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Further validation of Hanson’s Learning Profile Indicator and Silver, Hanson, and Strong’s Teaching Style Inventory

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Abstract. The purpose of this study was to validate Hanson’s Learning Profile Inventory (LPI) and Teaching Style Inventory (TSI) further, and to assess the degree to which self-reported style preferences on these scales corresponded to actual observable learning and teaching style behaviors of students and teachers in differing instructional situations. No significant differences were found between the reported and observed learning and teaching style preferences of students and their instructors. Further, student and teacher classifications on the OEFT test of field independence/dependence corresponded to their classifications on the introversion/extroversion scale of the LPI and TSI further clarifying and validating this component of this scale on these two measures. This study was a formative study with a small sample ($N = 12$) due to the burdens of observational ratings, which needs to be replicated with a confirmatory study.

Keywords: Learning styles, teaching styles, instrument validation designs, observational validation, constructs review

1. Introduction

A number of methods and instruments have been developed to assess learning and teaching styles. These instruments, moreover, utilize various constructs and definitions for identifying style preferences. The majority of instruments assess style through self-reporting techniques, and, regardless of critical reviews, these instruments continue to be used in a variety of settings today, as focusing on learning and teaching styles is quite popular currently.

The purpose of this study was to validate the Hanson Learning Profile Inventory (LPI) and Silver, Hanson, and Strong Teaching Style Inventory (TSI) further and in new ways. Both instruments are self-diagnostic assessments used to identify individual learning and teaching style preferences. The instruments are based on Jung’s theory of psychological types [16], in which he identified characteristics of six learning styles and two information processing functions. This study sought to generate reliability and convergent and discriminate validity data on these two instruments, as well as to see the degree to which direct observation of students learning styles and teachers expressed teaching styles agreed with the preferences they reported on these two scales.

While the LPI measures two types of learning styles, its counterpart, the TSI, measures only sensing-thinking, sensing-feeling, intuitive-thinking, and intuitive-feeling combinations of teaching styles. The TSI does not include items for measuring the introversion/extroversion classification. Although the operational definitions and theoretical framework for introversion/extroversion and field independent/dependent classifications were very similar, no view could be found in the literature that indicated these two concepts were commensurate. Therefore, it was decided to test how equivalent the introversion/extroversion scale was.
to field independence/dependence for several different practical and theoretical reasons, as well as to validate the LPI and TSI using a "known (i.e., valid) marker" scale or test.

The Group Embedded Figures Test (GEFT) was used as the "known marker" test to validate the LPI and TSI scales. The GEFT assesses cognitive style as related to one's use of external and internal environment. Field dependence/independence is considered to be a reliable and valid indicator of a person's global cognitive style, and the GEFT is a highly and well-validated test and thus an excellent "marker variable" for assessing the validity of other tests and scales.

2. Review of related literature

Learning styles and teaching styles are common ideas in education today, and a great deal of literature can be found that focus on the assessment and practical application of these ideas. Determining what a learning style is has become an issue, however, because of varying and sometimes nonspecific definitions [14] of the concept.

Dunn et al. [6] define learning style as a person's ability to "absorb and retain" information as affected by 18 elements from four basic stimuli. The four stimuli include: 1) environmental elements such as sound, light, temperature, and design of surroundings; 2) emotional elements such as motivation, persistence, responsibility, and the need for structure; 3) sociological elements such as working alone, with peers, with adults, or some combination; and 4) physical elements such as perceptual strengths, intake (auditory, visual), time of day, and the need for mobility. Unfortunately, this definition is limited in that there is no indication let alone clarity with regard to how these 18 elements interact. The definition only refers to learning as absorption and retention of information. It provides no insight into the effect these elements have on processes such as skill acquisition, problem analysis, and problem solving. Furthermore, the term style implies and usually leads one to refer to observable actions (see [14]), and Dunn, Dunn, and Price [6] scale only makes references to descriptive characteristics rather than actions.

Hunt [13] defines learning style as the "educational conditions under which a student is most likely to learn" (p. 27) with "educational conditions" being the amount of structure the student needs. For Hunt, conceptual level is based on a developmental hierarchy of conceptual complexity, which describes the degree to which a student processes information. Measured by a paper and pencil test, a students' conceptual level indicates the degree to which students need structured educational conditions. Although Hunt's conceptual complexity construct is directly related to thinking, analyzing, and levels of independence, his definition does not indicate observable student behavior and action.

Kolb [20] describes the development of learning style as both hereditary and environmental experience. He theorizes that styles are developed over a period of time, through adult years, as an adaptation to the environment. Kolb's theory is characterized first by how the learner perceives information; i.e., either abstractly or concretely. Second, the theory addresses the degree to which the learner emphasizes reflection over action when processing information. Measured by Kolb's Learning Style Inventory, the degree to which a mode of perceiving and processing is emphasized is associated with one of four learning styles: Diverger, Assimilator, Converger, or Accommodator.

Other learning style theories, including the Myers Briggs Type Indicator (MBTI) and the Hanson Learning Style Indicator (LPI), are based on Jung's theory of psychological types. According to Jung, learners possess two perceptive functions; sensing and intuition, and two judging functions; thinking and feeling. Only one perceiving and one judging function can be used at a time, and are, therefore, mutually exclusive. However, while all four types can exist in an individual, the learner tends to prefer one perceiving and judging function over the other. Another dimension of Jung's theory concerns the learner's approach to the environment, whether focusing on the outside world (extraversion), or directing focus inwardly (introversion). According to Jung, these preferences are present from childhood, and although the environment may enhance or inhibit a preferred function, they will stay consistent throughout adult years.

The MBTI measures Jung's personality types with four bipolar dimensions: extraversion/introversion; sensing/intuition; thinking/feeling; and judgment/perception. From these dimensions, individual may be identified as preferring one of 16 learning styles [23]. Hanson [9] utilized both Jung's theory and the MBTI definitions to develop the LPI. Hanson's LPI instrument collapses the 16 MBTI styles into four learning styles: sensing/feelers, sensing/thinkers, intuitive/thinkers, and intuitive/feelers, as well as introverts and extraverts. This collapsing of the 16 MBTI styles into 4 styles by Hanson is far more parsimonious and practical as well as more tractable, theory and researchwise.
Learning style and cognitive style are often used interchangeably in the literature. However, learning style is a broader term that encompasses cognitive style [17]. Witkin et al. [29] defines cognitive style as "the characteristics, self-consistent modes of functioning which individuals show in their perceptual and intellectual activities" (p. 3). A great deal of research has been done in this area, and Messick [22] identifies more than 20 different dimensions of cognitive style. Perhaps the most familiar (and well-validated) of these dimensions is field independence/dependence.

Field independent/dependent classification represents the way in which an individual experiences his or her environment. According to Witkin et al. [29], field independents perceive things as distinct from the organized environment. Field dependent perceptions are influenced by the overall organization of the surrounding environment (i.e., "field," or "gestalt"). Witkin and his associates have developed a number of instruments to measure this cognitive attribute, including the Group Embedded Figures Test.

Information regarding teaching style is limited, with no research having been done in the area of teaching athletic trainers, who were the subjects used in this validation study. Teaching style has been defined by Conti [3] as "a pervasive quality that is being taught may change" (p. 7). Although some researchers have investigated the interactions between teacher and students (e.g., Flanders [7]; and Henri [12]), the educational implications of the interactions between teachers and learners relative to the styles of each still remains somewhat unclear.

3. Assessment of preferred learning style

As many as 47 different learning style constructs were identified by Curry [5], and in an attempt to sort out these theories, she developed her "Onion Model". This model organizes the various constructs into three layers. The outermost layer consists of constructs developed based on instructional preferences. Least stable due to the interactions with the environment, these constructs assess style based on physiological aspects such as sensory perception, characteristics of the environment, and time of day. An example of a construct within this layer is Rezler and French’s (Rezler and Rezmovic [25]) Learning Preference Inventory. Developed to assess the learning preferences of students in allied health programs, the instrument measures the following preference dimensions:

Abstract: student prefers learning theories and formulating hypotheses, focusing on general principals and concepts.
Concrete: student prefers to learn tangible, specific tasks, with focus on skills.
Individual: student prefers to work alone.
Interpersonal: student prefers to work with others, including harmonious relations between both teachers and among students.
Teacher-structured: student prefers a well-organized, teacher directed, environment with clearly defined expectations and goals; and,
Student-structured: student prefers an environment that is autonomous, self-directed.

This primary layer could be seen as similar in many ways to the lowest level of Maslow’s needs hierarchy with subsequently layers moving up this hierarchy.

The second layer of styles includes constructs associated with information processing. Because this processing is not directly associated with the environment, this layer is more stable, yet may still be modified (Curry [5]). Kolb’s [20] Learning Style Inventory is based on the concepts of experiential learning and meets the criteria for this layer. Used extensively in assessing the learning styles of students in higher education, medicine, and business, classifications within this model are as follows:

Converger: relies on abstract conceptualization and active experimentation, utilizes problem solving, practical application of ideas, and does best when a single answer exists.
Diverger: opposite from the converger, relies on concrete experiences along with imaginative ability to view situations from many perspectives.
Assimilator: relies on abstract conceptualization, reflective observation, inductive reasoning to create theoretical models; and,
Accommodator: opposite from the assimilator, relies on concrete experience, active experimentation, and doing things. Risk takers, these people are adaptable to immediate changes and rely on trial-and-error intuition.

Anyone familiar with the basic writings of Piaget and Bruner will see the above dimensions as essentially being basic or core and general cognitive processes.

The inner most layer of Curry’s [5] onion model is the cognitive personality, or an “individual’s approach to adapting and assimilating information” (p. 8). As with information processing, there is no direct interac-
4. Jung's theory of psychological types

The 16 personality types identified in the MBTI were based on Carl Jung's theory of psychological types (see [23] for details). Jung [16] theorized that people utilize two sets of opposing mental functions: perception functions (sensing or intuition), and judging functions (thinking or feeling). An individual is capable of invoking each of these sub-functions. However, the sub-functions are mutually exclusive, with only one perceiving and one judging function in use at a time. From childhood, a person has a tendency toward one or the other type of each function, and the preferred functions become stronger with use.

According to Jung [16], a person perceives, or collects data, in one of two ways. People with a sensing perception focus on things as they appear at the present moment, and trust data acquired through direct observation or experience. A person who perceives through intuition focuses on the inner meanings and relationships of data, seeing possibilities.

The second mental function is that of judging about significance. One may judge and organize perceived data through thinking. This type of judgment is based on logical, cause and effect analysis. Decisions made by thinking-judgers are described by Jung as rational and impersonal. Feeling judgments are made about perceived data by weighing values and personal beliefs. Judgments made by feeling are personal and subjective in nature, with consideration given to the human aspect of the issues at hand [16].

A third dimension was identified by Jung [16] which describes how one processes data after perceiving and judging. The extrovert is influenced by their surroundings, using the environment for stimulation and guidance. Seen as action oriented, extroverts focus on the external world of people and things, and are considered to be objective.

Jung [16] identified introverts as reflective learners. The introvert is influenced inwardly, focusing on their own intentions and ideas that can be considered internally. Described as thoughtful and contemplative, an introvert's focus tends to be subjective. As with the functions of perceiving and judging, extrovert and introvert attitudes are mutually exclusive. Although one or the other attitude will tend to dominate, both may be present in an individual, and various circumstances may alter the predominance.

5. Teaching style research

As previously stated, only two style constructs were found that have a separate instrument to measure the learning style preferences of students and the teaching style preferences of instructors. These two instruments were (a) Canfield's [1] Learning Styles Inventory and Instructional Styles Inventory and (b) the Hanson [9] Learning Profile Indicator and the Silver, Hanson, and Strong [28] Teaching Style Inventory. This simple and basic fact would seem to indicate that the majority of learning style models and theories implicitly assume that learning styles and teaching styles are similar.

Lyons [21] questions this assumption, stating "Generally speaking, however, to this date research has not provided a theoretical model nor reasonable evidence to support this relationship (p. 1)" between learning and teaching styles. Lyons studied journal entries describing teaching style preferences of 20 prospective teachers, and compared these entries with each subject's preferred personality traits using the MBTI. Results indicated that there is a relationship between teaching and learning style, with identifiable teaching style behaviors reflecting learning style preferences. Although the subject group was small, it was concluded that these results provided a basic framework from which to build on this common theory [21]. In comparison, the Silver, Hanson, and Strong LPI and TSI were critiqued as measuring only perceptual modality and personality, which are broken down into four subgroups. Further, validity and reliability evidence for these two scales were characterized as moderate, while research based on them was identified as strong [15]. What then are the major differences between the Canfield and the Hanson scales?

There appears to be two substantial differences between the two instruments identified above. First, the
Canfield LSI has no theoretical constructs specifically and explicitly stated in the user's manual [1]. In comparison, Silver and Hanson [27] identify Jung's Typology Theory [16] as the underlying construct for the development of their instruments. Second, the number of subgroups (different styles) that each instrument generates is an important consideration with regard to use, interpretation and the practicalities of data analysis. Silver and Hanson's four subgroups are considerably more practical and tractable than the 17 in Canfield's instrument.

6. Methodology and results

Subjects for this study were from four nationally accredited undergraduate athletic training education programs in the United States. Of these, three were public institutions and one was private, and all were located in the northeast portion of the United States. Learning subjects included athletic training students \( N = 7 \) enrolled in a clinical experience course at one of the above mentioned institutions. Teaching subjects \( N = 5 \) were certified athletic trainers (ATC) who were responsible for out of classroom instruction and development of clinical/psychomotor skills (clinical instructors). Two important points must be noted about this sample.

First, this study had a direct behavioral observation component where students' learning style behaviors were directly observed while engaged in learning and instruction by two independent observers, and then these direct observations of learning style preferences were compared to the learning style preferences the students indicated on Hanson's learning style inventory. This kind of multi-method study, therefore, is labor intensive and can only be done with a relatively or comparably few subjects (with the resources typically available for such studies) and sample sizes in such studies typically will be small, if such a study is done (which is not often) with these kinds of scales. Consequently, one will not typically get a sample in a direct observational study that is four or five times larger the one in this study because of the very large amounts of time and resources that would be required to do such a study, particularly keeping the behavioral observers constant. There are, therefore, reasons why multi-method studies are not often done. But such studies need to be done, because such studies, if they do little else, ground "readings from these scales" in actual empirical observations, which not only needs to be done, but give one an indication of how grounded these types of instruments actually are.

The next point about this sample is that this particular sample of students and teachers, and this particularly learning context, were well-suited to validating Hanson's learning and teaching styles scale (or anyone else's) as the context involved both academic content, higher-order knowledge and understanding, as well as the teaching and learning of the specific skills associated with the academic component. This sample and specific context also had a high frequency of teacher-learner exchanges that were both academic (knowing that) and skill-focused (knowing how), which made it a more inclusive study sample and context than other validity studies of any of the scales mentioned in this article, and thus a more rigorous test of the Hanson scales and their generalizability to different contexts and situations (see [4] for details). In these respects, this sample is a good and representative sample, as it is like the typical learning and teaching contexts in various areas of allied health, as well as engineering and many of the sciences.

7. Instruments

The instruments utilized for this study were the Hanson Learning Profile Inventory (LPI) and Silver, Hanson, and Strong Teaching Style Inventory (TSI). As previously stated, both of these instruments are based on Jung's [16] theory of psychological types (see above), in which he identified characteristics of six learning styles and two information processing functions. According to Hanson, the Learning Preference Inventory developed in 1980 was the precursor to the current LPI instrument [9], which was designed to be shorter in length and easier to use. A correlation of 0.60 was reported between the earlier and later versions of the LPI.

Both the 1980 LPI and 1997 LPI are self-diagnostic assessments to identify individual learning style preferences. The four learning style preferences measured by the LPI are specifically:

1. Sensing-feeling (SF): Described as communicating learners, they focus on personal values and feelings. They are empathic and thoughtful.
2. Sensing-thinkers (ST): Described as realists, these learners focus on facts and skills, they are efficient and enjoy repetition, structure and direction.
3. **Intuitive-thinkers (IT):** Described as theorists, these learners focus on ideas and argument. They interpret, critique, and are cautious problem solvers.

4. **Intuitive-feelers (IF):** Described as creators, these learners focus on the new and unusual. They are imaginative, creative, and inventive.

Developed over a period of five years utilizing a population of 3,000 students from diverse backgrounds, the 1980 LPI has been used with elementary, secondary, higher education, and adult learners.

In 1984, Hanson et al. [10] reported a factor analytic study of the 1980 LPI. An initial pool of 500 items were analyzed and reduced to 100 items, which had 25 items for each of the 4 subscales (learning styles). These items were factor analyzed to determine construct validity. Items loading above 0.40 were retained. Six items were removed and seven items loaded on style factors other than what was originally hypothesized. Therefore, 94 items were retained. It was further reported that the perception and judging factors retained accounted for 70.31 percent of the original total variance. The four retained factors were found to have accounted for the following percentages of the common variance: (1) Sensing/Feeling = 23.50%, (2) Sensing/Thinking = 15.63%, (3) Intuitive/Feeling = 16.28%, and (4) Intuitive/Thinking = 14.90%. That each of these factors accounted for roughly equal variance, as hypothesized, was and is remarkable.

In a separate analysis, 40 items hypothesized to predict introversion and extroversion were considered. These 40 items included ten question items with four response options, two representing introversion and two representing extroversion. Only two items did not meet the 0.40 standard, and were removed (see [10]).

The remaining 38 items accounted for 71.28% of the original total variance, with Extroversion accounting for 35.79% and Introversion accounting for 35.49%, which again was an equal balance. In light of the reported results of analysis, the developers concluded that there is strong evidence that the 1980 LPI assesses the learning styles described and defined by both Jung and the MBTI.

The 1997 LPI developed by Hanson, specifically for adult use, has not been factor analyzed to date. However, the construct is based closely on the work done with the 1980 inventory. The inventory is made up of 50 sets of behaviors with four descriptive items for each set. A total of five points are to be assigned to each set according to which words or phrases best represent the preferred choice when learning something new. The ranked responses are then transferred by hand to the scoring sheet to compute the preferred learning style. There are no right or wrong answers, and the instrument does not measure intelligence or personality strengths and weaknesses [9].

8. **Teaching style inventory**

The TSI developed by Silver et al. [28] is an extension of the 1980 LPI, and allows the educator to identify one's preferred teaching style. The four teaching styles are named and described as those found in the LPI. The TSI includes 14 sets of behaviors which are grouped into seven decision-making categories including planning, implementation, setting, curriculum objectives, operations, roles, and evaluation. Each set has four descriptions which are to be rank ordered based on the individual's preferred response. The ranked responses are then transferred to the scoring sheet to compute the preferred teaching style. As with the LPI, there are no right or wrong answers and the instrument is intended to measure only one's instructional decision making preferences. No reliability or validity evidence has been reported for this instrument. Hanson (personal communication, July 22, 1998) refers to the factor analysis completed on the LPI and seems to simply assume the TSI is valid because it is based on the LPI.

9. **Field independence/dependence**

Field dependence/independence is considered to be a reliable and valid indicator of a person's global cognitive style. The GEFT assesses cognitive style as related to one's use of external and internal environment, and is described as follows [29]:

1. **Field dependence:** Trust external environment cues and tend to view information from a global perspective.

2. **Field Independence:** Rely on internal cues, with a tendency toward an analytical approach in viewing information.

A pencil and paper test, the GEFT is a perceptual task, asking subjects to locate a simple figure within a more complex one. It has been administered to undergraduate students in a variety of academic programs [18]. Three sections make up the test, including seven simple items in the first section used for prac-
tice. The other two sections contain nine items each, with a five minute time limit for the completion of each section. Scores range from 0–18 and are based on the number of figures correctly identified and traced in sections two and three. Test-retest reliability is estimated at 0.82 for males and females [29]. Predictive validity is reported to be −0.82 for males and −0.63 for females [29]. The GEFT is the highly validated instrument and thus "known marker" in this study (see [18]).

One inherent weakness of both the LPI and TSI, as well as other style inventories, is that they are self-reporting. This indicates that measures reported are subject to no external criterion to check responses. To check the construct validity of the LPI and TSI, a multitrait-multimethod design and analysis [18] was used. Silver, Hanson, and Strong [28] and Hanson [9] provide several examples of observable behaviors that are characteristic of each of the learning and teaching styles identified in the LPI and TSI. If the LPI and TSI are valid instruments, an individual's observable behavior in the field should match the style preferences reported on the LPI and TSI. In order to test this hypothesis, two observers went into the athletic training clinical setting and observed seven athletic training students and five clinical instructors. The independent observation of actual hypothesized behaviors component of this study is one of the factors that makes this study unique in providing validity evidence about this class of instruments, and the Hanson scales in particular, as such observation of actual hypothesized behaviors and their correspondences to the behavioral preferences checked by the subject on the scale is not often done in this area or many other areas as well. This study, if it does little else, grounds "reading from these scales" in empirical observation, which not only needs to be done, but give one indication of how grounded these types of instruments actually are.

The use of observation as a supplemental technique to complement a dominant technique is supported by Robson [26]. Kerlinger [19] also recommends the use of observation when interactions and behaviors are variables in the study. He states further that there is no substitution for seeing behavior as directly as possible. With regard to the athletic training clinical setting, Gardner [8] designed and validated an observation instrument. Gardner reported that the behaviors and interactions between student athletic trainers and clinical instructors can be measured through systematic observation. Therefore, this study utilized independent and direct observation to validate that the behaviors associated with preferred styles, as measured by the LPI and TSI, are also those behaviors being displayed most often by students and clinical instructors in the clinical setting.

The LPI and TSI Observation Form was a simple 2 x 4 grid with each style listed with space for observed behaviors to be recorded with one row for students and one row for teachers. The two observers were present in the clinical environment, positioned in a way so as to see and hear behaviors and interactions between the clinical instructor and athletic training student. After each observation event, the number of behaviors reported in each style category was tabulated. Each of the seven students and five clinical instructors were observed during two separate events which occurred for at least 15 minutes, but not longer than 20 minutes as recommended by Gardner [8]. After observations were completed for each subject, frequency distributions were compared and analyzed using chi-squares to determine their relation to reported style preferences on the LPI and TSI.

Examples of behaviors for each learning and teaching style are provided by Silver, Hanson, and Strong [28] and Hanson [9], and were used to define and describe each observation category. The same four categories were included in the observation of learning and teaching styles and these four categories were operationally defined as follows:

1. Sensing/Feeling: Learners described as focused on personal values and feelings. Examples of behaviors include: reading, group work, and mentor relationships. Teachers described as empathetic and people oriented, with emphasis placed on student's feelings of positive self growth. Examples of behaviors include: personal sharing of feelings and experiences, group investigation, and journaling.

2. Sensing/Thinking: Learners described as focused and purposeful. Examples of behaviors include: drill and practice, demonstration, directions, and facts. Teachers described as outcome oriented, with highly structured environments. Examples of behaviors include: clear, concise directions, teacher as primary information source, command, demonstrations, and competition.

3. Intuitive/Thinking: Learners described as focused on ideas and arguments, interpretive, critical, and hypothetical. Examples of behaviors include: independent work, lectures, brainstorming, organizing/planning, inquiry, simulations, and challenging.
Teachers described as intellectually oriented, with primary emphasis on student intellectual development. Examples of behaviors include: critical thinking, challenging, questioning, debate, lecture, brainstorming, and independent research.

4. Intuitive/Feeling: Learners described as focused on the new and unusual, comfortable with confusion. Examples of behaviors include: imaging, designing, open-ended discussion, and self-expressive activities.

Teachers described as innovation oriented, encouraging students to be creative. Examples of behaviors include: creative thinking, values, flexible planning, imagination, and self-expression.

The above scheme and topology was developed and used to make learning and teaching styles logically congruent with each other so that matches and mismatches between learning and teaching styles could be studied at a later date. The style categories that had the most behaviors listed in it was used to determine the overall style classification for each student and teachers. For 11 out of 12 subjects, one category was clearly dominant and accounts for roughly 80% or more of the observations. One teacher had a tie between two classification categories and had to be “double counted” (see below).

Gardner [8], in his inter-observer reliability studies, reported that the training time of raters does affect the inter-rater reliability of his instrument, and recommends at least 20 hours of training to achieve an acceptable reliability level of 0.70. Therefore, prior to conducting observations, the two observers spent approximately two hours reviewing and discussing the various learning and teaching styles and the behaviors associated with them. The observers then went into the clinical setting and conducted observations, discussing the events as they were being observed to determine the appropriate style associated with the particular behavior. Finally, a pilot study was done (N = 7), with each observer independently determining and recording observed behaviors in the appropriate style categories. By comparing the results of the observations, inter-rater agreement percentages and reliability coefficients were calculated. An inter-rater agreement of 71%, with an inter-rater reliability of 0.84 was established between the two observers.

Inter-rater reliability for the observers was also calculated during the main study (N = 12). Using all of the observed events (24), an inter-rater agreement of 69%, with an inter-rater reliability of 0.83, was established between the two observers. The inter-rater reliability results were consistent with the reliability levels established during the pilot observations. Inter-rater reliability coefficients were within acceptable limits.

An issue that had to be overcome during the design stages of this study was the fact that while the LPI measured two types of learning styles, whereas its counterpart, the TSI, measured only for sensing-thinking, sensing-feeling, intuitive-thinking, and intuitive-feeling. The instrument did not include items for measuring the introversion/extroversion classification. Rather than eliminate introversion and extroversion from the study, the investigator chose to incorporate the GEFT to measure the clinical instructors’ field independence/dependence. Although the operational definitions and theoretical framework for introversion/extroversion and field independent/dependent classifications were very similar, there was no view or study found in the literature that indicated these two concepts as comparable. Therefore, it was decided to test the validity of the introversion/extroversion scale in comparison to field independence/dependence. This test was accomplished by asking ten athletic training students to complete the GEFT. Their preference toward field independence/dependence was then compared to their preference toward introversion/extroversion as measured by the LPI.

A GEFT score indicating field independence was considered a match with introversion, and a GEFT score indicating field dependence was a match with extroversion. The results from the GEFT were then compared to the introversion/extroversion classifications reported in the LPI in order to determine construct validity for this portion of the LPI as well. The resulting agreement percentage between the GEFT and LPI classification scores was 60%, which is a concurrent validity coefficient of 0.77 (N = 10). This finding is both a good and acceptable concurrent validity coefficient for underlying interval variables that are reduced to dichotomies, even given the small sample size. The introversion/extroversion classifications of the Hanson (and other) scale is more than moderately related to the field independence/dependence classifications of the GEFT scale (and Witkin’s theory), which further validates and makes each scale more interpretable.

A reliability check of both the revised LPI and TSI was done as well. After a period of approximately 14 weeks, six clinical instructors and ten athletic training students were asked to complete the inventories for a second time. Results were compared to determine agreement percentages for the LPI and TSI. When the TSI results were compared, five of the six clinical in-
strutors were identified as having reported the same style preference. This is an agreement of 83% with a reliability of 0.91. Due to the very small sample size, this reliability coefficient is inflated, but it still (even with increased sample size shrinkage) indicates a reasonably good level of reliability. A similar analysis was done for the LPI. The agreement for ten students who completed the LPI for a second time at the conclusion of the academic term was also high at 70%, with a reliability of 0.84.

Using SPSS 13, a chi-square test was done to analyze whether a subject's empirically observed preferred style differed from the preferred style reported for the subject by the LPI and TSI. Students \( N = 7 \) and teachers \( N = 5 \) were pooled in this analysis because the common observational topology and classification system devised and outlined above corresponded to the classifications of students given by the LPI and the classifications of Teacher given by the TSI and to maximize the sample size for testing as well. Table 1 presents the frequencies of observed and reported style preferences. Although 12 subjects were observed, the table indicates a total of 13 subjects. The discrepancy in the number of N's is due to a tie in the observed frequencies. Because there were no reported or observed subjects in the intuitive-feeling (NF) cell (and thus a limitation of these results), the chi-square table was reduced to a \( 2 \times 3 \) appropriate and better analysis. The resulting Chi-Square \((df = 2)\) of 4.8 \((p > 0.05)\) indicated that there were no significant differences between the reported and observed learning and teaching style preferences of students and clinical instructors. Again, it must be emphasized here that the sample size is very small, but also that the sample sizes in a direct behavioral observation study such as this one will not typically be four or five times larger because of the very large amounts of time and resources that would be required to do such a study, particularly keeping the behavioral observers constant. Given these facts, the agreement observed between direct observation of style preferences and the scale values for style preferences on the Hanson scales is reasonably good independent and multi-method evidence for the validity of the LPI and TSI, particularly in relationship to the field independent/dependent finding and the reliability findings.

10. Discussion and conclusions

The purpose of types, topologies, taxonomies and other classification systems is to reduce inordinate complexities and details into a reasonable number of cognitively manageable conceptual and intellectual (thinking) units for use and processing, as all cognitive capacities are quite limited, as George Miller showed with his famous short-term memory parameter of \( 7 \pm 2 \).

Type theories and topologies can be quite problematic and difficult to use practically and in terms of research and thinking for several different reasons, and they are often disparaged by the "harder science" views of these matters, issues and phenomena, but education, psychology and allied health are in the "individual difference business", like it or not, and types, topologies, styles and their associated taxonomies are very prevalent and widely used, as was pointed out in detail at the beginning of this article. It behooves us, then, to know how reliable, valid, and grounded in actual observable (empirical) behavior the scales and classification systems we use are, as well as how parsimonious and non-overlapping (mutually exclusive and independent) their classification categories are so that we may use and interpret them with some reasonable level of surety and hopefully wisdom. Hanson's LPI and TSI inventories (scales) are the most parsimonious of the many scales out there and factor analytical studies of the older versions of these two scales have shown that there classification categories are mutually exclusive and independent as well as of equal weight relative to the percentage of total variance explained (i.e., none of the categories in Hanson's topologies are relatively minor ones). His newer versions of his LPI and TSI needed confirmatory factor analytical studies. However, these studies will not and have not answered two of the outstanding questions about his scales and scales like them. These two questions were (1) to what degree do subjects' selection of style preferences on these scales correspond to actual and observable style preferences as expressed in real behaviors in learning and teaching contexts, and (2) what are the introversion/extroversion components of these (and other) scales a measure of (most probably) as they are fairly murky classifications in and of themselves.

One of the main foci of this study was to better validate and ground the self-reported learning and teach-
ing style classifications of the LPI and TSI instruments. Through the use of direct observation by two independent observers, the empirical groundedness and validity of the LPI and TSI scales was supported when the chi-square test showed no significant differences between the preferred styles reported and the behaviors observed in both students and clinical instructors (N = 12). Relative to the second unanswered question stated above, comparisons of the LPI and GEF in terms of classifying subjects that similarly showed that they did (r = 0.77, N = 10) and this further supported the construct validity of the introversion/extroversion scale and helped to clarify its interpretability relative to the general and more validated psychology literature. Although the number of subjects in this study was small, this study or parts of it should be replicated with a larger sample. This study, therefore, was a formative study, but one that has given both strong and clear indications that the confirmatory study is more than well worth doing. Hanson's [9] claim that the LPI and TSI are valid instruments to assess learning and teaching style were supported in this study, which represents a step in the full and further validation of these scales.

References