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CONSTRUCT VALIDITY OF THE LEARNING BEHAVIOR SCALE WITH AN INDEPENDENT SAMPLE OF STUDENTS

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In this study, the factor structure of the Learning Behavior Scale (LBS; McDermott, Green, Francis, & Stott, 1999) was examined in an independent sample of 257 elementary school students. The LBS is a 29-item, four-factor scale on which teachers rate students' positive and negative learning behaviors. The results indicated that the internal consistency of the total LBS scores and the scores on two subscales (Competence Motivation and Attitude Toward Learning) were high enough for individual decision making, whereas the reliability estimates of scores on the Attention/Persistence and Strategy/Flexibility subscales were appropriate only for research or screening purposes. Factor analyses extracted factors similar to three of the factors on the LBS (Competence Motivation, Attitude Toward Learning, and Strategy/Flexibility), and suggested that the fourth factor (Attention/Persistence) may benefit from additional study. In general, the results indicate that the LBS may be a useful tool for examining students' learning behaviors.

One of the most pressing concerns in working with students is identifying ways to assist those who are not making adequate educational progress. Although terms like "learning disabled" and "slow learner" are often used to describe these students, labels do not provide directions for intervention (Gresham & Witt, 1997). Schaefer and McDermott (1999) pointed out that measured intelligence also "has not demonstrated sufficient utility for educational intervention" (p. 299). A more promising approach is to identify behaviors that are related to the learning process (McDermott & Glutting, 1997). Focusing attention on observable behaviors has a number of advantages. First, measurement is improved because relatively little inference is involved. Second, one can use multiple raters to assess accuracy. Third, by focusing on behaviors related to learning, interventions can be tied directly to the data that are obtained on a particular student (McDermott, 1999).

Although researchers have been concerned with learning behaviors for some time (e.g., McKinney, Mason, Perkerson, & Clifford, 1975; W.M. Reynolds, 1979), this area has not received the attention given to other domains (McDermott, 1999). Much of the behavior scale development in psychology has focused on areas such as social skills (e.g., Social Skills Rating System; Gresham & Elliott, 1990), adaptive behavior (e.g., Vineland Adaptive Behavior Scales; Sparrow, Balla, & Cicchetti, 1984), or the internalizing and externalizing behavior categories (e.g., Behavior Assessment System for Children; C.R. Reynolds & Kamphaus, 1992). In contrast, the Learning Behaviors Scale (LBS; McDermott, Green, Francis, & Stott, 1999) was developed to provide a behaviorally based rating scale related to the learning process.

In developing the LBS, McDermott et al. (1999) had a number of concerns in mind. The authors wanted to develop an instrument that would result in reliable and valid scores. They were also concerned with ease of administration, and this concern translated into more practical consideration for complexity of administration and length of time to complete the instrument. Another overarching concern was nomothetic. The authors wanted the scores on the LBS to be based on a representative sample of the population to allow for normative comparisons of students' performance on learning behaviors.

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The LBS was developed over a period of about 15 years (e.g., McDermott, 1984, 1999; McDermott & Beitman, 1984; Stott, Green, & Francis, 1983; Stott, McDermott, Green, & Francis, 1988). In its current form, the LBS is a 29-item scale completed by a teacher who has observed the target child for at least 50 days. The LBS was standardized on a national sample of 1,500 students (750 males and 750 females) ranging in age from 5 to 17 years (see McDermott, 1999, for details). The sample matched the 1992 U. S. Census profile with matrix blocking for age, gender, and grade level. McDermott (1999) reported that the factor structure of the instrument's scores was invariant across age, gender, and ethnicity, with mean invariance coefficients of .95. Internal consistency estimates for scores on the four subscales ranged from .75 to .85, and 2-week stability coefficients averaged .92. The average intraclass correlation for the four subscales of .82 (Buchanan, McDermott, & Schaefer, 1998) indicated excellent interobserver agreement (Cicchetti, 1994).

Convergent and discriminant validity evidence was reported between LBS scores and the Differential Ability Scale (Elliot, 1990), the Basic Achievement Skills Individual Screener (The Psychological Corporation, 1983), teacher-assigned grades, and the Adjustment Scales for Children and Adolescents (McDermott, Stott, & Marston, 1993). The relationships between the LBS scores and other scores were in the appropriate directions and meaningful (McDermott, 1999). Further, Schaefer and McDermott (1999) reported that LBS scores predicted variation in teacher-assigned grades beyond the contribution of demographic factors (e.g., gender) and intelligence.

Although the available evidence for the LBS is supportive, Goodwin and Goodwin (1999) reminded us that reliability and validity are "properties of the scores on a measure—under certain conditions and with a particular group of participants, rather than properties of the instruments per se" (p. 409). Benson (1998) also noted that "one study does not validate or fail to validate the scores from a test. Numerous studies may be required, utilizing different approaches, different samples, and different populations. . . . As such validation is a continual process" (p. 10).

Much of the recent validity evidence for LBS scores has been drawn from large multischool samples. In this study, the factor structure of LBS scores was examined in a sample of students from a single elementary school. Two questions were examined in this study. First, what are the reliability coefficients of LBS scores? Given the current evidence for LBS scores, reliability estimates were expected to be moderate to high. Second, what is the factor structure of LBS scores. A four-factor solution similar to the one reported by McDermott (1999) was hypothesized.

Method

Participants

The participants consisted of 10 teachers of 257 students attending a suburban elementary school located in a southwestern state. Students were in grades 1 to 5 and the 10 classrooms had class sizes ranging from 23 to 29. There were four grade 1 classes, two grade 2 classes, one grade 3 class, one grade 4 class, and two grade 5 classes. The students ranged in age from 6 to 12 (M = 8.21, SD = 1.6). However, ages were not provided for 76 students in three classes (one grade 1 class, one grade 2 class, and one grade 5 class). Fifty-one percent of the students were female (n = 130) and 49% were male. Additional demographic information (i.e., ethnic background, socioeconomic status) for students and teachers was not available because data for this study were provided anonymously. However, schoolwide demographic data indicated that students' ethnic status was 94% White, 4% Hispanic, 1% Black, and 1% Asian. The socioeconomic level of the school was determined to be middle class, based upon the percentage of students (<10%) participating in free or reduced cost lunch programs (Peng, Wang, & Walberg, 1992). Publicly reported group achievement test summary scores for the school ranged from the 55th to the 71st percentile across grades 3–5.

Measure

The teachers rated the students on the Learning Behavior Scale (LBS; McDermott et al., 1999), a questionnaire listing 29 behaviors that have been found to be related to effective learning. Teachers rate the frequency with which a student manifests the behaviors that make up the LBS on a 3-point scale (2 = *Most often applies*, 1 = *Sometimes applies*, 0 = *Does not apply*). Both negative and positive learning behaviors are included to control for response set. Negative items are recoded and higher scores indicate the presence of good learning behaviors. Raw scores of only 25 of the 29 items are used to compute the total score and the four subscale scores: Competence Motivation (CM), Attitude Toward Learning (AL), Attention/Persistence (AP), and Strategy/Flexibility (SF).

Competence Motivation encompasses behaviors related to anticipation of success (e.g., says task is too hard; fearful of new tasks). Attitude Toward Learning items indicate a willingness to engage in learning activities (e.g., unwilling to accept needed help; uncooperative in class activities). Attention/Persistence items focus on distractibility and seeing tasks through to completion (e.g., tries but concentration soon fades; easily distracted). Strategy/Flexibility items denote the way in which tasks are approached (e.g., follows peculiar or inflexible procedures; doesn't work well when in bad mood). Five of the 25 items (6, 11, 15, 18, & 26) are scored on two factors. CM and AL share two items, CM and AP share one item, AL and AP share one item, and AP and SF share one item. The subscale and total scores are converted to normalized *T* scores ($M = 50$, $SD = 10$) for interpretation. As indicated earlier, a substantial amount of psychometric information on LBS (McDermott et al., 1999) scores has been published over the last few years (e.g., McDermott, 1999; Schaefer & McDermott, 1999). The factor structure of scores were found to be invariant across gender, ethnicity, and age, and reliability estimates of subscale scores were .75 or higher (McDermott).

Procedure

A schoolwide system of data was managed by school administration to evaluate current educational programs, plan future instructional programs, and demonstrate accountability to the community. Group achievement data were routinely collected and scales that purport to tap other important predictors of student performance (i.e., interest, motivation, behavior) were occasionally included to evaluate their usefulness. Given its potential incremental validity above achievement, the LBS was included in this internal data collection effort. Accordingly, all 24 teachers in grades 1–5 were asked to complete an LBS on each student in their class during spring of the school year. Ten (42%) volunteered to do so. As the teachers completed LBS forms on about 26 students each, and the number of forms could result in fatigue or carryover effects, they were allowed several weeks to complete the forms.

Results

An examination of the item statistics indicated that mean scores were all relatively high (i.e., between 1 and 2). Item statistics were also examined for nonnormality (Fabrigar, Wegener, MacCallum, & Strahan, 1999). As is often the case when mean scores are high (Gorsuch, 1997), or when measuring abnormal or pathological behaviors (Floyd & Widaman, 1995), the distributions of item scores were skewed and kurtotic. The skews on item scores ranged from −.29 to −3.64, and kurtosis of item scores ranged from −1.4 to 10.79. Given the high skews and kurtoses of the distributions of item scores, participants' item scores were converted to *T* scores and compared to scores on the LBS normative sample. This comparison indicated that the means and standard deviations of this sample's *T* scores were approximately 50 and 10, respectively (see Table 1).

Table 1
Means and Standard Deviations of Learning Behavior Scale T Scores (N = 257)

Scale	Mean	Standard Deviation
Competence	50.80	11.44
Attitude Toward Learning	49.11	13.47
Attention/Persistence	46.88	10.42
Strategy/Flexibility	53.21	10.58
Total Score	50.72	7.70

Reliability Estimates

The reliability estimates for scores on the four LBS subscales and the total LBS scale were calculated for the whole sample, as well as by gender and grade level. These results are presented in Table 2. As Table 2 indicates, the reliability estimates for scores on the total scale were consistently high across all subgroups and the total sample (.88–.91). Reliability estimates for subscale scores were also acceptable for the entire sample, and for the first, second, and third factors across most subgroups. One estimate for scores on the third factor (Attention/Persistence) and four estimates for scores on the fourth factor (Strategy/Flexibility) were lower than .70, but the groups on which these estimates were based were small (i.e., 52 or less).

Factor Analyses

The correlation matrix of LBS items was factorable: the Kaiser–Meyer–Olkin Measure of Sampling Adequacy had a value of .90, and Bartlett's Test of Sphericity was 3400.98 ($p < .0001$). Although five factors had eigenvalues greater than 1, the scree test (Cattell, 1966) suggested extracting four factors, and parallel analysis using both tables (Lautenschlager, 1989) and computer software (Watkins, 2000) suggested three factors. As parallel analysis is typically more accurate than the eigenvalue rule or the scree test (Thompson & Daniel, 1996), and the LBS is based on a four-factor model, both a four- and a three-factor solution were extracted. Principal axis extractions were used for two reasons. First, this extraction method is recommended for distribu-

Table 2
Internal Consistency Estimates of Scores on the Learning Behavior Scale

	Gender		Grade					Total Sample
	Female	Male	1	2	3	4	5	
N	130	127	107	49	23	26	52	257
Competence Motivation (8)	.88	.84	.89	.89	.94	.80	.83	.86
Attitude Toward Learning (9)	.85	.91	.90	.91	.92	.71	.90	.89
Attention/Persistence (7)	.71	.77	.77	.87	.89	.82	.49	.76
Strategy/Flexibility (7)	.71	.81	.89	.68	.47	.54	.57	.79
Total LBS (25)	.89	.92	.93	.93	_[a]	.88	.88	.91

Note. The number of items on each scale are in parentheses.
[a]No reliability estimate calculated as a number of items greater than number of participants.

tions in which nonnormality is extreme (Fabrigar et al., 1999), as it is not based on assumptions about the distribution of variables (Cudeck, 2000). Additionally, the principal axis method reduces the influence of 3-level item scores (Cudeck).

An equamax rotation was examined as this method produced the most stable solution in the normative study (McDermott, 1999). However, a varimax solution was also applied as this method minimizes the complexity of factors and is often easier to interpret (Tabachnick & Fidell, 1996). The results of both rotation methods were very similar and the equamax rotations are reported in this manuscript.

Four-Factor Solution. Communality estimates ranged from .07 to .66 (*Mdn* = .55), with the majority of the estimates above .40, suggesting that a sample of at least 200 would result in accurate estimates of population parameters (Fabrigar et al., 1999; MacCallum, Widaman, Zhang, & Hong, 1999). The results of the four-factor solution are presented in Table 3. This solution

Table 3
Four-Factor Solution from Principal Axis/Equamax Rotation of LBS Scores (N = 257)

Item	Factor I Attitude Toward Learning	Factor II Strategy/ Flexibility	Factor III Competence Motivation	Factor IV Attention & Persistence	Communality
LBS8	.69	.25	.15	.31	.66
LBS5	.66	.14	.19	.31	.58
LBS6	.65	.20	.35	.28	.66
LBS18	.54	.16	.48	.31	.64
LBS21	.53	.05	.42	.27	.54
LBS9	.52	.08	.26	.21	.39
LBS23	.08	.76	.01	.03	.58
LBS15	.13	.73	.24	.13	.62
LBS7	.26	.67	.13	.05	.53
LBS27	.10	.62	.02	.02	.40
LBS16	.39	.57	−.09	.07	.50
LBS14	.15	.55	.47	.16	.57
LBS29	.13	−.02	.72	.06	.55
LBS17	.32	−.05	.65	.12	.54
LBS3	.41	.21	.61	.23	.64
LBS26	−.02	.36	.55	.18	.47
LBS2	.44	.23	.51	.28	.58
LBS28	.21	.06	.23	.72	.62
LBS4	.13	.05	.15	.68	.51
LBS25	.44	−.02	.34	.61	.68
LBS1	.11	−.12	.00	.61	.40
LBS11	.24	.31	.25	.57	.54
LBS20	.27	.03	.10	.47	.31
LBS24	.23	.38	.11	.11	.23
LBS13	−.05	.25	.05	−.09	.07
Eigenvalues	8.33	2.40	1.23	.82	
% of Variance	33.30	9.60	4.90	3.30	
Alpha	.79	.82	.77	.78	

Note. LBS = Learning Behaviors Scale. Alpha estimates are construct reliabilities based on salient loadings. Salient coefficients are underlined.

accounted for 51.1% of the variance in LBS scores, and identified three factors similar to the findings of McDermott (1999). Twenty-three of the 25 items achieved structure coefficient loadings above .40 on at least one factor and were used for interpretation in keeping with the norming of the LBS (McDermott) and Stevens's (1996) recommendation. Factor I consisted of nine items: seven of the nine Attitude Toward Learning (AL) items and two Competence Motivation (CM) items. Factor II consisted of five Strategy/Flexibility (SF) items and one Attention/Persistence (AP) item. Six CM items, one AP item, and one AL item made up Factor III. The fourth factor consisted of three AP items, two AL items, and one CM item. The first three factors were given labels from the original scale, as the majority of their items were on factors with the same name in the normative study (McDermott, 1999). Although the fourth factor consisted of as many non-AP items as AP items, it was still labeled Attention and Persistence, as two of the three non-AP items (i.e., is willing to be helped when a task proves too difficult, shows a lively interest in learning activities) seemed related to persistence and attention.

Three items cross-loaded on two factors and four loaded onto factors that differed from the results presented by McDermott (1999). Two CM items cross-loaded on Factor I (AL) and an AL item cross-loaded on Factor III (CM), all in the .4 range. An AP item loaded on both the SF and CM factors, but not on the AP factor. Whereas the Competence Motivation, Attitude Toward Learning, and Strategy/Flexibility factors were relatively intact, the Attention/Persistence factor did not hold up as well. The construct reliability estimates for the factors based on the salient loadings ranged from .77 to .82, in keeping with results reported by McDermott.

Three-Factor Solution. The three-factor solution accounted for 47.4% of the variance and is presented in Table 4. Factor I consisted of 11 of the 14 AL and AP items and 1 CM item, and was labeled Attention and Learning Attitudes. Factor II consisted of seven CM items, two AL items, and one AP item, and was labeled Competence Motivation. Factor III, labeled Strategy/Flexibility, consisted of seven SF items and one AP item. One SF item did not achieve a salient loading on any of the factors, although it did have its highest loading on the SF factor. As in the four-factor solution, the AP items were the ones that differed the most from the McDermott (1999) results. Construct reliability estimates based on the salient loadings were all above .8 (see Table 4). This pattern of shifting loadings may be indicative of overfactoring (Gorsuch, 1997), so a four-factor solution may be the most appropriate for these data.

Discussion

In this study, the reliability estimates and factor structure of scores on the Learning Behavior Scale (McDermott et al., 1999) were examined in an independent sample of elementary school students. The reliability estimates of the LBS total score were high across genders and grades (i.e., $>$.8; Anastasi, 1988), and estimates on scores on three of the LBS subscales were in the moderate to high range. A four-factor extraction found factors similar to three of the four factors reported by McDermott (1999), and a fourth interpretable factor, all with construct reliability estimates of .77 or higher.

The LBS was designed to serve as part of assessments of students who are manifesting learning problems in the classroom, and aid in developing interventions for those students. Consequently, the reliability estimates of scores on this measure are critical since individual decisions will be made about students based on those scores. The reliability estimates found in this study suggest that the LBS total score as well as the Competence Motivation and Attitude Toward Learning subscale scores can be used to make individual decisions. As Clark and Watson (1995, p. 317) observed, once internal consistency estimates of .80 are achieved, "there is no need to strive for any substantial increases in reliability." However, the Attention/Persistence and Strategy/

Table 4
Three-Factor Solution from Principal Axis/Equamax Rotation of LBS Scores (N = 257)

Item	Factor I Attention & Learning Attitudes	Factor II Competence Motivation	Factor III Strategy/ Flexibility	Communality
LBS25	.71	.42	.02	.69
LBS28	.69	.24	.07	.54
LBS4	.62	.15	.05	.41
LBS1	.59	−.01	−.11	.36
LBS11	.56	.27	.32	.49
LBS8	.55	.35	.34	.54
LBS5	.54	.38	.23	.49
LBS20	.53	.15	.06	.31
LBS9	.40	.40	.15	.34
LBS17	.18	.72	−.02	.55
LBS29	.04	.71	−.02	.51
LBS3	.31	.69	.25	.64
LBS2	.38	.60	.28	.58
LBS18	.46	.60	.23	.63
LBS21	.44	.55	.12	.51
LBS6	.49	.52	.29	.59
LBS26	.09	.46	.33	.33
LBS23	.02	.00	.76	.58
LBS15	.11	.23	.73	.59
LBS7	.12	.18	.70	.53
LBS27	.03	.03	.63	.40
LBS16	.23	.03	.62	.43
LBS14	.13	.45	.54	.52
LBS24	.18	.16	.41	.23
LBS13	−.12	.03	.24	.07
Eigenvalues	8.29	2.38	1.18	
% of Variance	33.20	9.50	4.70	
Alpha	.84	.83	.82	

Note. LBS = Learning Behaviors Scale. Alpha estimates are construct reliabilities based on salient loadings. Salient coefficients are underlined.

Flexibility subscales, with some reliability estimates of scores in the high .70 range, should be used with caution for individuals. These two subscales are adequate for research and screening purposes.

With regard to validity, the factor analytic results were generally supportive of the purported LBS structure: Three of the four LBS subscales (Competence Motivation, Strategy/Flexibility, and Attitude Toward Learning) were substantially replicated when a four-factor structure was extracted, but the Attention/Persistence factor was not. That items cross-loaded onto the replicated factors is not entirely surprising in this smaller sample, given the theoretical relationships among these constructs. For example, an item related to "too lacking in energy to make a good effort" cross-loaded from the Attitude Toward Learning factor to the Competence Motivation factor. The cross-loadings on all of the factors also made theoretical sense. However, only in the case of the Attention/Persistence factor did cross-loadings constitute half of the items on the factor.

Although it can be argued that attention and persistence are characteristics that cut across many learning behavior categories, this does not provide an adequate explanation for the factor's failure to emerge clearly in this study. In 1978, Cattell made the following observation: "If the same underlying real influence is at work in different experiments the factor pattern should generally not be invariant but slightly or moderately different in response to circumstance. One seeks replication rather than invariance" (p. 268). This study is the first to examine the LBS in a single school, and three of the four factors were replicated substantially. Without replication, it is impossible to determine if the fourth factor did not emerge as a result of error (Cattell). If this study is replicated in another single-school context, "then the real substantive factors should show matching patterns, factor for factor, but the error factor patterns will be peculiar to each study" (Cattell, p. 60). Replication, then, is the best and perhaps the only way to examine the viability of the Attention/Persistence factor.

This study suffered from a number of limitations that qualify the results. First, the number of students at each grade level was not equal, and the response rate of teachers at the school site was only 42%. More importantly, only one class, and thus one teacher, was represented in three of the five grades from which participants were drawn. As indicated earlier, having teachers complete LBS forms on their entire class could have resulted in fatigue, even though ample time was available for completion of the forms. Additionally, it is not possible to determine if there is systematic bias in the data due to between teacher variance. These limitations affect the generalizability of these results, even to single-school settings. On the other hand, the similarity of these results to the results reported by McDermott (1999) suggests that the Learning Behavior Scale is a potentially useful instrument for identifying and intervening with students' learning-related behaviors.

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