Independent Investigations of Reliability and Validity of Learning Behaviors Scale Scores: Implications for Practitioners and Future Directions

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Abstract

This presentation reports on the results of four independent studies that investigated the reliability and validity of Learning Behaviors Scale (LBS; McDermott, Green, Francis, & Stott, 1999) scores. The LBS is a cost and time effective, nationally normed, and unobtrusive observation measure of key learning behavior variables that influence student learning. Study 1 examined the replication of the short-term (30-day) stability and the internal consistency of LBS scores with an independent sample of 209 students in grades K-8. Stability coefficients were high and statistically significant and mean differences between Time 1 and Time 2 were either not statistically significant or resulted in very small effect sizes. Internal consistency estimates of the LBS at Time 1 and Time 2 were also high and statistically significant and similar to those obtained with the standardization sample. An additional analysis of the LBS was conducted by examining the correlations of LBS subscale and total scores with academic performance measured by an ordinal summary rating of achievement for kindergarten and first grade students and grade point average for second through eighth grade students. Substantial evidence was found for the short-term stability and internal consistency of LBS scores. Construct validity of the LBS was also supported by statistically significant correlations with students' grades in school. Study 2 examined the replication of the convergent and divergent validity of the LBS through comparisons with the Adjustment Scales for Children and Adolescents (ASCA; McDermott, Stott, & Marston, 1993), an objective measure of child psychopathology. With a random sample of 246 students in grades 1-11, statistically significant and moderately high correlations were observed between the LBS and ASCA with better learning behaviors being associated with fewer symptoms of problem behaviors or psychopathology. These results were similar to those reported by McDermott (1999) and suggest that the LBS and ASCA, although related, are measuring different constructs. Generally good learning behaviors were associated with the general absence of problem behaviors or psychopathology. Study 3 examined the replication of the four-factor structure and the internal consistency of LBS scores with an independent sample of 241 randomly selected students from grades 1-7. 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 this study were associated with the identical factor found with the standardization sample. Further, four of the five LBS items that cross-loaded in the present study were the same items that cross-loaded in the standardization sample and did so on the same factors. Coefficients of congruence (Gorsuch, 1983; Harmon, 1976; Watkins, 2002) were calculated to estimate the factorial invariance of LBS scores in present study in comparison to the LBS standardization sample and these estimates indicated "good" or "excellent" (MacCallum, Widaman, Zhang, & Hong, 1999, p. 93) matches to the standardization sample. Study 4 examined the reliability and validity of the LBS with four different samples of students of Native American Indian tribes (n = 666). Results showed that the LBS internal consistency estimates for Native American Indians were similar to the LBS standardization sample and previous independent studies of the LBS. Further, correlations between the LBS and the ASCA for the Native American Indians were similar to those obtained in previous independent samples suggesting, like previous studies, generally good learning behaviors were associated with the general absence of problem behaviors or psychopathology, particularly externalizing symptoms. The results from these four studies suggest the LBS may be helpful in identifying learning related behaviors that could be useful for recommending learning related interventions. Recommendations for future research will be discussed.

Independent Investigations of Reliability and Validity of Learning Behaviors Scale Scores: Implications for Practitioners and Future Directions

While measures of intelligence provide the best predictors of academic achievement (Sattler, 2001; Neisser et al., 1996) and such prediction is important, information from intelligence tests has generally not been found to be particularly important or relevant to designing effective cognitive or educational interventions (i.e., treatment validity) (Brown & Campione, 1982; Ceci, 1990, 1991; Glutting & McDermott, 1990a, 1990b; Macmann & Barnett, 1994; Neisworth & Bagnato, 1992; Reschly, 1988, 1997; Schaefer & McDermott, 1999; Scarr, 1981; Spitz, 1986; Ysseldyke & Christenson, 1988). Research has pointed to various learning related behaviors such as attention, active participation, reflective responding, accepting correction and feedback, and appreciation of novelty as facilitators of success in the educational process (Carter & Swanson, 1995; Finn & Cox, 1992; Jussim, 1989; Schuck, Oehler-Stinnett, & Stinnett, 1995). Such learning behaviors can be taught and thus have a direct impact on the learning of students (Barnett, Bauer, Ehrhardt, Lentz, & Stollar, 1996; Engelmann, Granzin, & Severson, 1979; Stott, 1978, 1981; Stott & Albin, 1975; Weinberg, 1979). Assessment of these learning behaviors may provide additional insights into student learning difficulties and aid in remediation of learning problems.

The development of the Learning Behaviors Scale (LBS; McDermott, Green, Francis, & Stott, 1999) was driven by a desire to create a measure that would be cost and time effective, nationally normed, and provide for unobtrusive observation of key learning behavior variables influencing student learning. Over the past 20 years, the LBS gained substantial empirical support (Birrell, Phillips, & Stott, 1985; Green & Francis, 1988; Green, Francis, & Stott, 1984; McDermott, 1984; McDermott & Beitman, 1984; McDermott & Watkins, 1987; Phillips, Stott, & Birrell, 1987; Pies, 1988; Stott, 1985; Stott, Green, & Francis, 1983; Stott, McDermott, Green, & Francis, 1988). 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). Further, no differences in mean ratings were observed between the raters on the LBS scales. Worrell, Vandiver, & Watkins (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 gender and grade subgroups.

Validity studies summarized by McDermott (1999) provided support for the convergent and divergent validity of the LBS in comparisons with the Adjustment Scales for Children and Adolescents (ASCA; McDermott, Stott, & Marston, 1993). Statistically significant negative correlations typified the relations between subscales and composite scores and canonical redundancy analysis indicated a 30% overlap between learning behaviors (LBS) and psychopathology (ASCA). Positive learning behaviors were 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).

The LBS standardization data suggested a four-factor model orthogonally rotated to equamax simple structure and was shown to be invariant across gender, 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). Worrell et al. (2001) provided partial support for the four factors and suggested the need for further replication with additional independent samples.

Study 1 examined the short-term stability (30 days) of LBS scores by examining correlations between subscales and the total scores across the retest interval to examine pattern agreement. Mean differences were also examined across the retest interval to assess level agreement. Additionally, internal consistency estimates were also examined at both times and correlations between the LBS and student grades assessed the validity of the LBS. Study 2 examined the relationships between the LBS and ASCA with an independent sample. Because several LBS scales measure learning behaviors that are related to characteristics of psychopathology (i.e., LBS Attention/Persistence and ASCA Attention-Deficit Hyperactive) it was expected that some scales of the LBS and ASCA would have moderately high and statistically significant negative correlations as McDermott (1999) reported. However, the scales should also not be correlated so high as to be redundant. Study 3 examined the factor structure of the LBS with an independent sample to replicate the results of McDermott (1999) with the LBS standardization sample. Study 4 examined the internal consistency reliability and convergent and divergent validity of LBS and ASCA scores for four independent samples of Native American Indian students to investigate differential reliability and validity (bias) among LBS and ASCA scores.

Study 1. Study 1 (Canivez & Gillespie, 2005) examined the short-term stability (30 days) of the LBS for a sample of 209 students ranging in grade from kindergarten through eighth grade and ranged in age from 5 to 14 ($M = 9.63$, $SD = 2.69$). Regular and special education students were included in the sample and approximated population estimates for disability groups. Sixteen teachers volunteered to participate by providing anonymous LBS ratings on randomly selected students from their classroom whom they had observed for a minimum of 40 school days. They rated the students twice with a retest interval of 30 days. Teachers were compensated by a chance to be randomly selected to receive one of three $10.00 gift certificates for each child rated. In addition to investigating the test-retest (stability) of the LBS, internal consistency estimates were also calculated at Time 1 and Time 2 and comparisons of LBS scores to student grades provided an index of construct validity. Due to the rank order nature of global ratings of student achievement for kindergarten and first grade students, Spearman rank order (r_{rho}) correlations were calculated between LBS scores and the global achievement ratings while Pearson product-moment correlations were calculated between LBS scores and students' GPAs for those in second through eighth grades.

Results indicated that LBS scores for all subscales and the Total score produced statistically significant correlations between Time 1 to Time 2 for raw scores *and T* scores, with correlations ranging from .84 to .91 for raw scores and from .73 to .82 for *T* scores (see Table 2). Statistically significant increases in LBS scores were observed for the CM and AP subscales and the LBS Total, but effect sizes were quite small (*d* ranging from .03 to .14 for raw scores, Δ ranging from .00 to .02 for *T* scores) and thus were not considered clinically or practically meaningful. Internal consistency estimates (see Table 3) at Time 1 ranged from .82 to .93 and ranged from .84 to .92 at Time 2. In examination of the LBS construct validity for the K-1 group (Table 3), the LBS CM subscale produced the highest correlation ($r_{rho} = .70$, $p < .001$) with global teacher ratings of achievement. The LBS AP scale also was significantly correlated with global achievement ($r_{rho} = .40$, $p < .001$), as was the LBS Total score ($r_{rho} = .48$, $p < .001$). The LBS AL and SF scales were not significantly correlated with global teacher ratings of achievement. Finally, LBS construct validity coefficients comparing the LBS subscales and Total score with students' GPAs ranged from .40 to .62 and all were statistically significant (Table 3).

These results replicated and extended previous research on the LBS with an independent sample and indicated that LBS scores appeared to be adequately stable over short-term time intervals and have good to excellent internal consistency. Further, LBS scores, which measure behaviors associated with efficient and effective learning, are significantly related to teacher ratings of academic performance and earned grades in the classroom.

Table 1
Sample Demographic Characteristics (N = 209) (Canivez & Gillespie, 2005).

Variable	*n*	*%*
Sex		
Male	108	51.7
Female	101	48.3
Race/Ethnicity		
Caucasian	200	95.7
Black/African American	9	4.3
Grade		
K	24	11.5
1	21	10.0
2	24	11.5
3	23	11.0
4	21	10.0
5	23	11.0
6	26	12.4
7	24	11.5
8	23	11.0
Disability/Exceptionality		
Not Disabled	174	83.3
Learning Disabled	26	12.3
Seriously Emotionally Disabled	5	2.4
Mentally Retarded	1	0.5
Speech/Language Disabled	1	0.5
Attention Deficit Hyperactivity Disorder	2	1.0

Table 2
Stability coefficients, descriptive statistics, dependent t-tests, effect sizes, and 95% confidence intervals for LBS raw scores and T scores (Canivez & Gillespie, 2005).

Raw Scores		Time 1		Time 2				95% CI	
	$r_{1,2}$	*M*	*SD*	*M*	*SD*	*t*	*d*	Lower	Upper
CM	.86	11.70	3.99	12.14	3.85	3.02*	.11	-0.73	-0.15
AL	.86	14.79	3.91	14.91	4.03	0.82	.03	-0.41	0.17
AP	.84	9.77	3.62	10.28	3.56	3.68*	.14	-0.79	-0.24
SF	.85	11.62	3.05	11.77	3.18	1.22	.05	-0.38	0.09
Total	.91	38.53	10.01	39.41	10.41	2.86*	.09	-1.49	-0.27
T Scores		Time 1		Time 2				95% CI	
	$r_{1,2}$	*M*	*SD*	*M*	*SD*	*t*	Δ	Lower	Upper
CM	.80	47.68	12.13	49.07	11.84	2.62*	.01	-2.44	-0.34
AL	.80	49.02	12.51	49.43	13.03	0.73	.00	-1.51	0.70
AP	.73	44.76	13.32	46.84	12.54	3.14*	.02	-3.39	-0.77
SF	.84	48.12	14.76	48.98	15.66	1.41	.01	-2.05	0.34
Total	.82	45.83	13.50	47.00	15.05	1.96	.01	-2.34	0.01

Note. LBS = Learning Behaviors Scale, CM = Competence Motivation, AL = Attitudes toward Learning, AP = Attention/Persistence, SF = Strategy/Flexibility, Total = LBS Total Score. All correlations significant, $p < .0001$.
*$p < .05$ (Bonferroni adjusted a = .01, *df* = 208). *d* = Cohen's *d* (effect size estimate; Cohen, 1960, 1998). Δ = Glass' Delta (effect size estimate; Glass & Hopkins, 1996).

Table 3
Internal consistency estimates at Time 1 and Time 2 and validity coefficients for LBS T scores at Time 2 (Canivez & Gillespie, 2005).

	Internal Consistency Estimates		Validity Coefficients	
	r_{α} Time 1	r_{α} Time 2	r_{rho} (Rank)	*r* (GPA)
CM	.87**	.87**	.70*	.62**
AL	.87**	.89**	.22	.51**
AP	.82**	.84**	.40*	.45**
SF	.84**	.87**	.26	.40**
Total	.93**	.92**	.48*	.54**

Note. LBS = Learning Behaviors Scale, CM = Competence Motivation, AL = Attitudes toward Learning, AP = Attention/Persistence, SF = Strategy/Flexibility, Total = LBS Total Score, Rank = Global performance estimate. Rank (high, medium, low) was reported for students in kindergarten and first grade. GPA = Grade Point Average (4 point scale). Grade point averages were reported for students in grades 2-8.
*$p < .001$. **$p < .0001$.

Study 2. Canivez, Willenborg, and Kearney (2004, 2005) studied randomly selected students ($N = 246$) from grades 1 through 11 who were rated on the LBS and ASCA in counterbalanced order. Students ranged in age from 6 to 17 years ($M = 9.61$, $SD = 2.40$). Teachers rated at least four male and four female students that they had observed for at least 40 days prior to the completion of the ASCA and the LBS. Because several LBS scales measure learning behaviors that are related to characteristics linked to psychopathology (i.e., LBS Attention/Persistence and ASCA Attention-Deficit Hyperactive) it was expected that some LBS scales and some ASCA scales would have moderately high and statistically significant negative correlations as McDermott (1999) reported but the correlations should be lower than .80 to indicate sufficient divergent measurement.

Pearson product-moment correlation coefficients (see Table 5) were calculated to provide estimates of convergent and divergent validity between the ASCA and the LBS. The ASCA global adjustment scales OVR and UNR were significantly and negatively correlated with the LBS Total score. This is consistent with the findings of McDermott (1999). The correlation between the ASCA OVR scale and the LBS Total ($r = -.64$) was significantly higher than the correlation between the ASCA UNR scale and the LBS Total ($r = -.43$), $z = 3.29$, $p < .001$. As in McDermott (1999), better learning behaviors were more strongly associated with fewer overactive/externalizing problems than underactive/internalizing problems. At the global scale level the LBS and ASCA appear to be measuring different (yet related) constructs as it appeared that most of the reliable variability of the LBS was unique and not confounded with psychopathology.

Among the LBS subscales and ASCA Core Syndromes, correlations ranged from .00 to -.61 ($Mdn_r = -.43$) and 20 of 24 were statistically significant after adjusting α (Bonferroni correction) for multiple comparisons (see Table 5). A statistically significant and moderately high correlation was observed between the ASCA ADH syndrome and the LBS AP scale ($r = -.61$, 37% shared variance) indicating that generally good attention and persistence toward learning tasks was associated with fewer behavioral symptoms of attention deficit-hyperactivity. The LBS SF scale had moderately high and statistically significant correlations with the ASCA ADH, SAP, and OPD core syndromes suggesting that inflexible approaches to learning were associated with attention deficit-hyperactivity, provocative aggression, and oppositional behaviors. Poor attitudes toward learning were associated with attention deficit-hyperactivity, oppositional behaviors, and avoidance. Low levels of competence motivation were associated with symptoms of attention deficit-hyperactivity, oppositional behaviors, and avoidance.

These are similar results to what McDermott (1999) reported in canonical redundancy analyses with the LBS and ASCA. Internal consistency estimates (see Table 6) closely approximated those from the LBS and ASCA standardization samples (McDermott, 1993, 1994, 1999).

Table 4
Sample Demographic Characteristics (*N = 246) (Canivez, Willenborg, & Kearney, 2004, 2005).*

Variable	*N*	*%*
Sex		
Male	122	49.6
Female	124	50.4
Race/Ethnicity		
Caucasian	172	69.9
Black/African American	27	11.0
Hispanic/Latino	14	5.7
Asian American	1	0.4
Native American	2	0.8
Missing Data	30	12.2
Grade		
1	35	14.2
2	53	21.5
3	52	21.1
4	12	4.9
5	11	4.5
6	28	11.4
7	50	20.3
8	0	0.0
9	3	1.2
10	0	0.0
11	2	0.8
Disability/Exceptionality		
Not Disabled	164	66.7
Learning Disabled	37	15.0
Seriously Emotionally Disabled	5	2.0
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	1.6
Traumatic Brain Injury	1	0.4
Remedial Reading	1	0.4
Missing Data	25	10.2

Table 5

Pearson Product Moment Correlations Between the ASCA and LBS (Canivez, Willenborg, & Kearney, 2004, 2005).

	LBS Scales				
Core Syndromes	CM	AL	A/P	S/F	LBS Total
ADH	-.44*	-.45*	-.61*	-.54*	-.57*
SAP	-.30*	-.35*	-.46*	-.56*	-.49*
SAI	-.22*	-.21	-.35*	-.40*	-.32*
OPD	-.35*	-.48*	-.46*	-.56*	-.54*
DIF	-.33*	-.32*	-.19	.00	-.26*
AVO	-.47*	-.58*	-.42*	-.18	-.50*
Supplementary Syndromes					
DEL	-.35*	-.35*	-.26*	-.35*	-.37*
LEH	-.48*	-.45*	-.43*	-.28*	-.48*
Global Adjustment Scales					
OVR	-.47*	-.51*	-.65*	-.63*	-.64*
UNR	-.46*	-.51*	-.34*	-.08	-.43*

Note. ADH = Attention-Deficit Hyperactive, SAP = Solitary Aggressive (Provocative), SAI = Solitary Aggressive (Impulsive), OPD = Oppositional Defiant, DIF = Diffident, AVO = Avoidant, DEL = Delinquent, LEH = Lethargic (Hypoactive), OVR = Overactivity, UNR = Underactivity, LBS = Learning Behaviors Scale, CM = Competence Motivation, AL = Attitude Toward Learning, A/P = Attention/Persistence, S/F = Strategy/Flexibility. $N = 246$ except for DEL ($n = 166$) and LEH ($n = 166$) as the DEL and LEH scales are not universally applied across sex and development (McDermott, 1994).

*$p < .05$ (with Bonferroni correction).

Table 6

Descriptive Statistics for LBS and ASCA T scores and Internal Consistency Estimates

	M	*SD*	Range	r_α
LBS Scales				
Competence Motivation	47.26	12.42	1 – 63	.87
Attitude Toward Learning	47.07	13.04	1 - 63	.86
Attention/Persistence	45.65	11.76	1 - 61	.82
Strategy/Flexibility	47.02	12.90	1 - 61	.78
LBS Total	45.83	12.73	1 - 66	.93
ASCA Scales				
Core Syndromes				
Attention Deficit-Hyperactive	51.74	10.70	39 - 81	.86
Solitary Aggressive (Provocative)	51.30	10.74	45 - 80	.81
Solitary Aggressive (Impulsive)	52.65	11.18	47 - 99	.61
Oppositional Defiant	51.25	12.71	43 - 99	.85
Diffident	49.10	9.93	40 - 76	.74
Avoidant	50.42	10.47	42 - 78	.75
Supplementary Syndromes				
Delinquent	51.11	10.92	45 - 75	.40
Lethargic (Hypoactive	49.83	9.44	44 - 71	.65
Overall Adjustment Scales				
Overactivity	52.37	11.12	39 - 79	.93
Underactivity	49.74	10.58	38 - 77	.80

Note. Internal consistency estimates (Coefficient a) were obtained from the present data. $N = 246$ except for DEL ($n = 166$) and LEH ($n = 166$) as the DEL and LEH scales are not universally applied across sex and development (McDermott, 1994).

Study 3. The factorial validity of the LBS (Canivez, Willenborg, & Kearney, in press) was examined in this study with data provided by 27 teachers from 9 different schools. A total of 241 students ranging from grade 1 through 7 in 3 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). The majority of students was Caucasian and not disabled. Of the disabled group, most were identified as Learning Disabled. Males and females were sampled in approximately equal proportions.

As with the Worrell et al. (2001) study, the present study utilized the principal axis method of exploratory factor analysis and 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; Lautenschlager, 1989; Watkins, 2000). 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. The present study also utilized results of the equamax rotation for direct comparison to the LBS standardization sample and the Worrell et al. (2001) study.

As in the Worrell et al. (2001) study, the present study showed 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 (Thompson & Daniel, 1996). 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. (2001) study. The five-factor model did not appear viable as it resulted in substantial 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).

The present study replicated 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 (.78 to .93; *Mdn* = .88) as well as for gender and grade level subgroups (.71 to .94; *Mdn* = .87) (see Table 9). These coefficients were also quite close to those obtained by McDermott (1999) and Worrell et al. (2001). Most of the alpha coefficients met or exceeded criteria suggested as necessary for use of the scales for individual decision-making or diagnostic purposes (Hills, 1981; Salvia and Ysseldyke, 1991).

The present study also provided substantial support for the four-factor model of the LBS (see Table 10) suggested by McDermott (1999) with almost all items loading on factors consistent with the standardization data. Coefficients of congruence (Gorsuch, 1983; Harmon, 1976; 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, Widaman, Zhang, & Hong, 1999, p. 93) matches to the factorial results of the LBS standardization sample. Coefficients of congruence ranged from .93 (SF) to .98 (CM). Results from the three-factor model fit those from Worrell et al. (2001) but was not as close a fit as the four-factor model (see Table 11).

Study 3 extended the results of Worrell et al. (2001) by providing support for the Attention and Persistence factor that was not clearly delineated in their study. Given that the present 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. (2001) study was, as they suggested, a result of error. It appeared that replication had indeed addressed and supported the viability of the AP factor. The present results strongly supported the four-factor solution proposed by McDermott (1999) and suggested the LBS may be helpful in identifying learning related behaviors that may be useful for recommending learning related interventions.

Table 7
Sample Demographic Characteristics (*N = 241) (Canivez, Willenborg, & Kearney, in press).*

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

Table 8
Descriptive Statistics for LBS T Scores (N = 241) (Canivez, Willenborg, & Kearney, in press).

	M	*SD*	Range	Skewness	Kurtosis
LBS Scales					
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 9

Learning Behaviors Scale (LBS) Internal Consistency Estimates (Canivez, Willenborg, & Kearney, in press).

	Grade		Sex		Total
	1-3	4-7	Male	Female	Sample
n	140	101	120	121	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

Table 10

Four-Factor LBS Solution of the Principal Axis/Equamax Rotation (Canivez, Willenborg, & Kearney, in press).

LBS Item	Factor I Competence Motivation	Factor II Attention & Persistence	Factor III Attitude Toward Learning	Factor IV Strategy/ Flexibility	Communality
1	***.41***	.21‡	.17	-.05	.24
2	***.53****	.35	.33	.28	.59
3	***.64****	.29	.29	.16	.60
4	.22	***.54****	.29	.14	.44
5	***.48***	***.42****	***.43****	.13	.62
6	***.46****	.30	***.40****	.18	.50
7	.18	.17	.21	***.59****	.46
8	.31	.32	***.56****	.20	.55
9	.30	.04	***.66****	.18	.56
11	.19	***.42****	***.47****	.13	.45
13	-.04	-.05	-.04	***.62****	.39
14	.30	***.85****	.02	.23	.86
15	.05	***.81****	.15	.24‡	.74
16	.03	.34	***.53***	.27‡	.47
17	***.76****	.03	.21	.00	.62
18	***.60****	.38	***.41****	.23	.72
20	.07	.05	***.52****	.12	.29
21	***.50***	.24	.28‡	-.05	.39
23	-.02	.28	.15	***.63****	.50
24	.20	.33	***.56***	.28‡	.54
25	***.58***	.33	***.40****	-.06	.62
26	***.50****	.25‡	-.02	.34	.43
27	-.01	.12	.24	***.57****	.39
28	***.59****	.29	.29	.06	.51
29	***.58****	.20	.09	.24	.44
Eigenvalues	9.23	1.76	1.04	.88	
% Variance	36.90	7.10	4.20	3.50	
r_c	.99	.96	.94	.94	
r_α	.91	.84	.89	.72	

Note. LBS = Learning Behaviors Scale. LBS items 10, 12, 19, and 22 are not used in scoring the LBS and were not included in the present EFA. Salient factor coefficients are presented in bold italics. Coefficients of congruence (r_c) obtained from Watkins (2002). Internal consistency (r_α) estimates are based on items with salient factor structure coefficients from the present sample.

*Salient factor structure coefficients corresponding to the same factor(s) identified in the LBS standardization sample (McDermott et al., 1999).

‡Factor structure coefficients failing to correspond to the same factor(s) identified in the LBS standardization sample (McDermott et al. 1999).

Table 11

Three-Factor LBS Solution of the Principal Axis/Equamax Rotation (Canivez, Willenborg, & Kearney, in press).

LBS Item	Factor I Competence Motivation	Factor II Attention & Learning Attitudes	Factor III Strategy/ Flexibility	Communality
1	***.43***	.24‡	.00	.24
2	***.55****	***.40***	.33	.57
3	***.64****	.36	.18	.58
4	.30	***.50****	.26	.41
5	***.60***	***.40****	.29	.61
6	***.56****	.29‡	.32	.50
7	.14	.27	***.54****	.38
8	***.50****	.25‡	***.45***	.52
9	***.55****	-.03‡	***.49***	.54
11	.36	.34‡	.36	.38
13	-.16	.08	***.42***	.21
14	.20	***.91***	.17‡	.89
15	.08	***.74***	.31‡	.65
16	.24	.23	***.54****	.41
17	***.71****	.15	-.01	.53
18	***.66****	***.41****	.33	.72
20	.30‡	-.04‡	***.40***	.25
21	***.58****	.24‡	.05	.39
23	-.07	.33	***.59****	.46
24	***.40***	.26	***.53****	.51
25	***.69****	.31‡	.09	.59
26	.34	.39	.17	.29
27	.00	.17	***.58****	.37
28	***.62***	.34‡	.12	.51
29	***.47****	.32	.14	.34
Eigenvalues	9.15	1.69	1.01	
% Variance	36.60	6.80	4.00	
r_c	.92	.85	.95	
r_α	.92	.87	.81	

Note. LBS = Learning Behaviors Scale. LBS items 10, 12, 19, and 22 are not used in scoring the LBS and were not included in the present EFA. Salient factor structure coefficients are presented in bold italics. Coefficients of congruence (r_c) obtained from Watkins (2002). Internal consistency (r_α) estimates are based on items with salient factor structure coefficients from the present sample.

*Salient factor structure coefficients corresponding to the same factor(s) identified in the Worrell et al. (2001) study.

‡Factor structure coefficients not corresponding to the same factor(s) identified in the Worrell et al. (2001).

Study 4. Native American Indian students (N = 666) from grades K through 12 were rated on the LBS and ASCA in counterbalanced order as part of a NIH/NIMH funded project examining the reliability and validity of the ASCA and LBS for Native American Indians (Canivez, 2005). The Native American Indian tribes sampled included the Ojibwe Tribe (n = 179) in north central Minnesota, the Yavapai Apache Tribe (n = 225) in north central Arizona, the Cocopah Tribe (n = 108) in southwest Arizona, and the Colorado River Indian Tribe (n = 154) in western Arizona. Students ranged in age from 5 to 20 years (M = 11.92, SD = 3.31). Teachers rated at male and female students that they had observed for at least 40 days prior to the completion of the ASCA and the LBS.

Internal consistency estimates were calculated to estimate the reliability of LBS and ASCA scores among the Native American Indian student scores (see Table 12). Pearson product-moment correlation coefficients were calculated to provide estimates of convergent and divergent validity between the ASCA and the LBS (see Table 13) as was done in Study 2 (Canivez, Willenborg, & Kearney, 2004, 2005) above and reported by McDermott (1999). Internal consistency estimates were very similar to

those obtained in the LBS and ASCA standardization samples as well as with other independent samples reported in the literature (Canivez, 2004; Canivez et al., in press; McDermott, 1993, 1994). The ASCA global adjustment scales OVR and UNR were significantly and negatively correlated with the LBS Total score. This is consistent with the findings of McDermott (1999) and Canivez et al. (2004, 2005). The correlation between the ASCA OVR scale and the LBS Total (r = -.60) was significantly higher than the correlation between the ASCA UNR scale and the LBS Total (r = -.39), z = 5.12, p < .0001. As in McDermott (1999), better learning behaviors were more strongly associated with fewer overactive/externalizing problems than underactive/internalizing problems. At the global scale level the LBS and ASCA appear to be measuring different (yet related) constructs as it appeared that most of the reliable variability of the LBS was unique.

Among the LBS scales and ASCA Core Syndromes, correlations ranged from .10 to -.63 (Mdn_r = -.39) and 23 of 24 were statistically significant after adjusting α (Bonferroni correction) for multiple comparisons. A statistically significant and moderately high correlation was observed between the ASCA ADH syndrome and the LBS AP scale (r = -.63, 40% shared variance) indicating that generally good attention and persistence toward learning tasks was associated with fewer behavioral symptoms of attention deficit-hyperactivity. Other associations of poor attention and persistence were noted with provocative aggression, and oppositional behaviors. The LBS SF scale had moderately high and statistically significant correlations with the ASCA ADH, SAP, SAI, and OPD core syndromes suggesting that inflexible approaches to learning were associated with attention deficit-hyperactivity, provocative aggression, impulsive aggression, and oppositional behaviors. Poor attitudes toward learning were mostly associated with attention deficit-hyperactivity and avoidance. Low levels of competence motivation were mostly associated with symptoms of attention deficit-hyperactivity and avoidance. These are similar to what McDermott (1999) reported in canonical redundancy analyses with the LBS and ASCA as well as findings from *Study 2* (Canivez, Willenborg, & Kearney, 2004, 2005).

Table 12
Descriptive Statistics for LBS and ASCA T scores and Internal Consistency Estimates for the total Native American Indian Sample (Canivez, 2005).

	M	*SD*	Range	r_α
LBS Scales				
Competence Motivation	41.37	14.15	1 - 63	.87
Attitude Toward Learning	40.54	15.47	1 – 61	.90
Attention/Persistence	44.19	11.35	1 - 61	.81
Strategy/Flexibility	46.47	11.68	1 - 61	.75
LBS Total	41.02	14.20	1 - 66	.92
ASCA Scales				
Core Syndromes				
Attention Deficit-Hyperactive	52.49	10.34	39 – 99	.85
Solitary Aggressive (Provocative)	52.53	11.26	45 – 99	.78
Solitary Aggressive (Impulsive)	52.16	9.92	47 – 81	.59
Oppositional Defiant	52.44	11.65	43 – 99	.79
Diffident	53.30	10.84	40 – 78	.77
Avoidant	54.21	11.67	42 – 99	.76
Supplementary Syndromes				
Delinquent	56.09	13.01	45 – 99	.51
Lethargic (Hypoactive	53.62	10.40	44 – 74	.61
Overall Adjustment Scales				
Overactivity	53.49	10.17	39 – 99	.91
Underactivity	54.50	11.08	38 – 81	.81

Note. Internal consistency estimates (r_α) were obtained from the present data. N = 666 except for DEL (n = 483) and LEH (n = 336) as the DEL and LEH scales are not universally applied across sex and development (McDermott, 1994).

Table 13

Pearson Product Moment Correlations Between the ASCA and LBS for the total Native American Indian Sample (Canivez, 2005).

	LBS Scales				
Core Syndromes	CM	AL	A/P	S/F	LBS Total
ADH	-.46*	-.44*	-.63*	-.62*	-.56*
SAP	-.29*	-.38*	-.50*	-.57*	-.45*
SAI	-.20*	-.29*	-.39*	-.45*	-.33*
OPD	-.30*	-.35*	-.40*	-.56*	-.43*
DIF	-.35*	-.30*	-.11*	.10	-.24*
AVO	-.48*	-.59*	-.37*	-.11*	-.45*
Supplementary Syndromes					
DEL	-.29*	-.36*	-.39*	-.31*	-.36*
LEH	-.53*	-.49*	-.37*	-.23*	-.49*
Global Adjustment Scales					
OVR	-.47*	-.49*	-.66*	-.69*	-.60*
UNR	-.47*	-.48*	-.26*	.02	-.39*

Note. ADH = Attention-Deficit Hyperactive, SAP = Solitary Aggressive (Provocative), SAI = Solitary Aggressive (Impulsive), OPD = Oppositional Defiant, DIF = Diffident, AVO = Avoidant, DEL = Delinquent, LEH = Lethargic (Hypoactive), OVR = Overactivity, UNR = Underactivity, LBS = Learning Behaviors Scale, CM = Competence Motivation, AL = Attitude Toward Learning, A/P = Attention/Persistence, S/F = Strategy/Flexibility. $N = 666$ except for DEL ($n = 483$) and LEH ($n = 336$) as the DEL and LEH scales are not universally applied across sex and development (McDermott, 1994).

*$p < .05$ (with Bonferroni correction).

Results from these studies support various forms of reliability (stability and internal consistency) and validity (convergent, divergent, factorial, and predictive) of LBS scores with independent samples and add to the empirical support for its use. As with all studies, limitations of sampling influence the generalizability of results and further replications of these studies are recommended with broader, more diverse samples. Further, studies examining the incremental validity of LBS scores in accounting for academic achievement of students above and beyond that predicted by general intelligence should also be conducted to further explore this important characteristic. Differential reliability and validity should be examined with other neglected subgroups of the population such as Asian American youths to explore potential bias. The *Standards for Educational and Psychological Testing* suggest such studies are of critical importance for the appropriate use of tests in clinical practice (AERA, APA, NCME, 1999). If results of future studies are as positive as those presented here, the LBS may likely become a standard instrument in school psychology and educational psychology assessments of student learning difficulties in order to facilitate better instructional interventions for at-risk and disabled youths.

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