw scores were examined and, like the Worrell et al. (2001) study, the sample produced generally high item mean scores. Item raw score means ranged from 1.18 to 1.79 (*Mdn* = 1.51). The LBS item raw scores were also generally skewed with skewness estimates ranging from –0.34 to –2.24 (*Mdn* = –0.99), and 12 items had skew-

Table 2
Descriptive Statistics for Learning Behaviors Scale (LBS) *T* Scores (*N* = 241)

LBS Scales	*M*	*SD*	Range	Skewness	Kurtosis
Competence Motivation	47.70	12.14	1-66	–0.64	1.07
Attitude Toward Learning	47.49	12.81	1-66	–1.26	2.84
Attention/Persistence	45.67	11.80	1-61	–0.89	2.31
Strategy/Flexibility	47.05	12.88	1-61	–1.24	2.68
LBS Total	46.14	12.43	1-66	–0.82	1.94

Table 3
Learning Behaviors Scale (LBS) Internal Consistency Estimates

	Grade		Sex		
	1-3 (*n* = 140)	4-7 (*n* = 101)	Male (*n* = 120)	Female (*n* = 121)	Total Sample (*N* = 241)
Competence Motivation	.88	.89	.89	.89	.89
Attitude Toward Learning	.87	.89	.87	.88	.88
Attention/Persistence	.85	.80	.85	.80	.83
Strategy/Flexibility	.79	.69	.81	.69	.77
LBS Total	.93	.92	.93	.92	.93

ness estimates exceeding –1.0. Kurtosis estimates ranged from –1.38 to 4.11 (*Mdn* = –0.11), and 10 items had kurtosis estimates exceeding 1.0. Thus, many item raw scores of the LBS in the sample did not appear normally distributed. Participant's LBS scale *T* scores were calculated, and descriptive statistics are presented in Table 2. Means and standard deviations approximated 50 and 10, respectively; and the skewness and kurtosis estimates indicated these data, as the item raw score, deviated somewhat from normality.

Internal Consistency

Internal consistency estimates (coefficient alpha) based on the LBS items keyed from the standardized scales were calculated for the total sample as well as across two grade-level groups (Grades 1-3 and 4-7) and sex to examine the generalizability of reliability across these demographic subgroups. Internal consistency estimates are presented in Table 3 and ranged from .69 to .93 (*Mdn* = .88) across the five demographic subgroups. For the total sample, internal consistency estimates ranged from .77 to .93 (*Mdn* = .88). All estimates were acceptable, and many met or came close to the minimum criteria (.85-.90) for use in individual decision making (Hills, 1981; Salvia and Ysseldyke, 1991).

Exploratory Factor Analyses (EFAs)

As presented earlier, many LBS item raw scores in this sample deviated from normality and all consisted of items scores of 0, 1, or 2. As with the Worrell et al. (2001) study and the LBS standardization sample (McDermott, 1999), this study utilized the principal axis method of EFA of the LBS item correlation matrix because it is not based on normal distribution assumptions (Cudeck, 2000; Fabrigar, Wegener, MacCallum, & Strahan, 1999; Tabachnick & Fidell, 2001). LBS Items 10, 12, 19, and 22 are not used in scoring the LBS based on the factor analysis of the standardization sample and were not included in the present EFA. EFA was conducted on the LBS item raw scores correlation matrix. Multiple criteria as recommended by Gorsuch (1983) were used to determine the number of factors to extract and retain and included the eigenvalues greater than 1 (Guttman, 1954), the scree test (Cattell, 1966), *and* parallel analysis (Horn, 1965). Parallel analysis was included as Thompson and Daniel (1996) indicated that it is usually more accurate in determining the correct number of factors to extract and retain than the eigenvalue rule and the scree test. The scree test was used to visually determine the optimum number of factors to retain, whereas parallel analysis indicated factors considered meaningful when the eigenvalues from the sample data exceeded those produced by random data containing the same number of participants and factors (Lautenschlager, 1989). Random data and resulting eigenvalues for parallel analyses were produced using the Monte Carlo PCA for Parallel Analysis computer program (Watkins, 2000) with 100 replications to provide stable eigenvalue estimates. Varimax and equamax rotations were both examined and produced similar results. The equamax rotation provided the most stable solution in the factor analyses of the LBS standardization data (McDermott, 1999) and was the solution presented in the Worrell et al. (2001) study. As with these previous studies, this study also presents results of the equamax rotation for comparison purposes and used factor structure coefficients ≥.40 to determine saliency.

To examine the factor invariance of this sample compared to the LBS standardization sample (McDermott, 1999) and the Worrell et al. (2001) sample, coefficients of congruence (Gorsuch, 1983; Harman, 1976) were calculated using Coefficient of Congruence Rc computer program (Watkins, 2002). MacCallum, Widaman, Zhang, and Hong (1999) offered "guidelines to interpret the congruence coefficient: .98-1.00 = excellent, .92-.98 = good, .82-.92 = borderline, .68-.82 = poor, and below .68 = terrible" (p. 93).

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .91, and Bartlett's Test of Sphericity was 3,179.75, $p < .00001$. As in the Worrell et al. (2001) study, five factors produced eigenvalues greater than 1, the scree test suggested extracting four factors, and parallel analysis suggested extracting three factors. The four- and three-factor models are presented because the LBS is based on a four-factor model (McDermott, 1999) and parallel analysis is usually more accurate than other methods in determining the correct number of factors to extract and retain. The three-factor model was also examined and presented for comparative purposes because it was suggested as a possible solution in the Worrell et al. study. The five-factor model resulted in considerable fragmentation and migration of items of two LBS factors that may likely be due to overestimation of the number of factors to retain (Zwick & Velicer, 1986).

Four-factor solution. Table 4 presents the results of the four-factor principal axis factor analysis with equamax rotation. Communality estimates ranged from .24 to .87 (*Mdn* = .48), and 21 of 25 communality estimates exceeded .40. This suggested that accurate population parameter estimates could be achieved with a minimum sample of 200 (Fabrigar et al., 1999; Floyd & Widaman, 1995; MacCallum et al., 1999). All but 1 (Item 1) of the 25 LBS items had factor structure coefficients that exceeded .40 on at least one of the four factors extracted. This four-factor solution accounted for 50.94% of the variability of LBS scores. Factor I (CM) consisted of all eight LBS CM items but also included one AP and AL item and two AL

Table 4
Four-Factor LBS Solution of the Principal Axis/Equamax Rotation ($N = 241$)

LBS Item/Component Behaviors[a]	Factor I: CM	Factor II: AP	Factor III: AL	Factor IV: SF	Communality
1. Responses show lack of attention	.39	.23[c]	.16	–.05	.24
2. Says tasks too hard, makes no attempt	**.53**[b]	.34	.32	.28	.57
3. Displays reluctance to tackle new tasks	**.63**[b]	.29	.30	.16	.60
4. Doesn't stick to tasks	.22	**.54**[b]	.28	.14	.44
5. Don't-care attitude to success or failure	**.46**	**.46**[b]	**.42**[b]	.12	.61
6. Takes refuge in dullness or incompetence	**.45**[b]	.32	.39[c]	.16	.48
7. Follows peculiar or inflexible procedures	.16	.19	.20	**.58**[b]	.43
8. Shows little desire to please teacher	.30	.31	**.56**[b]	.21	.54
9. Unwilling to be helped in difficulty	.28	.05	**.66**[b]	.18	.54
11. Uncooperative in class activities	.19	**.42**[b]	**.47**[b]	.13	.45
13. Has enterprising ideas that often fail	–.01	–.08	–.02	**.65**[b]	.43
14. Easily distracted or seeks distraction	.30	**.85**[b]	.01	.24	.87
15. Fidgets, squirms, leaves seat	.07	**.80**[b]	.16	.26[c]	.74
16. Aggressive or hostile when corrected	.05	.31	**.55**	.28[c]	.48
17. Very hesitant about giving answers	**.74**[b]	.06	.21	–.01	.29
18. Easily gives up tasks	**.61**[b]	.37	**.40**[b]	.21	.38
20. Unwilling to accept needed help	.06	.04	**.52**[b]	.12	.48
21. Too unenergetic for interest or effort	**.48**	.25	.29[c]	–.04	.53
23. Invents silly ways to do tasks	–.02	.28	.14	**.62**[b]	.59
24. Doesn't work well when in bad moods	.20	.32	**.56**	.28[c]	.47
25. Disinterest toward learning activities	**.56**	.34	.39[c]	–.07	.37
26. Tries but concentration soon fades	**.54**[b]	.22[c]	.00	.36	.51
27. Performs tasks by own, not accepted way	–.02	.12	.22	**.55**[b]	.42
28. Resistant or fearful about new tasks	**.58**[b]	.29	.29	.06	.29
29. Delays answers, waits for hints	**.58**[b]	.20	.07	.22	.38
Eigenvalues	9.53	2.24	1.49	1.35	
% variance (rotation)	16.33	13.21	12.49	8.91	
r_c	.99	.96	.94	.94	
r_α	.91	.84	.89	.72	

Note: LBS = Learning Behaviors Scale; CM = Competence Motivation; AL = Attitude Toward Learning; AP = Attention/Persistence; SF = Strategy/Flexibility. LBS Items 10, 12, 19, and 22 are not used in scoring the LBS and were not included in the present exploratory factor analysis (EFA). Salient factor structure coefficients (≥.40) are presented in bold. Coefficients of congruence (r_c) were obtained using the Coefficient of Congruence R_c computer program (Watkins, 2002) and compare the present EFA factor structure coefficients to those obtained with the LBS standardization sample (McDermott, Green, Francis, & Stott, 1999). Internal consistency (r_α) estimates are based on items with salient factor structure coefficients (≥.40) from the present sample EFA.
a. Item wording abbreviated and reversed for positive valence items as reported by McDermott (1999).
b. Salient factor structure coefficients corresponding to the same factor(s) identified in the LBS standardization sample (McDermott, 1999).
c. Factor structure coefficients failing to correspond to the same factor(s) identified in the LBS standardization sample (McDermott, 1999).

items. Factor II (AP) consisted of five of the seven LBS AP items. Two LBS AP items failed to achieve salient factor structure coefficients on this factor (Items 1 and 26). Factor III (AL) included six of the nine LBS AL items but also included two SF items (Items 16 and 24). Three LBS AL items (Items 6, 21, and 25) failed to achieve a salient factor structure coefficient on this factor but two (Items 6 and 25) had structure coefficients of .39. Factor IV (SF) consisted of four of the seven LBS SF items but three SF items (Items 15, 16, and 24) failed to achieve salient structure coefficients on this factor.

Coefficients of congruence (Watkins, 2002) tested the factorial invariance of the present factor structure results in comparison to the identical analysis with the LBS standardization sample and resulted in “good” or “excellent” (MacCallum et al., 1999, p. 93) match to the factorial results of the LBS standardization sample (see Table 4). Coefficients of congruence ranged from .93 (SF) to .98 (CM).

As in the McDermott (1999) and Worrell et al. (2001) studies, several LBS items cross-loaded on more than one factor. Items 5 (CM/AP/AL), 11 (AP/AL), and 18 (CM/AL) cross-loaded on the identical two factors as the standardization data, whereas Items 6 (CM), 15 (AP), and 26 (CM) failed to cross-load in the present study as they did in the standardization data.

These results indicated that most LBS items held together rather well with the four LBS factors to which they were assigned in the standardization sample. Only four items (Items 16, 21, 24, and 25) in this study migrated to factors that differed from their factor assignment in the standardization data (McDermott, 1999). Furthermore, the internal consistency estimates based on the salient factor structure coefficients from the present study (see Table 4) were also quite similar to those obtained by McDermott (1999) and Worrell et al. These internal consistency estimates ranged from .72 to .91. The lower internal consistency estimate for the SF factor is associated with the fewer number of items with salient factor structure coefficients.

Three-factor solution. Table 5 presents the results of the three-factor principal axis factor analysis with equamax rotation suggested by parallel analysis. This three-factor model accounted for 46.78% of the variance of LBS scores. Communality estimates ranged from .21 to .89 (*Mdn* = .50), and 16 of the 25 estimates exceeded .40.

Factor I (15 items) consisted of 5 LBS CM items, 4 AP items, 2 CM/AL items, 2 AL items, 1 CM/AP item, and 1 AL/AP item. Ten of the Factor I items in this study corresponded to items of Factor II of the Worrell et al. (2001) study, which they labeled Competence Motivation as these items seemed most consistent with LBS CM factor in the standardization sample (McDermott et al., 1999). Item 9 (AL), which was associated with Factor II (CM) in the Worrell et al. study, did not have salient factor structure coefficients on Factor I (CM) in the present study. Items 1 (AP), 4 (AP), 5 (AL/AP), 15 (AP/SF), and 28 (CM) achieved salient factor structure coefficients on Factor I (CM) in the present study but were not associated with Factor II (CM) in the Worrell et al. study. Factor II (8 items) consisted of 3 AL, 2 SF, 2 CM/AL, and 1 AL/AP items. Only 6 of the 12 Factor I items from the Worrell et al. study, which they labeled Attention and Learning Attitudes, were associated with Factor II in the present study. Items 1 (AP), 4 (AP), 11 (AL/AP), 21 (AL), 25 (AL), and 28 (CM) in the present study did not have salient factor structure coefficients on Factor II, and all but Item 11 demonstrated salient factor structure coefficients on Factor I in the present study. Items 16 (SF) and 24 (SF) had salient factor structure coefficients on Factor II but did not have salient

Table 5
Three-Factor LBS Solution of the Principal Axis/Equamax Rotation (*N* = 241)

LBS Item/Component Behaviors[a]	Factor I: CM	Factor II: A/LA	Factor III: SF	Communality
1. Responses show lack of attention	**.46**	.17[c]	.00	.24
2. Says tasks too hard, makes no attempt	**.57**[b]	.37	.31	.57
3. Displays reluctance to tackle new tasks	**.64**[b]	.36	.17	.58
4. Doesn't stick to tasks	**.45**	.20[c]	.38	.41
5. Don't-care attitude to success or failure	**.61**	**.40**[b]	.27	.61
6. Takes refuge in dullness or incompetence	**.52**[b]	**.41**[b]	.22	.50
7. Follows peculiar or inflexible procedures	.15	.24	**.54**[b]	.38
8. Shows little desire to please teacher	.38	**.54**[b]	.31	.52
9. Unwilling to be helped in difficulty	.21[c]	**.70**[b]	.15	.54
11. Uncooperative in class activities	.37	.39[c]	.32	.38
13. Has enterprising ideas that often fail	–.13	.08	**.44**	.21
14. Easily distracted or seeks distraction	**.68**	–.09	**.58**[b]	.89
15. Fidgets, squirms, leaves seat	**.46**	.04	**.61**[b]	.65
16. Aggressive or hostile when corrected	.17	**.48**	**.42**[b]	.41
17. Very hesitant about giving answers	**.61**[b]	.34	–.12	.53
18. Easily gives up tasks	**.66**[b]	**.45**[b]	.26	.72
20. Unwilling to accept needed help	.05[c]	**.51**[b]	.14	.25
21. Too unenergetic for interest or effort	**.54**[b]	.30[c]	.01	.39
23. Invents silly ways to do tasks	.05	.13	**.67**[b]	.46
24. Doesn't work well when in bad moods	.29	**.52**	.39[c]	.51
25. Disinterest toward learning activities	**.65**[b]	.39[c]	.03	.59
26. Tries but concentration soon fades	**.49**	.12	.27	.29
27. Performs tasks by own, not accepted way	–.03	.24	**.54**[b]	.37
28. Resistant or fearful about new tasks	**.62**	.33[c]	.09	.51
29. Delays answers, waits for hints	**.53**[b]	.17	.16	.34
Eigenvalues	9.53	2.24	1.49	
% variance (rotation)	21.63	12.86	12.29	
r_c	.92	.85	.95	
r_α	.92	.87	.78	

Note: LBS = Learning Behaviors Scale; CM = Competence Motivation; A/LA = Attention and Learning Attitudes; SF = Strategy/Flexibility. LBS Items 10, 12, 19, and 22 are not used in scoring the LBS and were not included in the present exploratory factor analysis (EFA). Salient factor structure coefficients (≥.40) are presented in bold. Coefficients of congruence (r_c) were obtained using the Coefficient of Congruence R_c computer program (Watkins, 2002) and compare the present EFA factor structure coefficients to those obtained with another independent LBS sample (Worrell, Vandiver, & Watkins, 2001). Internal consistency (r_α) estimates are based on items with salient factor structure coefficients (≥.40) from the present sample.
a. Item wording abbreviated and reversed for positive valence items as reported by McDermott (1999).
b. Salient factor structure coefficients corresponding to the same factor(s) identified in the Worrell et al. (2001) study.
c. Factor structure coefficients failing to correspond to the same factor(s) identified in the Worrell et al. (2001) study.

factor structure coefficients on Factor I (A/AL) in the Worrell et al. study. Factor III (7 items) consisted of 5 SF, 1 AP, and 1 AP/SF items, and 6 of the 7 Factor III (SF) items from the Worrell et al. study were consistent with the present study. Item 24 (SF) did not have a salient factor structure coefficient with Factor III in the present study but did in the Worrell et al. study. Item 13 (SF) had a salient factor structure coefficient on Factor III in the present study but did not in the Worrell et al. (2001) study. In the present study, Factor I and Factor III demonstrated fairly close correspondence to the similar factors in the Worrell et al. study. Seven LBS items in the present study migrated to different factors than those assigned by Worrell et al.

Coefficients of congruence (Watkins, 2002) tested the factorial invariance of the present factor structure results in comparison to the identical analysis with the Worrell et al. (2001) data and resulted in “borderline” to “good” (MacCallum et al., 1999, p. 93) match to the factorial results of the LBS standardization sample (see Table 5). Coefficients of congruence ranged from .85 (A/LA) to .95 (SF).

Internal consistency estimates for Factors I (CM), II (A/LA), and III (SF), based on the salient items from the present study were .92, .85, and .95, respectively. Several items for the three-factor solution in the present study had different factor associations than those observed in the Worrell et al. (2001) study and the LBS standardization sample (McDermott, 1999), particularly items from the LBS AP and the AL factors. As Worrell et al. noted in their study, differences in factor loadings may be the result of overfactoring (Gorsuch, 1997). Based on these results and examination of factor invariance (coefficients of congruence), it appears that the four-factor model is a better solution for these data.

Discussion

This study sought to investigate and replicate the internal consistency and factor structure findings of McDermott (1999) and Worrell et al. (2001) with a second independent sample. Internal consistency estimates for the four LBS factors and the LBS Total score were found to be high for the total sample as well as for sex and grade-level subgroups and were quite close to those obtained by McDermott and Worrell et al. Most of the alpha coefficients met or exceeded criteria suggested as necessary for use of the scales for individual decision-making and diagnostic purposes (Hills, 1981; Salvia and Ysseldyke, 1995). However, the AP and SF factors had alpha coefficients that were slightly lower, and thus caution should be exercised for use with individual decision making.

This study also provided substantial support for the four-factor model of the LBS suggested by McDermott (1999). This study extended the results of Worrell et al. (2001) by providing support for the AP factor that was not clearly delineated in the Worrell et al. study. Coefficients of congruence between the Worrell et al. factor structure coefficients and the LBS standardization data (McDermott, 1999) ranged from “poor” to “good” (MacCallum et al., 1999, p. 93) (CM $r_c = .94$, AP $r_c = .82$, AL $r_c = .93$, SF $r_c = .94$) and were generally lower than those found in this study. Coefficients of congruence for the four-factor model were higher than for the three-factor model in this study. Given that this study found support for the AP factor, it is likely that the failure of the AP factor to clearly emerge in the Worrell et al. study was a result of sampling error as they suggested. As Worrell et al. stated, “replication . . . is the best and perhaps the only way to examine the viability of the Attention/Persistence factor” (p. 214). It appears that replication has indeed addressed and supported the viability of the AP factor with the present sample based on item content and factor invariance estimates.

Although most of the items in this study were associated with factors consistent with the standardization sample (McDermott, 1999), several items showed salient factor structure coefficients on factors that differed from the standardization data. This could very well be a result of sampling error in this study, as this study had a sample much smaller than the standardization sample and was also much less diverse on variables of race/ethnicity, geographic location, grade level, and possibly social class.

With the structural support of the four factors of the LBS and strong internal consistency of the factors and total score in this study, the LBS appears to be an instrument of potential value to school psychologists in investigating learning behaviors. As these behaviors also possess incremental validity in predicting achievement beyond that of IQ (Schaefer & McDermott, 1999) and may be influenced through interventions, they should provide additional useful information in psychoeducational evaluations of referred children. Further replications of incremental validity of the LBS and investigation of diagnostic utility should be the focus of future research.

This study possesses several sampling limitations that qualify results even though students were randomly selected from within their classrooms. The fundamental limitation is that of diversity and representativeness of the sample. As illustrated in Table 1, Caucasian and Black/African American youths matched fairly closely the proportions observed in the overall population; however, Hispanic/Latino, Asian American, and Native American youth were underrepresented. As all data were collected in rural Illinois schools, geographic representation as well as community size was limited. Finally, it was not possible to determine the parental education levels for the sample that would have provided an index of social class, so it is not possible to determine how representative this sample is with respect to this variable. Given the geographic location of the sample, it is likely that there was less item variability than the standardization sample.

Given these limitations, generalizability to the larger population is obviously not recommended. It is desirable that future LBS studies include samples from urban and suburban areas as well as better representation of Hispanic/Latino, Asian American, and Native American youths to improve generalizability of results to these groups. Furthermore, it would be particularly useful to examine the factorial validity of the LBS with independent samples of youth from specific racial/ethnic groups, particularly Asian American and Native American groups, to specifically address the question of viability of LBS factors within these specific groups (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999) as their inclusion in the standardization sample, although proportionally represented, is insufficient to conduct separate analyses. However, the present results strongly support the four-factor solution proposed by McDermott (1999) and suggest the LBS may be helpful in identifying learning-related behaviors that could be of value for recommending learning related interventions. Studies further investigating the incremental validity (Schaefer & McDermott, 1999) and treatment validity of the LBS factors through experimental research would be particularly helpful.

References

American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (1999). *Standards for educational and psychological testing*. Washington, DC: American Educational Research Association.

Anderson, S., & Messick, S. (1974). Social competency in young children. *Developmental Psychology, 10*, 282-293.

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.

Birrell, H. V., Phillips, C. J., & Stott, D. H. (1985). Learning style and school attainment in young children: A follow-up study. *School Psychology International, 6*, 207-218.

Brown, A. L., & Campione, J. C. (1982). Modifying intelligence or modifying cognitive skills: More than a semantic quibble? In D. K. Detterman & R. J. Sternberg (Eds.), *How and how much can intelligence be increased* (pp. 215-230). Norwood, NJ: Ablex.

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

Canivez, G. L., Willenborg, E., & Kearney, A. (2003). *Construct validity of the Adjustment Scales for Children and Adolescents and the Learning Behaviors Scale*. Manuscript submitted for publication.

Carter, J. D., & Swanson, H. L. (1995). The relationship between intelligence and vigilance in children at risk. *Journal of Abnormal Child Psychology, 23*, 201-220.

Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate Behavioral Research, 1*, 245-276.

Ceci, S. J. (1990). *On intelligence . . . more or less: A bioecological treatise on intellectual development*. Englewood Cliffs, NJ: Prentice Hall.

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.

Cudeck, R. (2000). Exploratory factor analysis. In H. E. A. Tinsley & S. D. Brown (Eds.), *Handbook of multivariate statistics and mathematical modeling* (pp. 265-296). New York: Academic Press.

DiPerna, J. C., & Elliott, S. N. (2002). Promoting academic enablers to improve student achievement: An introduction to the mini-series. *School Psychology Review, 31*, 293-297.

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

Engelman, B. A., Granzin, A., & Severson, H. (1979). Diagnosing instruction. *Journal of Special Education, 13*, 355-363.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods, 4*, 272-299.

Finn, J. D., & Cox, D. (1992). Participation and withdrawal among fourth-grade pupils. *American Educational Research Journal, 29*, 141-162.

Floyd, F. J., & Widaman, K. F. (1995). Factor analysis in the development and refinement of clinical assessment instruments. *Psychological Assessment, 7*, 286-299.

Glutting, J. J., & McDermott, P. A. (1990a). Childhood learning potential as an alternative to traditional ability measures. *Psychological Assessment, 2*, 398-403.

Glutting, J. J., & McDermott, P. A. (1990b). Principles and problems in learning potential. In C. R. Reynolds & R. W. Kamphaus (Eds.), *Handbook of psychological and educational assessment of children: Intelligence and achievement* (pp. 296-347). New York: Guilford.

Gorsuch, R. L. (1983). *Factor analysis* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Gorsuch, R. L. (1997). Exploratory factor analysis: Its role in item analysis. *Journal of Personality Assessment, 68*, 532-560.

Green, L. F., & Francis, J. M. (1988). Children's learning skills at the infant and junior stages: A follow-on study. *British Journal of Educational Psychology, 58*, 120-126.

Green, L. F., Francis, J. M., & Stott, D. H. (1984). Confirmation of a relationship between children's learning styles and attainment by examination of discordant cases. *Human Learning, 3*, 295-304.

Guttman, L. (1954). Some necessary and sufficient conditions for common factor analysis. *Psychometrica, 19*, 149-161.

Harman, H. H. (1976). *Modern factor analysis* (3rd rev. ed.). Chicago: University of Chicago Press.

Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika, 30*, 179-185.

Hills, J. R. (1981). *Measurement and evaluation in the classroom* (2nd ed.). Columbus, OH: Merrill.

Jussim, L. (1989). Teacher expectations: Self-fulfilling prophecies, perceptual biases, and accuracy. *Journal of Personality and Social Psychology, 57*, 459-480.

Lautenschlager, G. J. (1989). A comparison of alternatives to conducting Monte Carlo analyses for determining parallel analysis criteria. *Multivariate Behavioral Research, 24*, 365-395.

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological Methods, 4*, 84-99.

Macmann, G. M., & Barnett, D. W. (1994). Structural analysis of correlated factors: Lessons from the verbal-performance dichotomy of the Wechsler Scales. *School Psychology Quarterly, 9*, 161-197.

McDermott, P. A. (1984). Comparative functions of preschool learning style and IQ in predicting future academic performance. *Contemporary Educational Psychology, 9*, 38-47.

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

Neisser, U., Boodoo, G., Bouchard, T. J., Jr., Boykin, A. W., Brody, N., Ceci, S. J., et al. (1996). Intelligence: Knowns and unknowns. *American Psychologist, 51*, 77-101.

Neisworth, J. T., & Bagnato, S. J. (1992). The case against intelligence testing in early intervention. *Topics in Early Childhood Special Education, 12*, 1-20.

Phillips, C. J., Stott, D. H., & Birrell, H. V. (1987). The effects of learning style on progress towards literacy and numeracy. *Educational Review, 39*(3), l-40.

Pies, D. L. (1988). The relationship between children's and teachers' perceptions of students' learning styles in a Black, low SES, elementary school population (Doctoral dissertation, University of Pennsylvania, 1987). *Dissertation Abstracts International, 49*(2-A), 232.

Reschly, D. J. (1988). Special education reform: School psychology revolution. *School Psychology Review, 17*, 459-475.

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. 437-483). New York: Guilford.

Salvia, J., & Ysseldyke, J. E. (1995). *Assessment*. Boston: Houghton Mifflin.

Sattler, J. M. (2001). *Assessment of children* (4th ed.). San Diego, CA: Jerome M. Sattler.

Scarr, S. (1981). Testing for children: Assessment and the many determinants of intellectual competence. *American Psychologist, 36*, 1159-1166.

Schaefer, B. A. (2004). A demographic survey of learning behaviors among American students. *School Psychology Review, 33*, 481-497.

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.

Schuck, L. A., Oehler-Stinnett, J., & Stinnett, T. A. (1995). Predictive validity of the Teacher Rating of Academic Achievement Motivation (TRAAM) with Hispanic students. *Journal of Psychoeducational Assessment, 13, 143-156*.

Spitz, H. H. (1986). *The raising of intelligence: A selected history of attempts to raise retarded intelligence*. Hilldale, NJ: Lawrence Erlbaum.

Stipek, D. (1998). *Motivation to learn: From theory to practice* (3rd ed.). Boston: Allyn & Bacon.

Stott, D. H. (1978). *The hard-to-teach child: A diagnostic-remedial approach*. Baltimore: University Park Press.

Stott, D. H. (1981). *The Flying Start Learning-to-Learn Kits*. Chicago: Science Research Associates.

Stott, D. H. (1985). Learning style or "intelligence"? *School Psychology International, 6*, 167-174.

Stott, D. H., & Albin, J. B. (1975). Confirmation of a general factor of effectiveness motivation by individual tests. *British Journal of Educational Psychology, 45*, 153-161.

Stott, D. H., Green, L. F., & Francis, J. M. (1983). Learning style and school attainment. *Human Learning, 2*, 61-75.

Stott, D. H., McDermott, P. A., Green, L. F., & Francis, J. M. (1988). *Learning Behaviors Scale and Study of Children's Learning Behaviors research edition manual*. San Antonio, TX: Psychological Corporation.

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

Thompson, B., & Daniel, L. G. (1996). Factor analytic evidence for the construct validity of scores: A historical overview and some guidelines. *Educational and Psychological Measurement, 56*, 197-208.

Watkins, M. W. (2000). Monte Carlo PCA for parallel analysis [Computer software]. State College, PA: Author.

Watkins, M. W. (2002). Coefficient of congruence (Rc) [Computer software]. State College, PA: Author.

Weinberg, R. A. (1979). Early childhood education and intervention: Establishing an American tradition. *American Psychologist, 34*, 912-916.

Wentzel, K. R. (1991). Classroom competence may require more than intellectual ability: Reply to Jussim (1991). *Journal of Educational Psychology, 83*, 156-158.

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

Ysseldyke, J. E., & Christenson, S. L. (1988). Linking assessment to intervention. In J. L. Graden, J. E. Zins, & M. Curtis (Eds.), *Alternative educational delivery systems: Enhancing educational opportunities for all students* (pp. 91-109). Silver Spring, MD: National Association of School Psychologists.

Zwick, W. R., & Velicer, W. F. (1986). A comparison of five rules for determining the number of components to retain. *Psychological Bulletin, 99*, 432-442.