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Development of a Learning Style Orientation Measure

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Trainees differ in their preferences for learning strategies, and these differences can moderate the effectiveness of training programs. Unfortunately, previous attempts to develop learning style preference measures have not yielded reliable measures. The authors conducted two studies as part of an effort to develop and provide an initial validation of a learning style orientation measure. Factor analyses revealed five distinct and reliable learning style orientations. Scores on these factors were related to personality and instructional methods preferences. Findings provided preliminary support of the convergent and discriminant validity of the measure.

Keywords: *styles; learning; training; measurement*

Although researchers have recognized the importance of considering individual differences in designing training environments (e.g., Cronbach & Snow, 1977; Noe, 1986), there has been a tendency to emphasize generic training methods that largely ignore the characteristics of trainees. As organizations choose from an increasingly diverse array of training methods, it seems important to consider these differences in the design and implementation of training programs. Over the past 50 years, there has been a plethora of research on the interaction of learners' characteristics, such as gender, motivation, aptitude, and instructional method, but few have found that these characteristics moderate the influence of instructional method on learning (see Hunt, 1975, for a review). However, this has not deterred researchers from searching for key characteristics of learners that support the person-environment paradigm, and in particular, learning style preference has attracted a considerable amount of interest by psychologists.

Learning style orientation is typically seen as bridging the gap between personality and cognition (Sternberg & Grigorenko, 1997) and has been described as the "way in which each learner begins to concentrate on, process, and retain new and difficult information" (Dunn, Griggs, Olsen, Beasley, & Gorman, 1995, p. 353). In a review of

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17 studies, Hayes and Allinson (1993) concluded that learning style orientation can moderate the effectiveness of instructional methods on trainee learning. In one study, computer users were trained to use an electronic mail filing system, using two training methods (Sein & Robey, 1991). The abstract training method depicted the computer system as a diagram, using abstract terms. The analogical training method depicted the computer system in terms of another with which the novice was familiar—an office filing cabinet. There was a significant interaction of training method and learning style. Learners who preferred abstract reasoning performed best in the abstract training method. Learners who preferred practical tasks performed better in the analogical training condition than in the abstract condition.

A major barrier in this research has been the lack of valid and reliable measures of learning style preferences. Sternberg and Grigorenko (1997), in a recent review of learning style, concluded that "in recent years, research on styles has been relatively 'out' with regard to mainstream psychological research" (p. 709). They suggested that a major problem is the internal consistency reliability and validity of the current measures. The most prominent measure currently in use is the Learning Style Inventory (LSI) (Kolb, 1976, 1985). Although extensively used in training settings, the evidence for the construct validity and reliability of this measure is not convincing. In this article, we first review the current literature on the LSI. We present evidence on the validity and internal consistency reliability of the LSI and then propose a new learning styles measure. The remainder of the article describes the development and initial research on this new measure.

The LSI: A Review and Assessment

The LSI distinguishes among four learning types and is based on a conceptualization of learning as a four-stage process that can be described along two bipolar dimensions of thinking to feeling and doing to watching. Learners with a feeling orientation have an intuitive approach to learning, demonstrate competency in interpersonal interaction, and function well in unstructured situations. Learners with a watching orientation focus on understanding the meaning of ideas, enjoy thinking about the meaning of situations, and are good at adopting different perspectives. Learners with a thinking orientation use logic and concepts in their reasoning and value the analysis of ideas as opposed to adopting an intuitive approach to problems. Finally, learners with a doing orientation enjoy practical situations, are good at getting things accomplished, and enjoy seeing results. These four learning orientations can be further combined into four learning styles: accomodator, diverger, converger, and assimilator (Kolb, 1979, 1984).

Much of the criticism of the LSI has been directed at the validity and internal consistency reliability of this measure. Furnham (1992) questioned its incremental validity based on evidence that the LSI was highly related to personality. Questions have also been raised about the internal consistency reliability of the LSI with several researchers showing test-retest reliability coefficients that range from .48 to .70 (Freedman & Stumpf, 1978; Geller, 1979). In response to these criticisms, Kolb revised the LSI in 1985, but Atkinson (1988) reported even lower test-retest reliabilities (.24 to .57) for the revised scale. Although Veres, Sims, and Locklear (1991) showed moderately higher internal consistency for scores on the revised 1985

LSI, the adequacy of these internal consistency reliabilities has been challenged (e.g., Highhouse & Doverspike, 1987).

In developing a new measure of learning styles, we started with what we considered to be the primary weaknesses of the LSI. First, the LSI is based on an a priori conceptualization rooted in Jungian theory. Jungian theory proposes a typology differentiating individuals in terms of their personality (extroversion and introversion), the way in which they perceive the world (intuition and sensing), and the process by which they judge (thinking and feeling) (see Grigorenko & Sternberg, 1995, for an overview). Although there are advantages to using theory to guide instrument development (DeVellis, 1991), it also may yield measures that ignore important facets of learning style differences that occur in actual learning situations. Hence, rather than using only theory, we also used an inductive approach in which we attempted to capture, through a critical incidents methodology, potential dimensions of learning style orientation. Items used in the self-report measures were based, in large part, on the information generated in this first phase. In terms of the deductive approach, previous research and theory suggests that an action-oriented and a reflective orientation constitute two dominant learning dimensions (e.g., Honey and Mumford, 1982; Kolb, 1976, 1984). An action orientation is typified by a preference to tackle problems directly and for concrete as opposed to theoretical problems. In contrast, a reflective orientation indicates a preference to reflect on ill-defined problems before acting. These orientations are present in several learning style theories. Kolb (1976, 1984) conceived a dimension of action-reflection ranging from active participation to detached observation. Honey and Mumford (1982) also differentiated between activators who involve themselves in new situations and reflectors who enjoy pondering experiences. Gregorc (1982) also differentiated between concrete/action learning and abstract or reflective learning.

A second potential problem with the LSI and other measures is redundancy between learning style orientation and personality (Jackson & Lawty-Jones, 1996). The items used in previous measurement tend to ask for self-reports of general and behavioral patterns rather than focusing specifically on learning situations. An important question is whether learning style orientation measures can contribute incrementally to prediction above and beyond personality. In developing the present measure, we attempted to focus the item content on how the individual typically feels, behaves, and acts specifically in learning situations. Moreover, we assessed the extent to which our measures contributed incrementally to the prediction of other variables beyond personality dimensions.

A third problem with the LSI is the use of ipsative (forced-ranking) scoring. Researchers have criticized this use of ipsative scoring because it contains no information on the relative differences among individuals on the four scales (e.g., Cornwell & Manfredo, 1994; Freedman & Stumpf, 1978). Rather, the measure only rank orders the learning styles for a single person. Factor analyses on the LSI have consistently demonstrated a two-factor bipolar dimension that runs from thinking to doing and from feeling to watching (e.g., Cornwell, Manfredo, & Dunlap, 1991; Geiger, Boyle, & Pinto, 1993). These patterns are in contrast to David Kolb's bipolar dimensions of thinking to feeling and doing to watching. Cornwell and Manfredo (1994) have also demonstrated that the ipsative ranking of the LSI contributes to the lack of validity of the LSI. The learning categories (i.e., accommodator, diverger, converger, assimilator) are based on calculating differences scores between pairs of ipsative scores. Cornwell

and Manfredo derived primary learning (doing, thinking, watching, and feeling) scores based directly on the primary rank ordering given by participants. Compared to the Kolb LSI, these primary learning scales demonstrated evidence of convergent validity. An orientation toward thinking was associated with higher scores on a cognitive ability measure, whereas an orientation toward doing was associated with high performance on a paper-folding task.

Conclusion

In summary, there is little evidence to support the construct validity and internal consistency reliability of the LSI. In this study, we attempted to circumvent these problems with the LSI by developing a measure (the Learning Style Orientation Inventory) that directly asks participants their learning style preferences. In the initial stages of developing a measure, it is essential to begin testing the construct validity before conducting substantive research (Schwab, 1980). In the first study, we tested the factor structure of the Learning Style Orientation Inventory and investigated the relations between this measure and the Big Five personality traits. In a second study, we further assessed our instrument in terms of its structure and internal consistency, incremental validity, and its relationship to Kolb's (1985) LSI.

Study 1

Item Development

The objective of this first study was to provide an exploratory factor analysis, furnish an initial assessment of content validity, and assess convergence of these factors with the Big Five personality dimensions. We used both deductive and inductive methods to generate items for the measure. With regard to the deductive method, we generated items with dichotomous (yes/no) responses to reflect the action and reflection orientations. These items were administered to 67 undergraduates, and those items having standard deviations higher than .40 and a reasonably high item-scale correlation were retained.

During the same session, the same 67 students recalled an event that involved learning something practical and an event that involved learning something theoretical. For both types, the students described when the task had gone both well and badly. The students were asked to describe what they learned and what strategies helped them learn the subject or perform the task. When the exercise had gone badly, students were asked to describe what happened in terms of what had prevented their learning. Table 1 shows a summary of the tasks described by the students and the types of things that helped or hindered student learning. Through describing their learning experiences, students identified those learning strategies that helped them learn or that failed to enable learning. For example, when learning material for a psychology exam, a student who had done well said, "Writing and rewriting notes is the best way for me to learn." When a student was learning how to cut hair and the task had gone badly, the student concluded, "I need to be taught by a professional to learn something." Based on these incidents and the deductive method, 112 items were constructed and were administered to a new student sample in the study described below.

Table 1
Summary and Classification of Results From the Critical Incidents Exercise

Type	*Task*	*Strategies That Aid Learning*
Theoretical	Processing and recalling information from a range of academic subjects including calculus, physics, chemistry, architecture, psychology, social science, anatomy, English literature, and computer science	Formal tests, visual examples, analogies, a set procedure, study guides, enthusiastic instructor, discussion groups, helping others aids learning, asking questions in class, learn best if study alone
Practical	Piano-playing, learning computer programming, cutting hair, changing oil, learning to drive, baking bread, bank clerk duties, leadership experience, golf	Need a lot of practice to do well, not enough for someone to tell me how to do something, demonstration by someone else, guidance by another, patient instructor, prefer to figure things out alone, require interaction, support from my peers

Method

Participants and Procedure

Participants were 154 undergraduate students (64 male, 90 female) from a university in the southern United States who participated in the study for course credit. Their ages ranged from 17 to 26 with a mean age of 20 years. A total of 36.4% were freshman, 22.7% were sophomores, 25.3% were juniors, and 15.6% were seniors. A total of 58.9% were social science majors, 28.1% were science and engineering majors, and 13% were humanities majors. They completed the 112 items of the Learning Style Orientation Inventory, in which they were asked to indicate to what extent each statement was characteristic of their preference for learning (1 = *strongly disagree*, 5 = *strongly agree*). They also completed the Big Five factor personality measure.

The five-factor personality measure. A scale developed by Goldberg (1992) was used to measure the Big Five personality factors. This scale consists of 100 personality items that measure agreeableness, extroversion, openness to experience, emotional stability, and conscientiousness. Participants were asked to use the items to describe themselves as accurately as possible (1 = *extremely inaccurate*, 9 = *extremely accurate*).

Item Reduction and Internal Consistency Reliability

Principal axis factoring, using varimax rotation,[1] was performed on responses to the 112 Learning Style Orientation Inventory items. Following several analyses on varying numbers of factors and inspection of a scree plot, we retained five factors. Interpretability of factors was difficult after five factors, and the scree plot suggested that the absolute size of the slope showed little decrease after five factors. Items that had loadings less than .40 and items that had cross loadings greater than .30 were eliminated. This resulted in 54 items being retained (to conserve space, the items from the Study 1 solution are not displayed). The first factor consisted of 14 items and was labeled a preference for discovery learning (eigenvalue = 12.33, 11.1% of the vari-

ance) because it showed an inclination for exploration during learning. Items included, "I like problems which don't have a definitive solution" ($\alpha = .91$). The second factor consisted of 13 items and was labeled a preference for experiential learning (eigenvalue = 7.30, 8.15% of the variance) because it indicated a desire for hands-on approaches to instruction. Items included, "I like to put new knowledge to immediate use" ($\alpha = .81$).

The third factor consisted of 9 items and was labeled a preference for observational learning (eigenvalue = 7.94, 7.1% of the variance) because it indicated a preference for external stimuli such as demonstrations and diagrams to help facilitate learning. Items included, "I learn best when pictures or diagrams are provided" ($\alpha = .81$). The fourth factor consisted of 11 items and was labeled a preference for structured learning (eigenvalue = 5.89, 5.3% of the variance) because it indicated a preference for processing strategies such as taking notes, writing down task steps, and so forth. Items included, "I enjoy making outlines of text and lecture material" and "I like to take notes while reading" ($\alpha = .91$). The fifth factor consisted of 7 items and was labeled a preference for group learning (eigenvalue = 4.27, 3.8% of the variance) because it indicated a preference to work with others while learning. Items included, "I prefer to study in a group." The five factors accounted for 36% of the variance in the item responses ($\alpha = .82$).

Content Validity

Eight graduate students in industrial and organizational psychology examined the content validity of the 54-item Learning Style Orientation Inventory. We gave students the definition of each learning style orientation construct and asked them to match items with their corresponding definition. Results were as follows: (a) 94% of the experiential items were sorted as experiential, (b) 89% of the discovery items were sorted as discovery, (c) 97% of the observational items were sorted as observational, (d) 89% of the structured items were sorted as structured, and (e) 79% of the group items were sorted as group. These results provided preliminary evidence for the content validity of the Learning Style Orientation Inventory (Hinkin, 1998).

Convergent and Discriminant Validity

In an initial assessment of convergent and discriminant validity, correlational analyses were performed among the learning style orientation variables and the five factor personality variables. Table 2 shows the means, standard deviations, and coefficient alphas for the variables in Study 1. The correlations among the five learning style orientation factors suggest that they are reasonably distinct. The only significant correlation was between observational learning and structured learning ($r = .32$). However, patterns of correlations between these factors and other constructs were dissimilar, suggesting the retention of five factors. Coefficient alphas were reasonably high for all five learning style orientation factors. In support of the convergent validity of the factors, discovery learning was positively related to openness to experience ($r = .42$), and group learning was positively related to extroversion ($r = .34$). Structured learning, suggesting an orderly and planned approach to learning, was positively related to conscientiousness ($r = .41$). In addition, structured learning was negatively related to emotional stability ($r = -.22$), and observational learning was negatively related to openness to experience ($r = -.26$).

Table 2
Means, Standard Deviations, Reliabilities, and Zero-Order Correlations for Variables in Study 1

Variable	M	SD	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Learning style												
Experiential	3.48	0.57	(.81)	.04	–.10	.03	–.11	–.02	.21*	.32**	.09	.15
Observational	3.86	0.53		(.81)	.32**	.07	–.19	.12	.19*	–.06	–.26**	.16
Structured	3.35	0.82			(.83)	.01	–.10	.12	.41**	–.04	.01	–.22**
Group	3.07	0.60				(.82)	–.08	.14	.04	.34**	.04	–.00
Discovery	2.95	0.62					(.91)	.02	–.19*	.06	.42**	.11
Personality variable												
Agreeableness	6.74	0.86						(.87)	.26**	.10	.10	.33**
Conscientiousness	6.28	1.14							(.91)	.00	.09	.04
Extroversion	5.63	1.29								(.93)	.23**	.16
Openness	6.58	0.88									(.85)	.09
Stability	4.84	1.08										(.87)

Note. Coefficient alphas are in parentheses.
*$p < .05$. **$p < .01$.

Study 2

The results of the first study suggested five dimensions of learning style orientation. The aim of this second study was to further verify the structure of the Learning Style Orientation Inventory and to establish evidence of predictive validity. To investigate whether the Learning Style Orientation Inventory might be useful in training settings, we investigated its relation to preferences for a wide range of instructional and assessment methods, including multiple-choice tests, case studies, simulations, interactional lecture, and distance learning (Goldstein, 1993). The Learning Style Orientation Inventory attempts to capture learners' preferences across a wide range of situations and is a broad measure of learning style. In comparison, the Instructional/Assessment Methods Inventory is a proxy measure of teaching methods and focuses on narrow preferences for particular teaching methods.

To assess the incremental validity of the Learning Style Orientation Inventory, we examined whether our measure predicted instructional and assessment method preferences after controlling for personality variables. A further test of the usefulness of the Learning Style Orientation Inventory was to compare its performance with the LSI.

Method

Participants and Procedure

Participants were 350 undergraduate students (99 male, 249 female; 2 did not state their gender) from a small, private university in the southern United States who took part in the study for course credit. Their ages ranged from 17 to 41 years ($M = 20$), and they were equally represented across college years. A total of 62% were social science majors, 27% were science and engineering majors, and 11% were humanities majors. They completed the 54-item Learning Style Orientation Inventory, the Kolb LSI, and Goldberg's Big Five factor personality measure. A subset of these participants ($n =$

193) also completed questionnaires in which they were asked to rate their preferences for specific instructional techniques and assessment methods. These data were collected in a different semester. There were no differences in age, gender, major, or learning style orientation scores between the two groups of participants.

The Kolb LSI. The LSI requires participants to rank order their learning style preferences on 12 items (Kolb, 1985). Using Cornwell and Manfredo's (1994) method, four scores were computed from these rankings: feeling, watching, thinking, and doing.

Instructional Methods items. Participants responded on a 5-point Likert-type scale (1 = *dislike very much*, 5 = *like very much*) the extent to which they liked or thought they would like 13 instructional methods. Each method was briefly described. The methods and their descriptions were the following: videotapes (short instructional feature or feature film that contains message relevant to a course), informational lecture (instructor conveys a lot of detailed knowledge), interactional lecture (the lecturer asks questions in class that need responses), one-on-one interaction with the instructor (dialogue between you and the professor), group discussion (discussion of ideas with several students while the instructor guides the discussion), role-plays (acting out a simulated role, e.g., supervisor dealing with a difficult employee), games/simulations (team players are given rules and conditions to follow in particular situations), field trips (visit a location outside the classroom to observe something relevant to the topic), noncomputerized self-study programs (working through a series of books or tapes without instructor), teleconferencing (interaction with an instructor and other students who are visible on a television screen; a camera enables the instructor to view your performance), computer conferencing (discussion of various topics with group of people over the computer), diaries (reflection on experiences that are important to a particular topic, e.g., social psychology), and experiment (conducting a study to test a hypothesis).

Assessment Methods items. Participants responded on a 5-point Likert-type scale (1 = *dislike very much*, 5 = *like very much*) the extent to which they liked eight assessment methods. Each assessment was briefly described. The assessment methods and their descriptions were the following: case studies (analyze the causes of a particular problem and propose solutions), multiple-choice questions (give a range of choices to a particular question), long essay questions (you are asked a general question and you write an answer in which you must integrate material learned), problem exams (problems are posed and you provide possible solutions; grading is based on correct/incorrect answers), short essay (write short answers to fairly specific questions; grading is based on answer accuracy and completeness), analysis papers (write an analysis of a book or article), oral examination (face-to-face interview with the instructor), or writing research papers (review and evaluate a topic based on library research).

Results

Descriptives and Correlations

Table 3 shows the descriptives and zero-order correlations among the Learning Style Preference Orientation variables, Kolb's LSI, and the personality scales.

Table 3
Zero-Order Correlations Between Personality Variables, Kolb Learning Style Inventory, and Learning Style Orientation Inventory in Study 2

	M	SD	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
Learning style																
Experiential (1)	3.44	0.62	(.74)													
Observational (2)	3.91	0.55	.15**	(.83)												
Group (3)	2.81	0.79	–.04	.15**	(.83)											
Discovery (4)	3.38	0.66	.06	–.08	.01	(.87)										
Structured (5)	3.28	0.70	.06	.23**	–.12*	–.11	(.83)									
Feeling (6)	2.04	0.66	.05	–.08	.09	.31**	–.16**	(.86)								
Watching (7)	2.58	0.65	–.14*	.10	–.15**	–.14*	.02	–.33**	(.83)							
Thinking (8)	2.78	0.63	–.07	–.17**	–.15**	.16**	.01	–.38**	–.23**	(.85)						
Doing (9)	2.62	0.63	.15**	.16**	.21**	–.31**	.12*	–.29**	–.40**	–.33**	(.85)					
Personality variable																
Agreeableness (10)	6.82	0.87	.01	.18*	.04	–.05	.11	.02	–.02	–.03	.05	(.90)				
Conscientiousness (11)	6.34	1.01	.07	.11*	.01	–.23**	.55**	–.22**	–.01	–.02	.24**	.25**	(.90)			
Extroversion (12)	5.61	1.27	.12*	.11*	.27**	–.06	.01	.19**	–.38**	–.09	.27**	.10	.04	(.95)		
Openness (13)	6.61	0.89	.05	–.08	–.10	.45**	.02	.17**	–.18**	.16**	–.13*	.27**	.06	.17**	(.87)	
Stability (14)	4.85	0.96	–.02	–.08	.14**	–.08	–.15**	–.06	–.09*	.12*	.04*	.21**	.09	.14**	.01	(.86)

Note. Coefficient alphas are in parentheses.
*$p < .05$. **$p < .01$.

Exploratory Factor Analysis of Instructional and Assessment Method Items

Principal axis factoring, using varimax rotation, was performed on responses to the 13 items of the Instructional Methods questionnaire. A preference for self-study failed to load on any of the factors and was subsequently removed from further analyses. The solution yielded five factors with eigenvalues greater than one that accounted for 63% of the variance in the 12-item measure. The first factor, labeled interactional (eigenvalue = 2.73), accounted for 21% of the variance and consisted of group discussion, interactional lecture, and one-on-one interaction.

The second factor, labeled active (eigenvalue = 2.02), accounted for 15% of the variance and consisted of games/simulations, role-plays, and informational lectures, which had a negative factor loading. The third factor, labeled technology (eigenvalue = 1.30), accounted for 10% of the variance and consisted of teleconferencing and computer conferencing. The fourth factor, labeled information (eigenvalue = 1.13), accounted for 9% of the variance and consisted of field trips and videotapes. The fifth factor, labeled active-reflective (eigenvalue = 1.05), accounted for 8% of the variance and consisted of experiments and diaries.

Principal axis factoring, using varimax rotation, was performed on responses to the eight items of the Assessment Methods Preference questionnaire. A preference for oral examinations failed to load on any of the factors and was subsequently removed from further analyses. The solution yielded two factors with eigenvalues greater than one that accounted for 44% of the variance in the seven-item measure. The first factor consisted of five items and was labeled subjective assessment because it included assessment methods that did not have a right or wrong answer. This factor (eigenvalue = 2.25) accounted for 28% of the variance and consisted of analysis article, long essay, research paper, short essay questions, and case study. The second factor consisted of two items and was labeled objective assessment because it included assessment methods that required correct answers. This second factor (eigenvalue = 1.28) accounted for 16% of the variance and consisted of problem exam and multiple-choice questions.

Confirmatory Factor Analysis

To confirm the dimensionality and internal consistency reliability of the Learning Style Orientation Inventory, we conducted structural equation modeling by using maximum likelihood estimation (Amos 4.0, Arbuckle & Wothke, 1999). To judge the goodness of fit of our measurement model, we relied on the comparative fit index (CFI), the goodness-of-fit index (GFI), and the incremental fit index (IFI). We also report the root-mean-square error of approximation (RMSEA) and the chi-square test for indices of model fit. Jöreskog (1969) suggested a ratio of chi-square to its degrees of freedom of less than five to be considered reasonable. Models resulting in CFI, GFI, and IFI of .90 or higher are considered acceptable (Bagozzi & Yi, 1988). A value of about .08 or less for the RMSEA indicates a reasonable error of approximation, whereas values higher than .10 are unacceptable (Browne & Cudeck, 1993).

We tested two models. The first model was our hypothesized five-factor model, in which each of the items was constrained to load on its respective latent variable. The second model was a one-factor model, in which all of the items were constrained to

load on one latent variable. In Model 1, the hypothesized measurement model was established with five latent variables (experiential, discovery, structured, group, observational), each represented by its expected indicators. The test of the hypothesized five-factor model resulted in a significant chi-square value, $\chi^2(1{,}367, N = 350) = 349.79$, $p < .001$, although the chi-square/*df* ratio was less than three, suggesting that the model was an adequate fit to the data. The normed fit indexes also indicated a strong fit to the data (CFI = .96, IFI = .96, GFI = .97, RMSEA = .06). Correlations among the latent variables ranged from .02 to .56 (experiential and observational), with most correlations in the low teens.

In Model 2, we tested the dimensionality of the Learning Style Orientation Inventory by comparing the fit of the hypothesized model to a model with a single learning style orientation construct. The fit of the single-factor model was significantly worse than the hypothesized model, $\chi^2(1{,}377, N = 350) = 649.86$, $p < .0001$ (CFI = .71, IFI = .71, GFI = .64, RMSEA = .10). The chi-square difference test also revealed that the single-factor model was a significantly worse fit than the hypothesized model, $\Delta\chi^2(10, N = 350) = 300.07$, $p < .001$.

To further assess the psychometric properties of the five-factor measure, we computed composite reliability and average variance equations. The composite reliability is an indication of how reliably the construct is represented by the indicators, and the average variance extracted assesses the amount of variance in the measures that is captured by the construct. The composite reliabilities of the five latent variables ranged from .79 to .84, and the average variance extracted ranged from .51 to .85. All values fell above the recommended cutoff of .50, lending support to the five-factor structure (Fornell & Larcker, 1981). Table 4 shows the final version of the measure.

Relation of the Learning Style Orientation Inventory to the Big Five. As shown in Table 3, 21 of the 25 correlations among the Learning Style Orientation Inventory variables and the Big Five are similar to those found in Study 1.

The incremental validity of the Learning Style Orientation Inventory. We performed a series of hierarchical regression analyses entering the Big Five personality variables at Step 1 and the Learning Style Orientation Inventory variables at Step 2. We also conducted the same analyses entering the Big Five at Step 1 and the LSI at Step 2. The results are displayed in Table 5. The top half of Table 5 reports the results from the Big Five and the Learning Style Orientation Inventory scales, whereas the bottom half reports the results from the Big Five and the LSI. The results show that the inclusion of the Learning Style Orientation Inventory scales significantly increased the prediction of the Big Five, from an R^2 of .06 to an R^2 of .21 for five of the assessment and instructional methods. Discovery learning was the most consistent predictor; discovery learners showed a preference for subjective assessments, interactional activities, informational methods, and active-reflective activities. Experiential learning was positively related to a preference for action activities. Observational learning was positively related to preference for informational methods and active-reflective methods. Group learning was related to preferences for action and interactional learning, whereas structured learning was related to preferences for subjective assessments. The inclusion of the LSI only increased the prediction of one of the instructional method preferences beyond the Big Five.

Table 4
Final Version of the Learning Style Orientation Inventory

Scale Item	*Item Loading (Study 1)*	*Item Loading (Study 2)*
Discovery		
I like instructors who make me think about abstract ideas.	.77	.81
I enjoy learning subjects that deal with abstract ideas.	.75	.81
I enjoy abstract ideas when learning.	.74	.79
I like to learn subjects which allow me to ponder.	.69	.71
I like problems which don't have a definitive solution.	.69	.70
I like classes where there is no one correct answer but a matter of opinion.	.64	.67
I am a reflective person when learning.	.64	.68
I like to theorize abstract ideas.	.63	.67
I like instructors who allow me to explore my own ideas.	.62	.64
I enjoy classes when the instructor deviates from the text.	.50	.59
I like instructors who are spontaneous.	.45	.53
I prefer to learn material where there are right or wrong answers to problems. (R)	.43	.53
I learn a lot from instructors who stray from the main topic.	.41	.52
I like classes where I know exactly what to expect. (R)	.40	.50
Group		
I enjoy studying in a group.	.83	.91
I prefer to study in a group.	.80	.90
When learning, I like to go through the process with others.	.70	.73
When learning, I enjoy working through problems alone. (R)	.70	.72
When learning, I prefer to spend time alone thinking about material. (R)	.55	.60
I prefer to figure things out on my own when learning a new task. (R)	.49	.54
I like discussion groups.	.40	.55
Experiential		
I like to put my ideas straight into practice when learning.	.75	.80
I enjoy jumping into a task when learning.	.71	.73
I learn best when I am given the opportunity to obtain practical experience.	.66	.70
I like to put new knowledge to immediate use.	.65	.69
I like to dive in and practice.	.59	.63
I perform poorly if I just leap in. (R)	.56	.65
For me the best way to learn something is to put an idea straight into practice.	.48	.55
I like to turn ideas into practical applications when learning.	.44	.56
I enjoy being given hands on experience.	.42	.60
I do not enjoy starting a task straight away when learning. (R)	.41	.54
I enjoy learning practical topics.	.40	.59
Learning material that requires action appeals to me.	.40	.43
I prefer to sit and listen. (R)	.40	.45
Structured		
I enjoy work schedules.	.72	.82
I enjoy making outlines of text and lecture material.	.73	.72
I like to make a plan before I set out to learn something new.	.72	.71
Devising a work schedule is something I enjoy.	.71	.74
When learning, I like to make an outline of the ideas.	.65	.65
When learning a new task, I like to first write down the steps I need to perform.	.57	.58

(continued)

Table 4 (continued)

Scale Item	*Item Loading (Study 1)*	*Item Loading (Study 2)*
I like to take notes while reading or listening to a lecture.	.52	.53
I have good study habits.	.54	.55
I am often disorganized when I go about learning something new. (R)	.56	.57
I like to break a task into simpler terms.	.42	.42
My approach to learning is spontaneous. (R)	.41	.45
Observational		
I like the instructor to give me many practical examples.	.71	.75
I like to see actual demonstrations of what I am learning.	.61	.69
I learn best when I am given specific examples.	.61	.65
I learn best when pictures or diagrams are provided.	.60	.60
I prefer that the instructor provides handouts or slides covering each part of the lecture.	.49	.59
When learning a new task, I need the instructor to give me specific guidance.	.44	.55
To understand an abstract subject, I need to relate it to practical situations.	.56	.57
I need the instructor to give me guidance.	.43	.50
I prefer things that I can actually see or touch.	.52	.52

Note. R = reverse-scored items.

Discussion

Designing training interventions that consider trainee characteristics has long been considered important (Cronbach & Snow, 1977; Noe, 1986). However, empirical research has consistently demonstrated that popular learning style measures such as the Kolb LSI lack firm internal consistency reliability and validity (Furnham, 1992; Highhouse & Doverspike, 1987). In these two studies, we attempted to circumvent some of these problems in development of a learning style orientation measure by the use of empirical inquiry. There was evidence of five interpretable and internally consistent factors: experiential, discovery, observational, group, and structured. In a second study, a confirmatory factor analysis supported the five-factor model found in Study 1.

Landy (1986) has argued that the construct validation of a measure involves using hypothesis testing based on the relationship between the construct of interest and other constructs to establish a "nomological network." This goes beyond choosing convenient or random variables but selecting variables that are believed to have a logical relationship (Landy, 1986). To this end, we conducted a series of correlational analyses based on the notion that styles are related to personality (e.g., Sternberg & Grigorenko, 1997; Honey & Mumford, 1982). Findings from our studies identified learning style orientations that are similar to dimensions identified by Jungian theory, as manifested by Kolb's LSI, but also expand on previous conceptualizations of learning style orientations. Experiential learners enjoy jumping straight into a task and putting new acquired knowledge to immediate use. Experiential learning is positively related to extroversion, consistent with previous research showing that extroverts have

Table 5
Hierarchical Regression Analyses of Instructional and Assessment Method Preferences on the Independent Variables

Dependent Variable	*Step 1: Big Five* ΔR^2	*Step 1: Big Five* ΔF	*Step 2: Learning Style Orientation Scales* ΔR^2	*Step 2: Learning Style Orientation Scales* ΔF	*Discovery* (β)	*Experiential* (β)	*Observational* (β)	*Group* (β)	*Structured* (β)	*Total* R^2	F
Assessment: subjective	.21	9.69***	.15	8.35***	.43***	.08	.00	.04	.29***	.35	9.97***
Assessment: objective	.02	0.78	.05	1.90	–.12	.07	.13	–.13	–.04	.07	1.40
Active	.05	1.86	.09	3.61**	–.01	.19*	.08	.17*	–.13	.14	2.80**
Interactional	.16	7.19***	.21	12.41***	.42***	.06	.09	.30**	.11	.34	10.89***
Information	.11	4.37**	.06	3.10*	.24*	–.10	.15*	.12	–.02	.16	3.49***
Technology	.05	2.04	.02	0.87	–.17	.08	.04	.07	–.05	.08	1.45
Active-reflective	.11	4.38**	.07	2.44*	.25*	–.10	.13	.10	–.03	.16	3.10**

Dependent Variable	*Step 1: Big Five* ΔR^2	*Step 1: Big Five* ΔF	*Step 2: Kolb's Learning Style Inventory* ΔR^2	*Step 2: Kolb's Learning Style Inventory* ΔF	*Doing* (β)	*Thinking* (β)	*Watching* (β)	*Feeling* (β)	*Total* R^2	F
Assessment: subjective	.21	9.69***	.01	0.67	.21	.24	.29	.29	.22	5.65***
Assessment: objective	.02	0.784	.04	1.85	–.15	–.17	–.16	–.36	.06	1.27
Active	.05	1.86	.09	4.98**	.29**	–.10	–.24**	.03	.14	3.33**
Interactional	.16	7.19***	.04	2.08	–.08	.03	–.06	.12	.20	5.01***
Information	.11	4.37**	.00	0.16	–.15	–.16	–.17	–.12	.11	2.45*
Technology	.05	2.04	.02	1.18	.39	.37	.34	.23	.08	1.67
Active-reflective	.11	4.377**	.00	0.16	.04	.02	.16	–.12	.11	2.45*

*$p < .05$. **$p < .01$. ***$p < .001$.

an impulsive orientation and enjoy taking the initiative (Hogan, 1986). Based on our findings, experiential learners enjoy exercises such as role-plays and simulations and tend to be less comfortable in a traditional lecture setting, where they are required to be passive; this suggests that they might perform better in training courses that emphasize experiential experiences.

Also related to Jung's extroversion dimension, group learners enjoy learning with others and enjoy learning opportunities such as group discussion and one-on-one discussion where they are in contact with people. Group learning was negatively related to Kolb's LSI watching dimensions, suggesting that they might perform less well in situations requiring them to sit and watch. Future research could focus on how well group learners perform in distance-learning courses. Given that group learners enjoy interacting with others, a reduction in face-to-face interaction might impede their learning.

The discovery dimension appears related to Jung's intuitive and Kolb's feeling dimensions. Discovery learners enjoy a broad range of learning situations, such as interactional lectures and active-reflective activities that allow them to engage in abstract thought and to contemplate complex issues. In particular, they enjoy subjective assessments that do not require a right or wrong answer. There was a strong positive relation between discovery learning and openness to experience, consistent with previous research that high openness to experience is frequently associated with originality and curiosity. These findings suggest that discovery learners might perform well on creative tasks in unstructured learning situations. Given the negative correlation between discovery and conscientiousness, discovery learners probably perform less well in situations that require attention to detail.

Observational learners tend to be passive learners who need external cues to help them learn. This dimension is similar to Jung's sensing dimension, and the findings suggest that observational learners do not enjoy activities that required them to use logical and analytical thinking. Sensing individuals prefer concrete direct experiences and are more dependent on the ideas of those in authority (Jung, 1923). As our findings showed, observational learners enjoy concrete experiences that have been organized by others, such as film or field trips. These types of activities are realistic and concrete and do not require observational learners to consider abstract ideas. These findings suggest that observational leaders will perform best in training that is structured and provides immediate and practical experiences. Observational learning was also negatively related to openness to experience. This makes sense given that openness-to-experience individuals enjoy novelty and autonomy. Observational learners will probably do less well in learning situations that are student centered and require a high level of autonomy.

A dimension that does not immediately appear related to Jung's personality types is structured learning. Structured learners rely on their own information-processing strategies to enable effective learning to occur, and their preference for subjective assessment suggests that they prefer to impose their own structure on learning. Although structured learning does not appear to fit into Jung's personality types, there are indications that structured learning is related to personality. Structured learning was consistently and positively related to conscientiousness, consistent in the conception of conscientiousness as an indicator of a methodical attention to detail. Research on the conscientiousness construct provides indicators on the types of learning situation that might benefit structured learners. For example, conscientious individuals per-

form best in autonomous situations where they are given discretion in selecting tasks (Barrick & Mount, 1993). This suggests that structured learners might perform best in learning situations where they are given autonomy and choices in training. One surprising result was the negative correlation between structured learning and emotional stability. One reason for this findings is that structured learners through their attention to detail might be more insecure, nervous, and apprehensive (Mount & Barrick, 1995) in their effort to achieve perfection.

Another aim of our research was to demonstrate that the Learning Style Orientation Inventory was not redundant with measures of personality. It has been suggested that personality variables might adequately describe the fit between trainee characteristics and training method (Furnham, 1992). To address this issue, we conducted a series of hierarchical regression analyses to determine whether the Learning Style Orientation Inventory made a unique contribution to explaining preferences for instructional methods, after accounting for personality variables. Our findings showed that after controlling for the Big Five, the Learning Style Orientation Inventory accounted for a significant amount of variance in liking for most of the instructional and assessment methods. In contrast, the Kolb LSI accounted for little variance explained in liking for instructional and assessment methods. The Kolb LSI only made a unique contribution to explaining preferences for active instructional methods, such as role-plays and simulations, with doing and watching (reverse) being significant predictors. The R^2 was similar in size to the relationship between the Learning Style Orientation Inventory and preference for active instructional methods, with experiential and group being significant predictors. The similarities in findings have implications for personality theory in that it supports previous research findings of an active learning style orientation as suggested by Jungian theory.

It could also be argued that the Learning Style Orientation Inventory and the Instructional/Assessment Method preferences measure are measuring the same concept. Researchers have differentiated between learning style orientation and preferred instructional methods (e.g., Furnham, 1995). Learning style is a broad orientation toward learning that attempts to bridge the gap between cognition and personality (Sternberg & Grigorenko, 1997). The Learning Styles Orientation Inventory attempted to capture broad learning preferences across a range of situations, and this is reflected in the majority of the items (e.g., "I am a reflective learner," "I enjoy working alone"). The Instructional/Assessment Methods questionnaire was a proxy measure of actual methods, and this is reflected in the items (preferences for lecture, for role plays, etc). In addition, the Instructional/Assessment Methods questionnaire attempted to capture learner's preferences for particular methods and was not an attempt to capture broad orientations toward learning. The extant literature suggests that learning style is *independently* related to teaching and assessment methods and that achievement can be enhanced or diminished through the compatibility of learning style and teaching method (Furnham, 1995). Given this, we believe that the two measures were independent but related. Future research that tests the relation of our new Learning Style Orientation Inventory to actual teaching methods is the obvious next step.

One potential limit on the generalizability of this research is that our samples were drawn from students in a university setting. Although future validation of the Learning Style Orientation Inventory would benefit from replication of this research in other training and educational settings, we do not believe that the use of student samples seriously limits our findings. As noted in previous discussions of generalizability,

whether a student sample is appropriate or not depends on the organizational variables that are the focus of the research (Dipboye, 1990; Locke, 1986). As observed by Campbell (1986, p. 276), the use of students in research is appropriate if there is "substantive reason" to expect students to be similar to nonstudents with regard to the phenomenon under investigation. In the case of our research, we had reasons to believe that students would be quite similar with regard to the basic underlying structure of their learning style orientation to employees. Virtually all employees were once students involved in school settings, and the meanings that they attach to learning situations seem likely to carry over to the work setting. When learning at work, employees also observe experts, take notes, try things out, listen to lectures, read books, and engage in all the other activities that students in a university setting would do. Moreover, we would agree with Berkowitz and Donnerstein (1982, p. 249) that whether subjects in the situation attach a similar meaning to the situation as persons in the real-world setting is a more important determinant of external validity than "the sample's demographic representativeness or the setting's surface realism." Although being similar to nonstudents in these essential characteristics, the student samples in our research offered some advantages over the typical opportunity sample in a single organization. In some respects, our sample was more diverse than the typical organizational sample. Field research in organizations tends to oversample male subjects from managerial, professional, and technical occupations (Dipboye, 1990). In our sample, there was a representation of both male and females and a variety of academic majors, including the physical sciences, engineering, the humanities, social sciences, and management. Also, the students in our sample were actively involved in learning and were exposed to a variety of different methods and experiences, as opposed to a typical employee sample for which learning may be somewhat less salient. Consequently, we believe the student sample was appropriate for the purpose of developing an instrument that is generic in content and can be used across a variety of settings to assess the possible dimensions of learning preference. At the same time that we would make this argument, it is obvious that the limits on generalizing these findings will only be determined after additional research across a large number of other settings. In particular, we acknowledge that college students' learning styles might differ from those of employees who were not college educated. Students are rewarded for learning styles that match those of their teachers, and this congruency can result in academic success (Sternberg & Grigerenko, 1997).

Another limitation of our study is our reliance on self-report measures. Future research could include objective criterion measures to validate further the Learning Style Orientation Inventory. Although common method bias is a potential problem, most of our measures differed in terms of scaling and wording, and the weak correlations among the Learning Style Orientation Inventory scales suggested that inflation of correlations was not a serious issue. Given that we were interested in capturing the feelings and attitudes that people have toward learning, our use of self-report seems justified at this early stage in the development of the Learning Orientation Preference Inventory. The sample size in Study 1 was rather small ($N = 154$), throwing some doubt on the adequacy of the measures. Although there has been debate over the sample size needed for scale development, there is some agreement that a sample size of 150 observations is sufficient to obtain an accurate solution in exploratory factor analysis (e.g., Guadagnoli & Velicer, 1988; Hinkin, 1998). Each of the factors derived in Study 1 possessed four or more items with loadings above .60, allowing the factor solution to be

interpreted regardless of the sample size used (Guadagnoli & Velicer, 1988). Use of a new and reasonably large sample in Study 2 ($N = 350$) also lent support to the convergent and divergent validity of the Learning Style Preference Inventory. This initial research lays the groundwork for future research on the construct validity of the Learning Style Orientation Inventory and the development of a theory of learning style orientation.

Note

1. Due to the moderate correlations among the learning style factors, we also conducted a principle axis factoring analysis with oblique rotation. We obtained similar results with items loading on the same factors and loadings being of a similar strength. We also performed this analysis on the Instructional/Assessment Method items and obtained the same results.

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