DOCUMENT RESUME

ED 466 696 TM 034 275

AUTHOR Hwang, Dae-Yeop; Henson, Robin K.

TITLE A Critical Review of the Literature on Kolb's Learning Style Inventory with Implications for Score Reliability.

PUB DATE 2002-02-14

NOTE 29p.; Paper presented at the Annual Meeting of the Southwest Educational Research Association (Austin, TX, February 14-16, 2002).

PUB TYPE Information Analyses (070) -- Speeches/Meeting Papers (150)

EDRS PRICE EDRS Price MF01/PC02 Plus Postage.

DESCRIPTORS *Cognitive Style; Meta Analysis; Psychometrics; *Reliability; Scholarly Journals; *Scores; *Test Use

IDENTIFIERS *Learning Style Inventory (Kolb)

ABSTRACT

The Learning Style Inventory (LSI; Kolb, 1976; 1985) is a commonly used measure of learning styles based on Kolb's Experiential Learning Model. The psychometric soundness of LSI scores has been critiqued historically. This study reviewed the literature on the LSI and evaluated the psychometric properties of Kolb's original and revised versions of the LSI. Researchers identified 110 articles that used the LSI. Fifty-nine articles made no mention of reliability, and slightly fewer than a third of these reported reliability for the obtained scores appropriately. Findings indicate that continued use of the LSI should be considered questionable. Reliabilities can vary as researchers administer the instrument across different settings. Thus reliability generalization may be warranted to examine score reliability meta-analytically across studies. Based on the work of L. Vacha-Haase, this study discusses the possibility of examining the variance of measurement error across studies as part of the literature review. (Contains 2 tables and 68 references.) (Author/SLD)

Running head: KOLB'S LSI

A Critical review of the Literature on Kolb's Learning Style Inventory with Implications for Score Reliability

Dae-Yeop Hwang

Robin K. Henson

University of North Texas

Paper presented at the annual meeting of the Southwest Educational Research Association, February 14, 2002, Austin, TX.

Abstract

The Learning Style Inventory (LSI) is a commonly employed measure of learning styles based on Kolb's Experiential Learning Model. Nevertheless, the psychometric soundness of LSI scores has historically been critiqued. The present article reviews the literature and critically evaluates the psychometric properties of Kolb's original and revised versions of LSI. Reliabilities can vary as researchers administer the instrument across different settings. Thus, reliability generalization (RG) may be warranted to meta-analytically examine score reliability across studies. Based on Vacha-Haase (1998), this study will discuss the possibility of examining the variance of measurement error across studies as part of the literature review.

A Critical Review of the Literature on Kolb's Learning Style Inventory with Implications for Score Reliability

The study of individual learners' preferences or styles is an appealing concept for educators (cf., De Bello, 1990). Many researchers make an a priori assumption that learning style is measurable (e.g., Cross, 1976; Keefe, 1979), and a number of theories and resulting instruments have been developed (De Bello, 1990). Researchers have used these theoretical frameworks and inventories in diverse disciplines and have attempted to correlate learning style or preference with many other variables (Geller, 1979).

Kolb's Experiential Learning Model (ELM)

Historically, one of the more popular theoretical models of learning style has been Kolb's (1976) ELM. The ELM depicts learning as a cyclic process involving four modes: (a) concrete experience (CE), (b) reflective observation (RO), (c) abstract conceptualization (AC), and (d) active experimentation (AE). According to the theory, the effective learner typically participates in new experiences (CE) and then reflects upon these experiences (RO) in order to develop informal theories (AC). Then, the learner uses these theories to make decisions or solve problems (AE).

Kolb (1976) further proposed that CE and AC, as well as RO and AE, represented polarized abilities that lie on different

ends of a continuum. These two dimensions were also hypothesized to be orthogonal. Although the ideal learner integrates and utilizes all four abilities, the average learner favors one ability on each dimension. Consequently, from the combination of an individual's ability on abstractness over concreteness (AC-CE) and action over reflection (AE-RO), an individual is assigned to one of four learning styles: (a) Assimilator (AC and RO), (b) Converger (AC and AE), (c) Accommodator (CE and AE), or (d) Diverger (CE and RO). The reader is referred to Atkinson (1991), Kolb (1974, 1976, 1985), and Pickworth and Schoeman (2000) for broader discussions of the ELM.

The Learning Styles Inventory (LSI)

To operationalize his theory, Kolb (1976, 1985) developed the LSI as a measure of learning style, which enabled the classification of individuals into of the four dominant styles noted above. The LSI is one of the more commonly used instruments in this area continues to be employed in recent years (cf. Chou & Wang, 1999; Geiger & Boyle, 1992; Yuen & Lee, 1994).

Based largely on the work of Kolb himself, Geller (1979) noted that even early on:

The inventory has been used to examine relationship between

> learning style and age (Kolb, 1971, 1976), sex (Kolb, 1976), educational level (Kolb, 1971, 1976), undergraduate major (Kolb, 1971, 1974, 1976), creativity (Kolb, 1976), personality (Kolb, 1976), occupation (Kolb, 1971, 1976), career choice (Kolb, 1976; Kolb & Fry, 1974; Plovnick, 1975; Sadler, Plovnick, & Snope, 1978; Wunderlich & Gjerde, 1978), career-choice influences (Plovnick, 1975; Wunderlich & Gjerde, 1978), approach to management education (Kolb, 1974), creating and maintaining an effective learning organization (Kolb, Rubin, & McIntyre, 1971), communication among different functional units in an organization (Kolb, 1974), and preference for a particular instructional method or learning situation (Kolb, 1976; Sadler, Plovnick, & Snope, 1978; Whitney & Caplan, 1978). (p. 556)

With a more recent revision of the LSI (Kolb, 1985), the inventory has enjoyed a relatively long tenure of use. However, as noted below, the LSI has also been severely criticized regarding its psychomtric properties.

Original/revised versions of the LSI

The first formal version of the LSI appeared in 1976 (Kolb, 1976); the inventory was revised in 1985 (Kolb, 1985). The original LSI (1976) consisted of nine items of four words representing each experiential style. Respondents rank order their preferences concerning the four words in each row that

corresponded to Kolb's four learning styles: CE, RO, AC, and AE. The original LSI used only six items in each column and three items per column served as distracters and were omitted from scoring.

The 1976 version was subject to psychometric critique that largely centered poor score reliability (see e.g., Geller, 1979; Wilson, 1986). Kolb (1985) therefore revised the format and scoring of the instrument, resulting in twelve rows of four sentence completion items that related to the four learning styles. Respondents again rank order their preferences on the four sentences in each row from 1 to 4. Unlike the prior version, all 12 items are used in scoring with no distracters. Further, each column represents a single style (i.e., CE, RO, AE, AC), leading some to suggest the risk of a response-set bias (Atkinson, 1988, 1989; Ruble & Stout, 1990, 1991; Sims, Veres, Watson, & Buckner, 1986; Veres, Sims, & Shake, 1987).

In spite of apparent face validity and frequency of use, both versions of the LSI have been attacked as regards the validity and reliability of their scores. Previous measurement studies have addressed several psychometric problems such as the use of ipsative scoring (cf. Merritt & Marshall, 1984), questionable factor structure (cf. Geiger, Boyle, & Pinto, 1992, 1993), response-set bias (cf. Ruble & Stout, 1994), and reliability and validity (cf. Atkinson, 1991).

Issues with ipsativity

Cattell (1944) coined the term "ipsative", referring to "measures that can be meaningfully interpreted intraindividually, as contrasted with 'normative' measures that can be interpreted interindividually" (Pedhazur & Schmelkin, 1991, p. 21). Essentially, ipsative measures require respondents to rank order responses, thus representing ordinal data that does not contain information regarding magnitude between observations. Both versions of the LSI use a rank order format for rating preferences for words (1976) or sentences (1985).

Importantly, the ranking is not an ordering of individuals on a trait (e.g., highest in concreteness, next, and so on), but rather is performed within the individual as respondents rank sets of items (i.e., CE, RO, AE, AC) from 1 to 4. Accordingly, responses to one item will necessarily be dependent on responses to other items in the set. Furthermore, the ipsative nature of this ranking creates artifactual negative correlations among measured attributes, because when a person ranks one attribute as 1, other attribute ranks must be higher than 1. Of course, the converse of this would be true as well, creating a situation where low scores on one attribute tend to correspond to higher scores on the other attribute. Table 1 provides a heuristic example (adapted from Cornwell and Dunlap [1994, p. 91]) of this problem for five subjects across the four scales in the LSI and

illustrates the tendency for the negative interdependence of the correlations.

INSERT TABLE 1 ABOUT HERE

Reliability Issues

Because ipsative scores are interdependent, they have limited value for many psychometric purposes. As noted, artifactual negative interdependence is a function of the scoring method. This limits the factorability of ipsative scores and can yield artificial bipolar factors, such as those proposed by Kolb (1976, 1985) (i.e., AC-CE and AE-RO). Accordingly, the validity of LSI scores has been questioned (Atkinson, 1991; Cornwell, Manfredo, & Dunlap, 1991; Ruble & Stout, 1994; Wilson, 1986). Cornwell and Dunlap (1994) and Hicks (1970) provide useful summaries of the limitations of ipsative scores.

Importantly, the 1976 LSI did not use all items in the final scoring due to the inclusion of distracters; the 1985 LSI scored all items. Some authors have therefore characterized the 1976 version as partially ipsative and the 1985 version as completely ipsative (cf. Ruble & Stout, 1994). Logically, the negative interdependence noted above would be most pronounced in fully ipsative data (Hicks, 1970).

The LSI has also been challenged on reliability grounds. Atkinson (1991), Geller (1979), Pickworth and Schoeman (2000),

Ruble and Stout (1990, 1994), Sims et al. (1986), and others have discussed the historical reliability of LSI scores for both versions. The notable number of published psychometric reviews speaks to both the wide use of the LSI and the debate surrounding its measurement quality.

The 1976 LSI appeared to yield scores with marginal internal consistency and poor test-retest reliability. Scores from the 1985 LSI appeared to have stronger, perhaps acceptable, internal consistency but continued to have poor, perhaps even worse, temporal stability. However, the interpretation of LSI score reliabilities is confounded with the ipsative nature of the scoring. Tenopyr (1988) demonstrated the artifactual reliability possible for multiple forced choice scales. Ruble and Stout (1994) further argued that the internal consistency improvement for 1985 LSI scores was inflated due to the fully ipsative nature of the scoring, as against the 1976 version which was only partially ipsative.

Another possible reason for reliability inflation in 1985 LSI scores is response bias (Atkinson, 1991; Sims et al., 1986; Wilson, 1986). For the LSI, response bias may be caused by the simplified scoring format for the same learning mode in the same column. Wilson (1986) examined this possibility with three different LSI versions: standard items, randomized items, and elaborated items. Wilson noted that the randomized and

elaborated versions produced less reliable scores than the standard version for both test-retest stability and internal consistency. He suggested that correlation for standard version might be inflated by response bias.

Validity Issues

Several studies have assessed construct validity of LSI scores using factor analysis. Factor analysis examines the internal structure of an instrument, which is relevant to the assessment of construct validity (Nunnally & Burstein, 1994; Thompson & Daniel, 1996). Kerlinger suggested that the misunderstanding of ipsative measures might lead to false interpretation of factor analysis. The ipsative format of the LSI can cause spurious negative correlations among the items and distort factor analysis results.

Kolb (1976b) proposed a bipolar two-factor structure in his ELM. Extant factor analytic studies provide confused results about these bipolar dimensions in the LSI. Given Kolb's theory, factor analysis should not extract four distinct factors (i.e., one for each style) but two orthogonal factors (i.e., one for each dimension). The extraction of four distinct factors suggests that the learning abilities are independent. Unless the two bipolar factors are the result of spurious negative intercorrelations caused by ipsative scales, a two-factor

solution would support two bipolar dimensions of learning proposed by the ELM while four independent factors would not.

Certo and Lamb (1980) compared the ipsative scales with normative (Likert) scales in their study. The ipsative version provided a two-factor structure, but the normative version did not. Further, Merritt and Marshall (1984) found a four-factor structure with the normative instrument, rather than the two bipolar dimensions posited by the ELM. They concluded that the normative form supports construct validity of the LSI.

Cornwell, Manfredo, and Dunlap (1991) provided both two-factor and four-factor solutions, with results unsupportive of Kolb's two bipolar dimensions. Geiger, Boyle, and Pinto (1992) also provided two-factor and four-factor solutions. In the two-factor solution, CE and RO items tended to weight together, as did AC and AE items. In the four-factor solution,

Geiger, Boyle, and Pinto (1993) used the standard LSI (ipsative format) of the 1985 version and a modified version (normative format). In the two-factor structure, CE items and RO items tended to weight together, while AC items and AE items tended to weight together. In the four-factor structure, only the AC items weighted as a distinct factor. Their results did not support the hypothesized bipolar dimensions.

According to the bipolar assumptions of the ELM, the opposite scales (i.e., CE with AC and RO with AE) should have

strong negative correlations with each other and the orthogonal ("not-opposite") scales (i.e., CE with RO, AE with AC, CE with AE, and RO with AC) should have zero (or near zero) correlations. However, previous studies have observed negative correlations of a given style with other "non-opposite" styles (Highhouse & Doverspike, 1987; Ruble & Stout, 1990; Smith & Kolb, 1986). Thus, the pattern of intercorrelations of scores from the revised 1985 version of the LSI tends not to support the bipolar structure of the ELM.

Implications for Score Reliability

Although several reviews exist that examine the reliability of LSI scores, most reviews do not simultaneously address differences in score reliabilities from both versions of the LSI as well as other modified versions. Further, none of the reviews identified study features that may be predictive of reliability variation across studies. We therefore examined the extant literature using the LSI to characterize the variation of measurement error across administrations of the LSI.

Method

Sample of Articles

Searches of the ERIC and PsycINFO databases using the keywords "Learning Style Inventory" and "LSI" were conducted. Only published articles were retained which left 127 ERIC and 199 PsycINFO articles. After eliminating duplicates between the

databases, 290 articles remained, of which 174 were false hits (i.e., did not address the LSI) and 11 were theoretical. These were also eliminated leaving 105 articles. An additional five articles were added to this pool as a result of secondary identification of articles by backtracking references in the articles originally noted in the database searches. This left a final pool of 110 articles that employed the LSI. Each article was read and placed into one of several categories.

Fifty-nine (53.6%) articles made no mention of reliability. Fifteen (13.6%) articles "inducted" (Vacha-Haase, Kogan, & Thompson, 2000) reliabilities by citing coefficients from prior studies or the test manual. Two articles reported reliability for data in hand but not in a usable format (e.g., reported a range of coefficients). A little less than a third (n=34, 30.9%) of the articles appropriately reported reliability for the obtained scores. However, many of these articles reported multiple reliability estimates, leaving a sample of 206 internal consistency and 182 test-retest coefficients across the various subscales and dimensions of the LSI.

Reliability generalization

Reliability generalization (RG) is a meta-analytic technique to characterize (a) the measurement error variance for a given test across studies, (b) the amount of variability in reliability coefficients for given measures, and (c) the sources

of variability in reliability coefficients across studies (Vacha-Haase, 1998). The present paper only examined variability of reliability estimates across studies. Study features that are predictive of reliability variation are reported elsewhere (Henson & Hwang, in press).

Results and discussion

Descriptive statistics (see Table 2) indicated considerably larger mean coefficient alphas for the 1985 version scores as compared to scores on the original 1976 form. For test-retest reliability, however, the 1985 form scores performed slightly worse than those from the 1976 test, and 1985 revisions yielded scores that did much better. These findings are consistent with prior studies (cf. Atkinson, 1991; Geller, 1979; Pickworth & Schoeman, 2000; Ruble & Stout, 1990, 1994; Sims et al., 1986).

It is clear that the 1985 version of the LSI yielded more reliable scores as regards internal consistency. However, scores from the revision gave slightly lower test-retest coefficients. Thus, the apparent improvement in internal consistency was not matched by a corresponding improvement in temporal stability. As the standard deviations in Table 2 demonstrate, the measurement error possible in LSI scores can be considerable.

At a minimum, researchers ought to examine reliability for their LSI scores and interpret effects in light of reliability (Wilkinson & APA Task Force on Statistical Inference, 1999).

However, the lack of reliability in LSI scores is substantial enough to warrant either (a) discontinuation of use or (b) considerable revision of the instrument. Indeed, several authors have called for the abolition of the LSI due to its psychometric infirmities (see e.g., Atkinson, 1991; DeCoux, 1990; Ruble & Stout, 1994).

The current results, however, suggest that some promise may be found in studies (cf. Pickworth & Schoeman, 2000) revising the 1985 form in various ways (e.g., use of normative rather than ipsative scaling). The mean score reliabilities for the 1985 revisions (see Table 3) are marginal for internal consistency (although much improved over the 1976 form) and strong for temporal stability. Perhaps the future of the LSI lies with continued revision. The current results would indicate that the LSI's past is sufficiently storied to preclude future use, particularly when one considers that reliability is a necessary but insufficient condition for validity.

In sum, the current findings indicate that continued use of the LSI should be considered questionable at best. Despite prior psychometric reviews with similar outcomes (Atkinson, 1991; Ruble & Stout, 1990, 1994), the LSI has enjoyed continued use in the literature. As explained by Atkinson (1991):

> Considering the popularity of the instrument, face validity may have been what has kept practitioners and researchers

> returning to the LSI. While authors like Freedman and Stumpf (1980) acknowledged the face validity of the LSI, they proposed, as did others, that what meets the eye may be less than the beholder suspects. ...Continued applications of the LSI-1985 seem warranted for dialogic, rather than diagnostic, purposes as long as the user is mindful and open about the instrument's apparent limitations. ...Heretofore, it seems face validity has been the saving grace of the LSI... (pp. 158-159, italics in original)

Unfortunately for the LSI, face validity is insufficient psychometric evidence for most applications.

References

References marked with an asterisk (*) were used in the review.

Anastasi, A., & Urbina, S. (1997). *Psychological testing* (7th ed.). Upper Saddle River, NJ: Prentice Hall.

*Atkinson, G. (1988). Reliability of the Learning Style Inventory—1985. *Psychological Reports, 62*, 755-758.

*Atkinson, G. (1989). Kolb's Learning Style Inventory—1985: Test-retest deja vu, *Psychological Reports, 64*, 991-995.

Atkinson, G. (1991). Kolb's Learning Style Inventory: A practitioner's perspective. *Measurement and Evaluation in Counseling and Development, 23*, 149-161.

Cattell, R. B. (1944). Psychological measurement: Normative, ipsative, interactive. *Psychological Review, 51*, 292-303.

*Chou, H. W., & Wang, Y. F. (1999). Effects of learning style and training method on computer attitude and performance in world wide web page design training. *Journal of Educational Computing Research, 21*, 325-344.

Cornwell, J. M. & Dunlap, W. P. (1994). On the questionable soundness of factoring ipsative data: A response to Saville & Willson. *Journal of Occupational and Organizational Psychology, 67*, 89-100.

Cornwell, J. M., Manfredo, P. A., & Dunlap, W. P. (1991). Factor

analysis of the 1985 revision of Kolb's Learning Style Inventory. *Educational and Psychological Measurement, 51,* 455-462.

Courville, T. & Thompson, B. (2001). Use of structure coefficients in published multiple regression articles: β is not enough. *Educational and Psychological Measurement, 61,* 229-248.

De Bello, T. (1990). Comparison of eleven major learning style models, Variables, appropriate populations, validity of instrumentation, and the research behind them. *Reading, Writing, and Learning Disabilities, 6,* 203-222.

DeCoux, V. M. (1990). Kolb's Learning Styles Inventory: A review of its applications in nursing research. *Journal of Nursing Education, 29,* 202-207.

*Freedman, R. D., & Stumpf, S. A. (1978). What can one learn from the Learning Style Inventory? *Academy of Management Journal, 21,* 275-282.

Freedman, R. D., & Stumpf, S. A. (1980). Learning style theory: Less than meets the eye. *Academy of Management Review, 5,* 445-447.

*Garvey, M., & Bootman, L., & McGhan, W. (1984). An assessment of learning styles among pharmacy students. *American Journal of Pharmaceutical Education, 1984,* 134-140.

*Geiger, M.A., & Boyle, E. (1992). Learning styles of students

and instructors: An analysis of course performance and satisfaction. *Accounting Educators' Journal, 4*, 86-101.

*Geiger, M.A., & Pinto, J. (1991). Changes in learning style preference during a three-year longitudinal study. *Psychological Reports, 69*, 755-762.

Geiger, M.A., Boyle, E., & Pinto, J. (1992). A factor analysis of Kolb's revised Learning Style Inventory. *Educational and Psychological Measurement, 52*, 753-759.

*Geiger, M.A., Boyle, E.J., & Pinto, J.K. (1993). An examination of ipsative and normative versions of Kolb's revised Learning Style Inventory. *Educational and Psychological Measurement, 53*, 717-726.

*Geller, L. M. (1979). Reliability of the Learning Style Inventory. *Psychological Reports, 44*, 555-561.

Henson, R. K. (2001). Understanding internal consistency reliability estimates: A conceptual primer on coefficient alpha. *Measurement and Evaluation in Counseling and Development, 34*, 177-189.

Henson, R. K., & Hwang, D. (in press) Variability and prediction of measurement error in Kolb's Learning Style Inventory scores: A Reliability generalization study. *Educational and Psychological Measurement.*

Hicks, L. E. (1970). Some properties of ipsative, normative, and

forced-choice normative measures. *Psychological Bulletin, 74*, 167-184.

Hopkins, K. D. (1998). *Educational and psychological measurement and evaluation* (8th ed.). Boston: Allyn & Bacon.

*Katz, N. (1988). Individual learning style: Israeli norms and cross-cultural equivalence of Kolb's Learning Style Inventory. *Journal of Cross Cultural Psychology, 19*, 361-379.

Kolb, D. A. (1971). *Individual learning styles and the learning process*. Massachusetts Institute of Technology, Sloan School of Management, Working Paper No. 535-71. Cambridge, MA.

Kolb, D. A. (1974). Management and the learning process. In D. A. Kolb, I. M. Rubin, & J. M. McIntyre (Eds.), *Organizational psychology: A book of readings* (pp. 27-42). Englewood Cliffs, NJ: Prentice Hall.

*Kolb, D. A. (1976). *Learning Style Inventory technical manual*. Boston: McBer.

Kolb, D. A. (1985). The *Learning Style Inventory: Technical manual*. Boston: McBer & Co.

Kolb, D. A., & Fry, R. (1974). *Toward an applied theory of experiential learning*. Massachusetts Institute of Technology, Sloan School of Management, Working Paper No. 732-74. Cambridge, MA.

Kolb, D. A., Rubin, I. M., & McIntyre, J. M. (1971). *Organizational psychology: An experiential approach.* Englewood Cliffs, NJ: Prentice-Hall.

*Lam, S. (1997). Reliability and classification stability of revised Learning Style Inventory in Hong Kong. *Perceptual and Motor Skills, 85,* 141-142.

*Loo, R. (1996). Construct validity and classification stability of the revised Learning Style Inventory (LSI-1985). *Educational and Psychological Measurement, 56,* 529-536.

*Loo, R. (1997). Evaluating change and stability in learning style scores: A methodological concern. *Educational Psychology, 17,* 95-100.

*Loo, R. (1999). Confirmatory factor analyses of Kolb's Learning Style Inventory (LSI-1985). *British Journal of Educational Psychology, 69,* 213-219.

*Marshall, J. C., & Merritt, S. L. (1985). Reliability and construct validity of alternative forms of the Learning Style Inventory. *Educational and Psychological Measurement, 45,* 931-937.

*Merritt, S. L., & Marshall, J. C. (1984). Reliability and construct validity of ipsative and normative forms of the Learning Style Inventory. *Educational and Psychological Measurement, 44,* 463-472.

*Newstead, S. E. (1992). A study of two "quick-and-easy"

methods of assessing individual differences in student learning. *British Journal of Educational Psychology, 62,* 299-312.

Pedhazur, E. J., & Schmelkin, L. P. (1991). *Measurement, design, and analysis: An integrated approach*. Hillsdale, NJ: Lawrence Erlbaum.

*Pickworth, G. E., & Schoeman, W. J. (2000). The psychometric properties of the Learning Style Inventory and the Learning Style Questionnaire: Two normative measures of learning styles. *South African Journal of Psychology, 30,* 44-52.

*Pinto, J. K., & Geiger, M. A. (1991). Changes in learning-style preferences: A prefactory report of longitudinal findings. *Psychological Report, 68,* 195-201.

*Pinto, J. K., & Geiger, M. A. & Boyle, E. (1994). A three-year longitudinal study of changes in student learning styles. *Journal of College Student Development, 35,* 113-119.

Plovnick, M. S. (1975). Primary care career choices and medical student learning styles. *Journal of Medical Education, 50,* 849-855.

Popham, W. J. (2000). *Modern educational measurement: Practical guidelines for educational leaders* (3rd ed.). Boston: Allyn and Bacon.

Reinhardt, B. (1996). Factors affecting coefficient alpha: A

mini Monte Carlo study. In B. Thompson (Ed.), *Advances in social science methodology* (Vol. 4, pp. 3-20). Greenwich, CT: JAI Press.

*Ruble, T.L., & Stout, D.E. (1990). Reliability, construct validity, and response-set bias of the revised Learning Style Inventory. *Educational and Psychological Measurement, 50*, 619-629.

*Ruble, T.L., & Stout, D.E. (1991). Reliability, classification stability, and response-set bias of alternate forms of the Learning Style Inventory. *Educational and Psychological Measurement, 51*, 481-489.

Ruble, T.L., & Stout, D.E. (1994). *A critical assessment of Kolb's Learning Style Inventory*. (ERIC Document Reproduction Services No. ED 377 221)

Sadler, G. R., Plovnick, M., & Snope, F. C. (1978). Learning styles and teaching implications. *Journal of Medical Education, 53*, 847-849.

Schumacker, R. E., & Williams, J. D. (1993). Teaching ordinal and criterion scaling in multiple regression. *Multiple Linear Regression Viewpoints, 20*(1), 25-31.

*Sims, R.R., Veres, J.G., III, & Shake, L. G. (1989). An exploratory examination of the convergence between the Learning Style Questionnaire and the Learning Style

Inventory II. *Educational and Psychological Measurement, 49*, 227-233.

*Sims, R.R., Veres, J.G., III, Watson, P., & Buckner, K.E. (1986). The reliability and classification stability of the Learning Style Inventory. *Educational and Psychological Measurement, 46*, 753-760.

*Stout, D. E., & Ruble, T. L. (1991). The Learning Style Inventory and accounting education research: A cautionary view and suggestion for future research. *Issues in Accounting Education, 6*, 41-52.

Tenopyr, M. L. (1988). Artifactual reliability of forced-choice scales, *Journal of Applied Psychology, 73*, 749-751.

Thompson, B. (1994). Guidelines for authors. *Educational and Psychological Measurement, 54*, 837-847.

Thompson, B., & Daniel, L.G. (1996). Factor analytic evidence for the construct validity of scores: A historical overview and some guidelines. *Educational and Psychological Measurement*, 56, 197-208.

Thompson, B., & Vacha-Haase, T. (2000). Psychometrics is datametrics: the test is not reliable, *Educational and Psychological Measurement, 60*, 174-195.

Vacha-Haase, T. (1998). Reliability generalization: Exploring variance in measurement error affecting score reliability

across studies. *Educational and Psychological Measurement, 58*, 6-20.

Vacha-Haase, T., Kogan, L.R., & Thompson, B. (2000). Sample compositions and variabilities in published studies versus those in test manuals: Validity of score reliability inductions. *Educational and Psychological Measurement, 60*, 509-522.

*Veres, J.G., III, Sims, R.R., & Locklear, T.S. (1991). Improving the reliability of Kolb's revised Learning Style Inventory. *Educational and Psychological Measurement, 51*, 143-150.

*Veres, J.G., III, Sims, R.R., & Shake, L. G. (1987). The reliability and classification stability of the Learning Style Inventory in corporate settings. *Educational and Psychological Measurement, 47*, 1127-1133.

*Wells, J. B., Layne, B. H., & Allen, D. (1991). Management development training and learning styles. *Public productivity & Management Review, 14*, 415-428.

Whitney, M. A., & Caplan, R. M. (1978). Learning style and instructional preferences of family practice physicians. *Journal of Medical Education, 53*, 684-686.

Wilkinson, L., & American Psychological Association (APA) Task Force on Statistical Inference. (1999). Statistical methods in psychology journals: Guidelines and explanations.

American Psychologist, 54, 594-604. (Reprint available through the APA Home Page: http://www.apa.org/journals/amp/amp548594.html)

*Willcoxson, L., & Prosser, M. (1996). Kolb's Learning Style Inventory (1985): Review and further study of validity and reliability. *British Journal of Educational Psychology, 66*, 247-257.

Wilson, D. K. (1986). An investigation of the properties of Kolb's Learning Style Inventory. *Leadership and Organization Development Journal*, 7, 3-9.

Wunderlich, R., & Gjerde, C. L. (1978). Another look at Learning Style Inventory and medical career choice. *Journal of Medical Education, 53*, 45-54.

*Yahya, I. (1998). Willcoxson and Prosser's factor analyses on Kolb's (1985) LSI data: Reflections and re-analyses, *British Journal of Educational Psychology, 68*, 281-286.

Yin, P., & Fan, X. (2000). Assessing the reliability of Beck Depression Inventory scores: Reliability generalization across studies. *Educational and Psychological Measurement, 60*, 201-223.

*Yuen, C. C. & Lee, S. N. (1994). Applicability of the Learning Style Inventory in an Asian context and its predictive value. *Educational and Psychological Measurement, 54*, 541-549.

Table 1

Illustrative Responses and Scale Intercorrellations for Five Subjects on LSI Scales.

	Ipsative Rankings				Correlations				
Subject No.	CE	RO	AE	AC	Scale	CE	RO	AE	AC
1.	1	2	3	4	CE	1.00			
2.	2	1	4	3	RO	-.84	1.00		
3.	3	1	2	4	AE	-.28	.00	1.00	
4.	1	3	2	4	AC	.25	-.28	-.84	1.00
5.	1	3	4	2					

Note. Subject responses are ranked, 1 to 4, across the four attributes.

Table 2

Descriptive Statistics for Coefficient alpha and Test-retest Reliabilities for Various Test Forms by LSI Subscale.

Coefficient alpha

	1976 version	1985 version	revised 1985 version
		Concrete Experience	
M	.420	.809	.680
SD	.112	.045	.090
N	10	26	15
		Reflective Observation	
M	.602	.812	.707
SD	.095	.034	.048
N	10	26	14
		Active Experimentation	
M	.489	.843	.666
SD	.181	.033	.122
N	10	26	14
		Abstract Conceptualization	
M	.635	.830	.763
SD	.094	.025	.056
N	10	26	15

Test-retest

	1976 version	1985 version	revised 1985 version
		Concrete Experience	
M	.460	.312	.877
SD	.095	.120	.225
N	11	20	7
		Reflective Observation	
M	.515	.472	.914
SD	.142	.136	.135
N	11	20	7
		Active Experimentation	
M	.450	.515	.904
SD	.109	.129	.145
N	11	20	7
		Abstract Conceptualization	
M	.581	.486	.917
SD	.091	.091	.145
N	11	20	7

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE

(Specific Document)

TM034275

I. DOCUMENT IDENTIFICATION:

Title: A Critical Review of the Literature on Kolb's Learning Style Inventory with Implications for Score Reliability	
Author(s): Dae-Yeop Hwang and Robin K. Henson	
Corporate Source: University of North Texas	Publication Date: February 14, 2002

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

1

Level 1

Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) *and* paper copy.

The sample sticker shown below will be affixed to all Level 2A documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2A

Level 2A

Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only

The sample sticker shown below will be affixed to all Level 2B documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2B

Level 2B

Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Sign here, please

Signature: Dae Yeop Hwang	Printed Name/Position/Title: Dae-Yeop Hwang
Organization/Address: University of North Texas	Telephone: (940) 565-4414 FAX:
	E-Mail Address: dyhwang@unt.edu Date: 2-15-2002

(Over)

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, *or*, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:
Address:
Price:

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:
Address:

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

ERIC Processing and Reference Facility
4483-A Forbes Boulevard
Lanham, Maryland 20706

Telephone: 301-552-4200
Toll Free: 800-799-3742
FAX: 301-552-4700
e-mail: ericfac@inet.ed.gov
WWW: http://ericfacility.org