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The Revised Learning and Study Strategies Inventory: An Evaluation of Competing Models

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Abstract

Two competing structural models for the revised Learning and Study Strategies Inventory (LASSI) were examined. The test developers promote a model related to three uncorrelated components of strategic learning: skill, will, and self-regulation. Other investigators have shown empirical support for a three-factor correlated model characterized by effort-related activities, goal orientation, and cognitive activities (ER-GO-CA). Neither model has been verified on scores from the second edition of the LASSI. In the present sample of 297 college students, confirmatory factor analysis of the subscale scores provided support for the ER-GO-CA model.

Keywords

LASSI; factor analysis; college students; learning strategies

Learning and study strategies are important factors in understanding the academic achievement of college students. Measures of learning and study strategies can help screen and identify students at risk for poor performance, be used diagnostically to evaluate areas of difficulty that can lead to prescriptive or remedial plans, serve as pre-post outcome measures in evaluating academic treatment programs, and be useful in advising college students seeking a better awareness of their academic strengths and weaknesses. The Learning and Study Strategies Inventory (LASSI; Weinstein & Palmer, 2002; Weinstein, Schulte, & Palmer, 1987) is a widely used instrument designed to accomplish the above tasks. It is estimated to be in use by more than 1,300 universities and colleges in the United States (Olaussen & Braten, 1998). LASSI scores have been shown to be positively correlated with grade point average, and the instrument is proposed to be an effective tool for predicting academic performance (Yip & Chung, 2002).

The LASSI is composed of 10 subscales that allow a student to self-report on his or her thoughts, behaviors, and attitudes related to strategic learning. The original version, with 77 items, was published in 1987 (Weinstein et al., 1987), and a second edition, with 80 items, was released in 2002 (Weinstein & Palmer, 2002). The second edition was designed to update the items, incorporate current research findings and changes in educational practice and instruction, broaden the scope of the scales, create equal numbers of items for each

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subscale, improve the inter-item correlations, and create national norms on a more broad-based sample (Weinstein & Palmer, 2002). An analysis of the second edition reveals that all subscales now have 10 items. There are 38 items unchanged from the first edition and 42 items that are unique to the second edition. Of these 42 additions, 12 items appear to be only slightly modified, whereas 30 items appear to be substantially different from the first edition.

A large body of research exists for the first edition of the LASSI. Much of this work has focused on the underlying structure of the test, particularly whether the 10 subscales adequately portray the factor structure. Previous researchers evaluating both college and high school populations have suggested that the 10 subscales might be better explained by a smaller number of factors, with a three-factor model generally being produced (Melancon, 2002; Murphy & Alexander, 1998; Olivarez & Tallent-Runnels, 1994; Samuelstuen, 2003). This notion of a three-factor model appears to have been followed in the new edition of the LASSI. As described by the test authors in the user's manual, "each of these scales are primarily related to one of the components of strategic learning: skill, will, and self-regulation" (Weinstein & Palmer, 2002, p. 4).

The skill component is characterized by thought processes, test preparation, and the ability to integrate new information (information processing, selecting main ideas, and test strategies). The will component measures the degree to which students worry and show interest in their academic performance, are receptive to learning, and show diligence and self-discipline in completing academic requirements (anxiety, attitude, and motivation). The self-regulation component is a function of time management, concentration, and appropriate use of study supports and self-testing (concentration, self-testing, study aids, and time management). The skill, will and self-regulation components have not been empirically documented by the test authors. However, other investigators have conducted exploratory and confirmatory factor analyses (CFAs) of the original LASSI to identify a structural measurement model. Olejnik and Nist (1992) evaluated two groups of 1st-year American college students enrolled in a developmental studies program. A principal components analysis, followed by principal factors method with promax rotation, resulted in a three-factor solution. A cross-validation CFA resulted in a proposed model with three latent variables: effort-related activities (indicated by motivation, time management, and concentration), goal orientation (indicated by concentration, anxiety, test strategies, and selecting main ideas), and cognitive activities (indicated by selecting main ideas, information processing, study aids, and self-testing). The Attitude subscale had low (below .40) but consistent coefficients on all three factors in the exploratory analysis and showed similar low relationships in the final model. Olaussen and Braten (1998) attempted to confirm the Olejnik and Nist (1992) model on two samples of Norwegian college students. They performed exploratory analyses with principal components analysis, resulting in a three-factor solution. Subsequent CFA with modifications refined the Olejnik and Nist (1992) model. The solution proposed by Olaussen and Braten (1998) added two indicators to the link for effort related activities: test strategies and attitude. In addition, a link was added between goal orientation and attitude. The proposed latent variable representing cognitive activities remained the same.

The authors of the revised version of the LASSI (Weinstein & Palmer, 2002) appear not to use these empirically generated models in advancing their theory of skill, will, and self-regulation. There is little similarity between the empirically proposed latent constructs effort-related activities, goal orientation, and cognitive activities and the theorized components of skill, will, and self-regulation. Because research suggests that the underlying structure of the LASSI is best explained by a three-factor model, it is important to validate the specific nature of that model and to determine whether either of the two proposed models can be verified using data from the new version of the LASSI.

The purpose of the current study is to determine whether Weinstein and Palmer's (2002) proposed skill, will, and self-regulation model can be verified through confirmatory factor analysis or whether the model proposed by Olejnik and Nist (1992) and revised by Olaussen and Braten (1998) provides a better fit for the LASSI. Because previous work has used only the LASSI first edition, it is possible that the older theories do not provide a good measurement model for the new version of the LASSI. Alternately, if Weinstein and Palmer's (2002) conceptualization of will, skill, and self-regulation is a valid measurement model for the new LASSI, it is important to provide psychometric evidence of this.

METHOD

Participants

Participants were 297 undergraduate students from a large university in the southeastern United States. To obtain a broad-based sample that would better approximate the national norms, participants were recruited to obtain a wide range of academic achievement. Approximately 47% of the sample was drawn from general education classes (n = 141), whereas the remainder (n = 156) were students who had been referred to a campus assessment center for academic difficulties. These latter students had been either self-referred or referred by an academic adviser and were either failing specific classes or were complaining of general academic difficulties. The mean grade point average (GPA) for the sample was 2.9 (SD=0.56) on a 4-point scale. The LASSI user's manual (Weinstein & Palmer, 2002) does not report a mean GPA for the normative sample; however, 66% of their sample had a GPA of 2.5 to 3.5. For comparison purposes, we calculated the same range, and 58% of the current sample had a GPA of 2.5 to 3.5. Approximately 65% of the present sample was female, which is the same proportion as the normative sample. Participants ranged in age from 18 to 56 years, with a mean age of 24 years (SD = 7.7). This is comparable to the normative sample; both samples are predominantly college- age students.

Procedure

Participants from general education classes were administered the LASSI in a group format during their regular class time. Referred participants completed the LASSI as the initial test in a battery of individually administered measures of academic performance.

RESULTS

Two structural models of the subscale scores were tested with CFA using LISREL 8.51 (Jöreskog & Sörbom, 2001). Model 1 was based on the skill, will, and self-regulation

components suggested by Weinstein and Palmer (2002) and is referred to as the S-W-SR model. The test authors state that there is "some overlap and interaction among and within the components and individual scales" (p. 4). However, they do not designate these relationships; therefore, a model was tested in which each of the subscales served as a single indicator for only one latent variable. That model is as follows:

Skill: information processing, selecting main ideas, and test strategies

Will: anxiety, attitude, and motivation

Self-regulation: concentration, self-testing, study aids, and time management

Model 2 (referred to as the ER-GO-CA) was based on the Olaussen and Braten (1998) refinement of the Olejnik and Nist model (1992), as follows:

Effort-related activities: motivation, time management, concentration, attitude, and test strategies

Goal orientation: concentration, attitude, anxiety, test strategies, information processing, and selecting main ideas

Cognitive activities: selecting main ideas, information processing, study aids, and self-testing

Internal consistencies (Nunnally & Bernstein, 1994), standard error of measurement estimates, and scale means and variances are presented in Table 1. The standard error of measurement is an estimate of error used in interpreting an individual's test score, allowing the reader to estimate confidence bands around an individual's score (McDonald, 1999), and is computed by the formula $SEM = \sigma \sqrt{1 - r_{xy}^2}$. With the exception of study aids (α = .66), all internal consistency reliabilities were greater than .70 and consistent with the normative data. Low to moderate multicollinearity was observed among subscales in the intercorrelation matrix presented in Table 2 for the 10 LASSI subscales. The relationships between selecting main ideas and test strategies (r = .83) and anxiety and test strategies (.70) were stronger. Because the aim of the current study is to estimate the proposed factor structures of two competing models, these subscales remained independent in the study as it was hypothesized that each would have a significant R^2 contribution.

The S-W-SR model (Model 1) was tested using CFA, with the maximum likelihood method of parameter estimation, and with all analyses performed on the variance-covariance matrix. The scale of each latent variable was specified by assuming that the latent constructs are standardized and thus have a variance of 1. To replicate the model proposed by Weinstein and Palmer (2002), the factors were treated as uncorrelated. The three-factor model was associated with $\chi^2(32, N = 300) = 678.59$, $p < .001$, and fit indices as follows: root mean square error of approximation (RMSEA) = .26 (.24, .28; 90% confidence interval), normed fit index (NFI) =.78, comparative fit index (CFI) = .79, and adjusted goodness-of-fit index (AGFI) = .46. The modification indices suggested that large decreases in the chi-square statistic could be obtained by changing numerous paths in the model. Next, the ER-GO-CA model (Model 2) was tested, using similar procedures. However, to replicate the Olaussen and Braten (1998) model, a correlated factors model was tested. This three-factor model was

associated with $\chi^2(27, N = 300) = 118.16$, $p < .001$, and fit indices as follows: RMSEA = .11 (.08, .13;90% confidence interval), NFI = .93, CFI = .95, and AGFI = .85. Interfactor correlations are presented in Table 3. The chi-square statistic for this model was greatly decreased compared to the S-W-SR model. The modification indices suggested the following changes: (a) add paths from goal orientation to motivation and from cognitive activities to time management and (b) set an error covariance between test taking and concentration. Estimated structure coefficients and proportions of variance explained are presented in Table 4.

Because these are not nested models, the chi-square change statistic cannot be used to determine the statistical significance of the relative fit of one model over another. A useful heuristic in this case is the ratio of the χ^2/df. As this ratio decreases and approaches 0, the fit of the model improves (Hoelter, 1983). For model 1, $\chi^2/df = 21.18$, whereas χ^2/df for Model 2 =4.4, indicating a better fit. However, the significant chi-square for Model 2 indicates that residual variance still needs to be explained. RMSEA is a measure of the discrepancy between the reproduced and observed covariances per degree of freedom and should be less than .08 to indicate an adequate fit (Tate, 1998). The value of .11 for Model 2 is high but better than the value of .26 for Model 1. The NFI measures how much better the assumed model fits the data compared to a baseline model and should be greater than .90 (Hu & Bentler, 1999). Model 2 meets this criterion, whereas Model 1 does not. The CFI measures how well the model fits compared to an independence model and should be greater than .90 (Hu & Bentler, 1999). Again, Model 2 meets this criterion, whereas model 1 does not. Finally, the AGFI reflects how much better the assumed model fits the data compared to no model at all, adjusting for the degrees of freedom, and should be greater than .90 (Hu & Bentler, 1999; Tate, 1998). Neither model meets this criterion. In sum, there is support for the adequacy of the ER-GO-CA model, no support for the adequacy of the S-W-SR model, and evidence suggesting that the ER-GO-CA model fits the data better than does the S-W-SR model.

DISCUSSION

The LASSI has recently been released in a second edition, and the test publishers present an underlying structure suggesting that the 10 subscales are primarily related to one of three components of strategic learning: skill, will, and self-regulation (Weinstein & Palmer, 2002). This theoretical model appears to be inconsistent with empirically derived models based on college student populations (Olaussen & Braten, 1998; Olejnik & Nist, 1992). The present study clearly provides stronger support for the empirically derived model, which suggests that the LASSI is composed of three latent variables: effort-related activities, goal orientation, and cognitive activities. Evidence of this stems from poorer fit indices in the S-W-SR model than the ER-GO-CA model, as well as R^2 estimates that explain less variance from the subscales. Although the structure coefficients from the S-W-SR model appear to be comparable to if not stronger in some cases than the coefficients in the ER-GO-CA model, it is important to recognize that these values solely reflect the subscale-factor fit and should not be used to form interpretations about overall model fit. Results from this study raise serious concerns about the S-W-SR model, given the low reliability of study aids and the overall poor model fit of the data.

The ER-GO-CA is a more complex model yet appears to provide better fit of the data. The modification indices in the CFA suggested a further improvement in model fit by adding paths from goal orientation to motivation and from cognitive activities to time management and by setting an error covariance between test strategies and concentration. This exploratory work should best be tested using CFA in an independent sample and was not attempted in the current study. The goal of the current study was to compare the adequacy of two existing models. However, the suggested modifications do raise interesting issues regarding the nature of the LASSI. First, what do the suggested path additions imply about the LASSI? Are they theoretically consistent? Motivation has been shown to be one of the strongest predictors of learning (Ley & Young, 1998), and it is not surprising that it is a component of both the ability to get and keep learning on track (effort-related activities)and the ability to stay calm and concentrated in approaching the goal of mastering study material. Olaussen and Braten (1998) characterized cognitive activities as strategies necessary for processing information and monitoring understanding. Adding time management to this component fits well with this conceptualization. Therefore, it appears as though making these changes would be theoretically viable.

The second suggested modification from the CFA was to free an error covariance between Test Strategies (TS) and Concentration (CON). This modification would suggest that there is a correlation between the variances of the two indicators that is not explained by the latent constructs. An examination of the content of the items on these two scales leads to several possibilities as to what variance in these two scales might be covarying. Items from each subscale appear to be similar in that both reflect time-management: “I end up cramming” (CON) and “I find it hard to plan my work” (TS). Items from each subscale also appear to share a common content involving comprehension: “I find I have misunderstood what was wanted” (TS), “I don’t understand” (CON), and “I have trouble understanding” (TS). Finally, two of the TS items might be interpreted by respondents to indicate concentration rather than a test strategy: “I have trouble figuring out what to do” and “I have difficulty adapting my studying.” Because the items were not originally subjected to factor analysis to determine scale content, one can evaluate the overlap between these scales based only on face validity. However, it is clear that there may be a problem with covariation.

The present work suggests that the ER-GO-CA model should be used. The latent factors underlying study and learning skills are multidimensional and quite complex, with most of the LASSI subtests serving as indicators for more than one latent construct. Practitioners should be aware that effort-related activities and cognitive activities are highly correlated, whereas goal orientation appears more distinct. Goal orientation, in itself a highly complex component, is composed of six different subtests. It appears to tap student’s knowledge about efficient strategies, which perhaps allows the student to maintain an efficient mental attitude (motivated, positive attitude, lack of anxiety). Practitioners should continue to look for patterns among the subtests, determining whether strengths and weaknesses occur at the subtest level or whether there are consistencies with in one of the three components. Helping a student to determine broad goals related to one of the three components can be perceived as more attainable. For example, a deficit in effort-related activities might be re mediated by career exploration, setting short- and long-term outcomes linked to rewards, and cognitive restructuring activities. A deficit in goal orientation might necessitate anxiety reduction

training and motivational strategies. Finally, a deficit in cognitive activities may require specific skill building in the "how-to" learning skills, with study skills training a useful intervention. The ER-GO-CA model demonstrates the interrelated nature of the skills associated with learning and study strategies, suggesting that practitioners will rarely find students with deficits in a single skill area and that improvement in one area is likely to affect functioning in other areas.

Further psychometric evidence is needed. The Olejnik and Nist (1992) sample was composed of students in a developmental studies program. The sample mean GPA of 2.53 suggests a low-performing group of students. Alternately, the sample tested by Olaussen and Braten (1998) was described as having received "very high grades." Although their factor analytic work suggested similar structures, the different samples may well have contributed to differences in their findings. The present study used a sample that better represented the entire range of college students. Future validity work with larger samples is needed to evaluate whether the underlying structure of the LASSI is maintained in samples of different academic ability levels. In particular, is the LASSI a useful tool for evaluating and making recommendations for college students with very low achievement or for those with a documented learning disability? It will also be important to determine whether the proposed latent constructs can be used to predict important learning outcomes such as GPA, graduation, or competency exams. If so, then early identification of at-risk students can facilitate early treatment planning and academic interventions.

Limitations

The present findings are limited by the lack of cross-validation. Although the model fit indices are all good, the resulting factor loadings on some of the paths are low, and some improvements might be made. It should be emphasized that measures such as χ^2 and AGFI are measures of the overall fit of the model to the data and do not express the quality of the model by any other criteria (Bentler & Chou, 1987). In addition, although the present results suggest a model fit that may be appropriate for hypothesis testing, this model may not be practical for the purpose of easily generating factor scores that can be used in applied settings. A model based on simple structure (with each subscale allowed to serve as an indicator for only one latent variable) might be more useful in applied settings. Given the widespread use of the LASSI on college populations, it is important to provide evidence for the new version of this test.

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Table 1

Reliability and SEM Estimates for Learning and Study Strategies Inventory Subscales

Subscale	Cronbach's Alpha	SEM	Mean	Scale Variance
Anxiety	.89	.27	23.29	66.39
Attitude	.71	.26	31.29	22.95
Concentration	.90	.23	24.57	55.68
Information Processing	.78	.25	27.74	28.79
Motivation	.86	.23	30.35	37.48
Self-Testing	.82	.27	24.17	39.94
Selecting Main Idea	.91	.23	27.09	54.41
Study Aids	.66	.32	24.76	34.09
Time Management	.86	.26	23.61	47.22
Test-Taking Strategies	.84	.26	27.90	41.71

Note: SEM = standard error of measurement.

Table 2

Interscale Correlations

Subscale	Anxiety	Attitude	Concentration	Information Processing	Motivation	Self- Testing	Selecting Main Ideas	Study Aids	Time Management
Anxiety									
Attitude	.22**								
Concentration	.53**	.54**							
Information Processing	.18**	.37**	.38**						
Motivation	.31**	.58**	.60**	.52**					
Self-Testing	.08	.42**	.46**	.63**	.56**				
Selecting Main Idea	.65**	.28**	.59**	.26**	.40**	.20**			
Study Aids	−.13*	.33**	.20**	.35**	.41**	.54**	−.03		
Time Management	.15*	.50**	.60**	.40**	.56**	.61**	.16**	.48**	
Test-Taking Strategies	.70**	.35**	.64**	.25**	.44**	.21**	.83**	.003	.28**

* $p < .05$,

** $p < .01$.

Table 3

Factor Correlations for Model 2

Factor	F1	F2
F2	.79**	
F3	.33*	.07

Note: F1 = Effort-Related Activities; F2 = Cognitive Activities; F3 = Goal Orientation.

* $p < .05$,

** $p < .01$.

Table 4

Competing Models' Factor Loadings

	Weinstein (Model 1)				Olaussen [a] (Model 2)			
Subscale	**Skill (λ)**	**Will (λ)**	**Self-Regulation (λ)**	R^2	**ER (λ)**	**CA (λ)**	**GO (λ)**	R^2
Anxiety		.50[b]		.25	.04	.36	**.76**[b]	.57
Attitude		.64[b]		.41	**.65**[b]	.29	**.05**	.45
Concentration			.75[b]	.56	**.61**[b]	.32	**.41**	.71
Information Processing	.30[b]			.09	.26	**.67**[b]	**.14**	.48
Motivation		.77[b]		.59	**.78**	.60	.43	.62
Self-Testing			.72[b]	.51	.06	**.91**[b]	.56	.82
Selecting Main Idea	.88[b]			.77	.19	**.13**[b]	.87[b]	.79
Study Aids			.51[b]	.26	.09	**.61**[b]	.38	.37
Time Management			.80[b]	.64	**.78**[b]	.15	.56	.61
Test-Taking Strategies	.94[b]			.89	**.17**[b]	.46	**.87**[b]	.87

[a] Effort-related activities (ER), goal orientation (GO), and cognitive activities (CA) are structure coefficient estimates. Bolded values are the estimates indicative of the factor structure proposed in Model 2.

[b] Structure coefficients statistically significant at $z > 2$.