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A PSYCHOMETRIC ANALYSIS OF KOLB'S LEARNING STYLES INVENTORY

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Kolb's Learning Styles Inventory (LSI) [4,6] was developed to measure an individual's use of four different learning abilities: Concrete Experience (CE), Reflective Observation (RU), Abstract Conceptualization (AC), and Active Experimentation (AE). These learning abilities are related to four stages (CE, RO, AC, AE) in a continuous cycle of learning. According to Kolb, these four abilities represent the extremes of two basic dimensions of learning. The first dimension is a concrete! abstract dimension (CE versus AC) while the second dimension is an active/reflective dimension (AE versus RU).

To measure the four learning abilities, Kolb developed a self-description questionnaire consisting of nine sets of four words (items). A respondent is required to rank order each set of four items without having any ties. Of the 36 items, only 24 are used in constructing scale scores (six per scale). Apparently, the ranking format is used to require the respondent to "resolve the tensions" that exist between learning abilities that are viewed as "polar opposites."

The LSI is apparently gaining in popularity as both a pedagogical device [2, 6, 11] and instrument for research [1, 10, 11, 12]. Unfortunately, the increasing use of the LSI has occurred despite a paucity of information on the psychometric properties of the instrument. That is, the basic question of the internal consistency, or reliability, of the LSI has been neglected. Since reliability is a necessary condition for developing a valid instrument [8, p. 173], the present study focuses on the internal properties of the LSI. Two main issues are investigated: (1) the internal consistency of the four scales (CE, AC, RO, AE) and (2) the pattern of relationships among the items (e.g., the dimensions, or factors, which account for the interrelationships).

METHOD

Two forms of the LSI were analyzed. The first was the standard LSI [6]. The second form required the subject to rate each item on a six point scale from "strong disagreement" (1) to "strong agreement" (6). All 36 items were rated but, as in the standard LSI, only 24 were used to construct the scale scores. The ranking format was completed by 166 MBA students and the rating format was completed by 544 business students including both graduates and undergraduates.

The alternate format (rating) was investigated because the ranking format essentially "forces" the data to fit into two opposing dimensions. First, the ranks are not independent for the items within each set of four. In this case, negative correlations are "forced." Once a high choice is made, each successive choice must be lower. Second, not all items are included in the scoring. If two items are scored from a set of four, those items will be negatively correlated. Further, if those two items are taken from the same "dimension" (e.g., AC versus CE), there is a built-in bias toward obtaining results that "confirm" the prediction of "polar opposites." The rating format should allow a less biased test of the "polar opposite" prediction.

RESULTS

Reliability

Kolb [4] reports "reasonable reliability coefficients" based on a "split-half" method of estimating reliability. However, Nunnally [8] points out that estimates of reliability based on the split-half method will vary depending on how the items are divided. Nunnally considers coefficient alpha to be "the basic formula for determining the reliability based on internal consistency" [8, p. 210]. Thus, coefficient alpha was used as a measure of reliability for the four measures of learning abilities. In addition, Nunnally's formula for estimating the reliability of linear combinations [8, p. 230] was used as a measure of the reliabilities of the dimension scores (AC-CE and AE-RO). The reliability coefficients are presented in Table 1. The reliabilities for the measures of the four learning

Table 1

Reliability Coefficients for LSI Scales

	Scales					
Format	CE	AC	RO	AE	AC-CE	AE-RO
Ranking	.46	.59	.53	.34	.71	.63
Rating	.47	.68	.52	.59	.44	.40

abilities are disappointing low. These low reliabilities suggest that use of the separate sub-scales may be questionable for purposes of basic research or individual counseling (including individual feedback) [see 8, p. 226 and 9, p. 29].

The estimates of reliability for the combination scales are somewhat higher under the ranking format and somewhat lower

under the rating format. However, the reliabilities of the combination scales must be interpreted with caution. Reliabilities of linear combinations are sensitive to intercorrelations of the component variables (e.g., sub-scales) [see 8, pp. 226- 231]. In the present case, the increased reliabilities under the ranking format are primarily due to negative correlations between the relevant sub-scales (CE with AC and AR with RU). However, as noted earlier, these correlations are not based on independent measures. Thus, it is quite likely that the coefficients reported for the ranking format overestimate the reliabilities of the combination scales.

The lower reliabilities under the rating format are also due to intercorrelations of the relevant sub-scales. However, in this case, the lower reliabilities reflect positive inter- correlations. Because the intercorrelations are important to both reliability and the prediction of "polar opposite" dimensions, it will be useful to consider the pattern of intercorrelations of the separate sub-scales.

Intercorrelations of LSI Scales

The intercorrelations matrices are presented in Table 2.

Table 2

Intercorrelation of LSI Scales

	Ranking				Rating			
Scale	CE	AC	RO	AE	CE	AC	RO	AE
CE		-.62*	.06	-.09		.25*	.41*	.43*
AC			-.25*	-.08			.29*	.47*
RO				-.51*				.26*

*p<.001

The "forced" negative correlations under the ranking format are apparent (3 of 6 are significant at $p < .001$). In contrast, all of the correlations under the rating format are positive (all are significant at $p < .001$). Thus, the rating data do not confirm the prediction of "polar opposites". One explanation for these results is that individuals may not have to choose between opposing tensions. Rather, it may be possible to be high on many learning abilities or low on many abilities (e.g., some people may be "better" learners than other people). Another explanation, however, is that the rating format elicits a strong response set toward agreement with all items. Further research in this area may clarify the value of a rating format versus a ranking format.

Factor Analysis of LSI Items

Examining the intercorrelation matrices provide only one approach to identifying the dimensions measured by the LSI. Factor analysis provides an alternative method for investigating the pattern of relationships among the items. Thus, a factor analysis was performed using programs from SPSS [7]. With one exception, the recommended method (principal-factors) and "default" options (e.g., Varimax orthogonal rotation) were chosen to control the factor analysis. This procedure represents a "well accepted" [7] approach to analyzing the data. The one exception was the specification of a two-factor solution (since Kolb predicts two basic dimensions). The results of the factor analysis for the ranking data and rating data are presented in Table 3.

Table 3

Factor Loadings of LSI Items

Ranking Format

Item	Sub-scale	Factor I	Factor II
Practical	AE	44	
Doing	AE	75	
Intuitive	CE	-43	
Active	AE	40	
Reflecting	RO	-48	
Reserved	RO	-46	
Analytical	AC		-48
Thinking	AC		-56
Accepting	CE		43
Evaluative	AC		-57
Rational	AC	40	-42

Rating Format

Item	Sub-scale	Factor I	Factor II
Practical	AE	40	
Analytical	AC	48	
Thinking	AC	46	
Evaluative	AC	44	
Logical	AC	63	
Pragmatic	AE	45	
Rational	AC	61	
Responsible	AE	42	
Feeling	CE		43
Watching	RO		65
Observing	RO		58
Observation	RO		60
Experimentation	AE		40

Note: Decimal points omitted; Loadings <.40 are not shown

The results for the ranking data indicate that only 10 of the 24 items loaded primarily on one of the two factors (one of the items loaded on both factors). This suggests that most of the LSI items do not represent two major dimensions. However, the two dimensions that emerged did seem to reflect the dimensions proposed by the four-stage model. Factor I reflected an active/reflective dimension and Factor II reflected a concrete! abstract dimension. Unfortunately, the "forced" nature of the ranking format may have contributed to this pattern of interrelationships.

The results for the rating data yield a somewhat different pattern of relationships. In this case, the major factor appears to reflect a combination of AC and AE, a learning style labeled "convergent" by Kolb [5]. In any event, the dimensions predicted by Kolb were not identified by the factor analysis.

SUMMARY AND DISCUSSION

The present research raises serious questions about the value of the LSI as a research and pedagogical instrument. Sub- scale reliabilities were quite low. Moreover, the reliability coefficients of the combination (dimension) scores were probably overestimated in the case of the ranking format. Finally, the factor analysis indicated that the two major dimensions of learning were only partially represented by the items currently included on the LSI.

The present research also raises questions regarding the validity of the proposition that certain learning styles are "polar opposites." The results obtained from the rating format suggest that learning abilities may be related in a positive manner. More research is needed on this issue to separate the effects of method (ranking versus rating) from the phenomenon under investigation.

Despite the relatively pessimistic assessment of the LSI in its current form, the present results suggest that further research may be beneficial. Changing from a ranking format to a rating format increased the average reliability of the sub- scales from .48 to .57 (with a change in the AE scale from .34 to .59). If the sub-scales are not combined to form dimension scores, an improved rating format may further enhance reliabilities. However, the rating format yielded quite low reliabilities for the combination of sub-scales. Again, more research is needed on the issue of "polar opposites" to determine whether combined sub-scales are warranted. Finally, Nunnally [8] has suggested that reliabilities of .50 or .60 are adequate in the early stages of instrument development. Thus, further research may lead to the development of a more adequate measure of learning styles.

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