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A PSYCHOMETRIC ANALYSIS OF KOLB'S REVISED LEARNING STYLE-INVENTORY

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ABSTRACT

This study investigated the psychometric properties of Kolb's 1985 revision of the Learning-Style Inventory (LSI). The LSI was revised to overcome some of the psychometric limitations of the original instrument. Results from this study suggest that the internal consistency of the LSI has been improved but some of this gain may be due to a response set. Despite gains in internal consistency, factor analysis failed to support the bi-polar assumptions of the LSI. Additional studies are recommended to clarify the validity of the LSI and the bi-polar view of experiential learning, which provides the rationale for the LSI.

INTRODUCTION

The Learning-Style Inventory (LSI) was introduced in the 1970s by David Kolb (Kolb, 1974) to measure an individual's use of four different learning abilities: (1) concrete experience (CE), (2) abstract conceptualization (AC), (3) reflective observation (RO), and (4) active experimentation (AE). The LSI was based on the Experiential Learning Model (ELM), a two dimensional model for classifying learning styles corresponding to different stages in the learning process. The ELM assumed that CE and AC were opposite abilities as were RO and AE. Thus, the model proposed two separate, bi-polar dimensions in experiential learning. Since its introduction, the instrument and model have generated interest in a wide range of disciplines and over 200 references recently have been documented (Smith & Kolb, 1986).

The original LSI was criticized as having a variety of psychometric limitations (Certo & Lamb, 1980; Freedman & Stumpf, 1978; Lamb & Certo, 1978; Merritt & Marshall, 1984; Ruble, 1978; Sims et al., 1986). Recently, however, the LSI has been revised to overcome some of the problems of the original version (Kolb, 1985; Smith & Kolb, 1986). The revised version, LSI-1985, has 12 blocks of four items. Each block has one item representing each of the four learning abilities. Individuals are asked to rank order the four items to describe their preferred approach to learning. The items are arranged in four columns on one page so that all items for a single scale are in the same column. The columnar format is designed to facilitate self-scoring.

Early research on the revised LSI indicates that some improvement in the psychometric properties has been achieved. For example, a fundamental problem with the original LSI was the reliability of the scales. With 12 items per scale, the revised LSI is twice the length of the original version. Studies of the revised LSI indicate that coefficient alpha reliability estimates for individual scales range from .73 to .86 with an approximate average in the low .80s (Sims, Veres, & Shake, 1989; Sims, et al., 1986; Smith & Kolb, 1986; Veres, Sims, & Shake, 1987). Although these coefficients represent a substantial improvement in internal consistency over the original, it has been recognized that some of this gain may be due to a

response set created by the columnar-scoring format (Sims et al., 1986; Smith & Kolb, 1986).

Despite the improvement in internal consistency, studies examining test-retest reliability and classification stability have not been encouraging. The few studies to date have found rather low test-retest correlations with the time intervals ranging from nine days to five weeks (Atkinson, 1988; Sims, et al., 1986; Veres, Sims, & Shake, 1987). However, these results may reflect the dynamic nature of different learning situations and further research is needed to clarify the classification stability of the revised LSI.

After the reliability of the LSI-1985 has been examined, the next issue is construct validity. Construct validity is based on the extent to which the revised LSI measures constructs consistent with the two bipolar dimensions proposed by the ELM. Factor analyses of the original LSI yielded mixed results (cf., Ferrell, 1983; Freedman & Stumpf, 1978; Merritt & Marshall, 1984). However, some studies suggested that support for the bi-polar model was based on instrument bias due to the ranking method of scoring (Certo & Lamb, 1980; Freedman & Stumpf, 1978; Ruble, 1978). At this writing, the authors are not aware of research on the factor structure of the revised instrument. However, one study has reported a correlation matrix of the four scales, which suggests that the revised LSI may not represent two separate, bi-polar dimensions (Highhouse & Doverspike, 1987).

The present study investigates the psychometric characteristics of the revised LSI. First, we examine the internal consistency of the four scales (CE, AC, RO, AE). Next, the study focuses on the construct validity of the instrument. Construct validity can be assessed in part by examining the pattern of inter-correlations of the four scales. However, factor analysis provides a more comprehensive view of the pattern of interrelationships among all the items and provides a basis for judging the efficacy of the revised LSI in representing the two-dimensions proposed by the ELM.

METHOD

Subjects

Three hundred twelve upper division business students participated in the study. The sample was heterogeneous in terms of site of school and geographical distribution. Approximately 53% of the subjects were male.

Procedure

The LSI was administered with another instrument as part of a larger study. The additional questionnaire was a 60 item, forced-choice psychological instrument. This questionnaire took approximately 15 minutes to complete. Approximately half of the

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subjects completed the LSI first ($n=149$) while the remainder completed the LSI after the companion questionnaire ($n=163$). Completing the LSI with a second instrument allows an assessment of order effects or fatigue in self-reports of learning style.

RESULTS

Descriptive Statistics

Table 1 presents a comparison of the scale means and standard deviations of the current sample with the normative sample provided in the LSI user's guide (Smith & Kolb, 1986). The descriptive statistics are very close to those reported by Smith and Kolb in that the order of preference (AE, AC, RU, CE) is the same and the means and standard deviations are close for the AE, AC, and RU scales. The current sample had a slightly lower mean score and higher standard deviation on the CE scale.

Reliability

Coefficient alpha was used to estimate the internal consistency of the scales. The coefficients for different orders of completing the Instruments are presented in Table 2. The reliabilities are very close to the reliabilities reported by other investigators (Sims, Veres, & Shake, 1989; Sims, et al., 1986; Smith & Kolb, 1986; Veres, Sims, & Shake, 1987).

TABLE 1
DESCRIPTIVE STATISTICS FOR LSI

	Current Sample		Normative Sample	
Scale	M	SD	M	SD
CE	23.7	7.9	26.0	6.8
AC	31.9	7.1	30.3	6.7
RO	30.3	6.8	29.9	6.5
AE	34.1	6.9	35.4	6.9

Note: Statistics for the normative sample from Smith & Kolb, 1986 ($n=1,446$).

The effects of order had little impact on reliabilities of CE, RO, and AE. However, coefficient alpha for AC increased from .77 when the LSI was completed before the other instrument to .86 when the LSI was completed after. Given the single-scale-per-column format, it may be easier to follow a pattern if one gets tired or bored with ranking items.

Construct Validity

To assess Construct validity, we examined first the intercorrelations of the four scales and then used factor analysis to provide more insight on the underlying relationships of all the items.

Intercorrelations

The intercorrelations of the scales are presented in Table 2. The results indicate that the four scales show moderate, negative correlations in all Cases. Given the ranking format of the LSI, the negative correlations are expected. However, given the bi-polar assumptions of the ELM, the magnitudes of the correlations are not expected. The ELM would be supported if the proposed bi-polar pairs showed stronger negative correlations with each other (CE with AC and RU with AE) and weaker correlations with the non-

TABLE 2
RELIABILITY AND INTERCORRELATIONS OF LSI SCALES

	Coefficient Alpha		Intercorrelations		
	Order First	Order Second	Scale AC	Scale RO	Scale AE
CE	.85	.85	-.39	-.36	-.38
AC	.77	.86		-.29	-.29
RO	.79	.81			-.28
AE	.82	.81			
n	149	163			

Note: Decimals omitted. All correlations significant at $p < .001$, two-tailed.

opposite scales. Clearly, this expected pattern did not emerge. The correlation of CE with AC was -.39 and RU with AE was -.28. The remaining correlations of the non-opposite scales ranged from -.29 to -.38. All the correlations were significant at $p < .001$, two-tailed.

Factor Analysis

Principal components factor analysis with Varimax rotation was used to assess whether the LSI measures the bi-polar dimensions proposed in the ELM. Separate analyses were performed for a two-factor solution and a four-factor solution. A two-factor solution was extracted because the ELM proposes two bi-polar dimensions. Thus, the two-factor solution would be most relevant to examine the construct validity of the LSI. A four-factor solution was extracted also because the ELM proposes four distinct learning abilities.

One criticism of the original LSI was that the two factors extracted in factor analysis accounted for a relatively small proportion of total measured variance (Freedman & Stumpf, 1979; 1980). In the present study, the two-factor solution accounted for 28.4% of the total variance. This represents a small gain over the 20.6% reported by Freedman and Stumpf (1978). However, some of this gain may be explained by a response set resulting from the single-scale-per-column format. Regardless, these results do not provide much support for the efficacy of the revised LSI as a measure of the two bipolar dimensions. In the four-factor solutions, the third factor accounted for an additional 11.5% of the total variance while the fourth factor accounted for little additional variance at 5.0%.

Factor Patterns

Table 3 presents the results of the rotated factor patterns extracted by the two separate analyses. The two-factor solution essentially yielded one factor of CE items and one factor of AC items. Only three items from the AE scale and none of the RU items appeared in the two-factor solution. Given these results for the two-factor solutions, it would appear that the revised LSI does not represent the expectations based on the ELM. To support the assumptions of the bi-polar model, CE items and AC items should have loaded together on one factor while RU items and AE items loaded together on the other factor. On each factor, one set of items should be positive while the other set should be negative (polar opposites).

In the four-factor solution, the AC, RO, and AE scale Items separately loaded on one, and only one, factor. The CE items had weaker factor loadings and loaded on two different factors. Thus, three of the four

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TABLE 3
ROTATED FACTOR PATTERNS

Item	2-Factor		4-Factor			
	I	II	I	II	III	IV
ce1	-81		-50	-50		
ce2	-79		-54			
ce3	-67		-50			
ce4	-88		-54	-52		
ce5	-52					
ce6	-63					
ce7	-58					
ce9	-82					
ce12						-66
ac1		55			55	
ac2		65			65	
ac3	56				66	
ac4		60			63	
ac5					57	
ac6		63			70	
ac7		57				
ac9		60			53	
ac10		52			66	
ac11		67			58	
ac12		57			60	
ro1			72			
ro2			73			
ro4			72			
ro6			73			
ro7			72			
ro9			66			
ro11			65			
ae1				64		
ae2				57		
ae4				75		
ae5		-52		56		
ae6				62		
ae7				70		
ae8	61			58		
ae9	52			70		
ae11				60		

Note: Decimal points omitted.
Items loading < .50 are not listed.

learning abilities seem to be measured distinctly while the fourth ability, CE, is somewhat ambiguous.

DISCUSSION

To be valid, a psychological instrument must first be reliable. The original LSI had such low reliability estimates that assessments of construct validity were actually premature. Given the evidence of improvement in the internal consistency of the revised LSI, research can now consider construct validity. For the revised LSI, construct validity includes the issue of whether the instrument represents the two bi-polar dimensions proposed by the ELM. The results of the present study do not support the construct validity of the revised LSI. Examinations of the matrix of intercorrelations and factor patterns did not yield evidence of two separate bi-polar dimensions.

Future Directions

Clearly, one study can neither confirm or reject the hypothesized relations between the LSI and ELM. However, the present study raises questions for future research: (1) what is the effect of the

possible response set on the LSI's reliability? (2) Are the learning abilities two bi-polar tendencies or four separate learning styles? (3) Does the revised LSI provide the best approach for measuring learning styles? These are just some of the issues as we rethink the roles of the LSI and ELM in experiential pedagogy.

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