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LEARNING ORIENTATION QUESTIONNAIRE CORRELATION WITH THE HERRMANN BRAIN DOMINANCE INSTRUMENT:

A validity study

by

Joanne Pamela Hall Bentley

A dissertation submitted to the faculty of

Brigham Young University

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Department of Instructional Psychology and Technology

Brigham Young University

December 2000

UMI Number: 9992331

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of a dissertation submitted by

Joanne Pamela Hall Bentley

This dissertation has been read by each member of the following graduate committee and by majority vote has been found to be satisfactory.

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As chair of the candidate's graduate committee, I have read the dissertation of Joanne P. H. Bentley in its final form and have found that (1) its format, citations, and bibliographical style are consistent and acceptable and fulfill university and department style requirements; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the graduate committee and is ready for submission to the university library.

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ABSTRACT

LEARNING ORIENTATION QUESTIONNAIRE CORRELATION WITH THE HERRMANN BRAIN DOMINANCE INSTRUMENT:

A validity study

Joanne Pamela Hall Bentley

Department of Instructional Psychology and Technology

Doctor of Philosophy

The purpose of this study was to discover how the Learning Orientation Questionnaire (LOQ) and the Herrmann Brain Dominance Instrument (HBDI) are related in an attempt to sharpen and elaborate their respective score meanings and theoretical interpretations in accounting for individual learning differences.

Based on expert judgment, items on the HBDI are primarily cognitive and the LOQ is primarily conative, confirming that the HBDI is more cognitively oriented and the LOQ more conative and affective. As experts sharpen distinctions between constructs, the clarity of their substantive processes increases, leading to improvements

in the construct validity of the instruments. Of practical importance is that experts found the LOQ to measure different constructs from the HBDI.

The correlations between the LOQ and the HBDI have significance in the story of similar substantive process operating for both instruments. The HBDI and the LOQ converge around measures of high intentionality. Intentionality appears to include HBDI scores in upper right, right mode, cerebral, whole-brainedness, CLWB, and CRWB. LOQ scores were more likely to correlate with multiple quadrant combinations (or whole-brainedness) than with single quadrant scores. The Upper Right was the most likely score to correlate with the LOQ scores. However, LOQ scores are also highly likely to correlate with multiple quadrant combinations (or whole-brainedness) such as CRWB.

Convergent and discriminant validation studies have been lacking in the past for both instruments. This study has begun to address issues of overlap and redundancy among individual difference instruments important in teaching and learning situations. Common areas in accounting for individual learning differences have been highlighted while drawing attention to distinctly different concepts for further consideration by authors of both instruments. As a result of this study, we have deepened our understanding of the content and substantive processes of construct validity for both instruments.

ACKNOWLEDGMENTS

There have been times when the obstacles in my path toward graduation seemed insurmountable. But now, despite all the oppositions and distractions, I will be the first person in my family to not only graduate with a Ph.D. but to have ever graduated from university at all.

To family, friends, and faculty on my committee, who have shaped me, encouraged me, and supported me throughout my graduate experience–I acknowledge your assistance, love, and support. I am especially grateful to my husband, Patrick C. Bentley. During the final stages of my dissertation he was a tower of strength as he encouraged me to finish. The Lord has blessed me greatly with such a loving and understanding companion.

I can do all things through Christ, which strengtheneth me.

Phillippians 4:13

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Introduction

In a classroom, seasoned teachers attempt to deliver subject-matter content to their students in such a way that the largest percentage possible can understand the material. However, even an exceptional master teacher knows that there will be some students who do not initially understand. Good teachers look for both verbal and non-verbal signals that identify students who are struggling with the content. Effective teachers adjust and augment their delivery to meet the specialized needs and background of these students. They may do this by giving additional examples, showing connections to a student's background or special interest, drawing pictures or diagrams to show relationships, or a variety of other means. Even then, it would help teachers respond more effectively if they had a valid and efficient method to assess and respond to individual learning needs.

Assessing individual differences in learning and then tailoring instruction to fit students' needs is less challenging when one can interact face-to-face with students for a semester or school year. If one strategy doesn't work one has the opportunity to try another, using verbal and non-verbal feedback to refine the delivery process. Over time, a student's preference for certain content delivery styles and study styles becomes evident. The ability to identify student's individual differences in learning and the opportunity to dynamically tailor instruction for an individual has always been possible in small groups and with one-on-one tutoring but has been difficult to do well in computer-based instruction (CBI) on more than a cognitive level.

Understanding individual differences in learning has been a major research interest since World War I. Over the ensuing years there have been many attempts to account for individual differences in learning (Gagné, 1967; Glaser, 1972, 1976; Ackerman, Sternberg, & Glaser, 1989; Jonassen & Grabowski, 1993). However, problems with getting a stable measure of these differences in learning, stable interactions with treatment alternatives, and limited, expensive technology made creating computerized instruction which accommodated a broad range of individual differences, too costly and time intensive.

During the era of media studies, it was common to assume that most people learned in a similar fashion. However, if we are intent on avoiding the "no significance differences" trap that Russell (1997) documents in his review of numerous media impact studies we should ask if lumping together different types of learners may not have confounded earlier research. Accordingly, if some learners were helped by a certain form of delivery, some were frustrated, and others were not particularly affected either positively or negatively, then it would not be surprising that there was frequently "no significance" in learning outcomes. If learners can be classified as Martinez (1998) suggests into intentional (transforming), performing, conforming, and resistant learners with different preferences for how they prefer to interact with content then it is little wonder that when multiple students' scores are combined that there is frequently no significant difference between treatments that ignore differences in individual learner preferences.

With the development of XML, meta-data, and cascading style sheets the potentially costly nature of re-working the delivery of content for individual learning preferences has been greatly reduced. "Designers are finally allowed to separate content from style of delivery" (Hall & Gottfredson, in press). Groups such as IMS, AICC, and IEEE are currently involved in developing learning standards which would allow small units of instruction, sometimes referred to as learning objects to be shared across different management systems. Using these and other technological advances in computing to support dynamic content adaption for different learning styles will be a huge step towards true mass-customization of instructional material. William S. Cohen, the U. S. Secretary of Defense, summarizes the vision of the Advanced Distributed Learning Network (ADLNet) as being to "provide access to the highest quality education and training, *tailored to individual needs*, delivered cost effectively, anywhere and anytime" (ADLNet, 2000, Emphasis added). The technology should be the tool delivering shareable content, assembled on the fly, using a variety of learning management systems, and new instructional design theories, which take into account a broader range of individual differences in learning.

Now, with the rapid expansion of the internet, web-based courses purporting to meet individual needs abound. However, the notion of mass-customization and personalized instruction has come of age faster than the instructional design theories needed to support it. Although the fledgling technology is now available for limited personalization of instruction, there are still few substantive, prescriptive solutions as to how to account for a variety of individual differences in web-based learning. Nowhere is

the issue of developing mass-customization in instruction more problematic than in the training arena where establishing return on investment for new innovations in training is crucial. It is in industry that Martinez and colleagues (1999a, 1999b, 1998, 1997; Martinez et al., 1999; Martinez & Bunderson, 1998) have begun an aggressive push to apply her theory of accounting for individual differences through learning orientations to web-based instruction.

The quest for personalized, adaptive, web-based instruction can be (and most likely will be) approached in the business arena through excessive promotion and hype based on seemingly face-valid ways of adapting to individual differences. Many will likely succumb to the initial allure of superficial instances of name recognition and the occasional opportunity for elements of self-directed learning and happily call it personalized learning. However, it is highly unlikely that these initial attempts at personalization will attempt any cognitive-based or whole-person-based efforts to personalize instruction due to the amount of additional effort required in development and only a vague understanding of what it means to really personalize instruction.

Alternately, personalized, adaptive, web-based instruction should be grounded in construct-valid instruments that diagnose significant learning differences which demand alternative delivery options. The first step in this process is understanding the content and substantive processes that lead to crucial learning differences. Then prescriptive propositions can be framed and tested that prescribe the different treatments which work best for different profiles. Understanding the substantive processes that lead to key learning differences is the key, both to improving diagnostic instruments that profile

individual learners, and to formulating the prescriptive design principles that lead to the adaptive treatments.

Martinez is one of the first in web-based instruction to attempt to account for individual differences in learning in a construct-valid manner, and couple these with dynamic delivery of content. Therefore, establishing a stronger case for the validity of her diagnostic instrument, the Learning Orientation Questionnaire (LOQ), which is based on the learning orientation construct, becomes a timely research endeavor. However, such research must be undertaken a step at a time. The next step is to obtain a deeper understanding of the construct validity of the LOQ and of other promising difference profiling instruments.

Statement of Purpose

There is a need for basic validation research on the new and promising Learning Orientation Questionnaire (LOQ) to examine issues of overlap and redundancy with other preference profile instruments in common use. The purpose of this study is to discover how the LOQ and the Herrmann Brain Dominance Instrument (HBDI) are related and if their items measure similar or distinctly different constructs in an attempt to sharpen and elaborate their respective score meanings and theoretical interpretations. This study will primarily address the issue of convergent and discriminant validity for the LOQ and the HBDI in accounting for individual differences in learning. In so doing, it will deepen understanding of the content and substantive process aspects of construct validity of both instruments.

Convergent and discriminant validation studies are lacking for the LOQ, although a number are available for the HBDI. In conducting a convergent and discriminant validity study of the LOQ and HBDI, common areas in accounting for individual learning differences are highlighted while drawing attention to distinctly different concepts for further consideration by both instrument authors. Out of such research we can hope for better instructions to the users of the instruments to assist in appropriate use and interpretation, and improved instrumentation to profile individual differences in learning.

It is important to remember that establishing the validity of an instrument is an ongoing process rather than a single event. Previous research has begun the process of building a validity argument for the LOQ, but convergent and discriminant studies have been distinctly lacking (Martinez, Bunderson, & Wiley, 2000). This research will provide further construct validation evidence, including the examination of theoretically explainable discriminant and convergent patterns between the LOQ and the HBDI. Both instruments are of particular promise in furthering our understanding of individual differences in learning.

The HBDI was chosen for comparison to the LOQ because unlike many other preference profiles, the HBDI has almost always been used and refined in adult learning settings. The Herrmann Group has worked to design valid approaches to help students with different profiles be successful learners. They instituted workshops in Applied Creative Teaching And Learning (ACTAL) to make use of the individual difference information generated by the HBDI. The Herrmann Group is committed to training and certifying educators and trainers in teaching methods designed to help all learners be

successful. They are especially interested in methods which will help small groups of people with vastly different profiles collaborate. The past and future utility of the HBDI in education made it a more attractive instrument than other commonly used instruments. Future research in educational settings will be able to build on the findings from this study as the case for validity of the LOQ and HBDI, their application and interpretation are strengthened.

The Learning Orientation Questionnaire (LOQ) was designed as an assessment instrument to reveal the dominant power of emotions and intentions in guiding and managing cognitive processes. The area of conation is slowly gaining recognition as an important influence on learning and is no longer demoted to a secondary role in the process (Snow & Jackson, 1993; Snow & Jackson, 1997; Jackson, 1998). It is in understanding the meta-structure or higher order nature of the complex relationships between learning orientations and interactions that we can return to Cronbach's (1957) hypothesis that we should find "for each individual the treatment to which he can most easily adapt." And, ultimately we should design treatments, not to fit the average person, but to fit groups of students with particular aptitude patterns. We should seek out the critical relationships between conative, affective, cognitive, and social factors which correspond to (interact with) modifiable aspects or presentation features of the treatment.

The Herrmann Brain Dominance Instrument (HBDI) originated from Ned Herrmann's study of research on brain function and his application of these ideas to a variety of business and social settings. During the era of cognitive research, he developed an instrument that proved accurate and useful in profiling dominant individual mental

preferences on a wide range of activities that can be expressed in terms of certain conceptual quadrants of the brain. Over the many years that the HBDI has been in use it has been determined to be a valid measure of individual preference (Bunderson, 1988). Correlation of the LOQ to the HBDI will show how closely related they are in the areas of the cognitive, conative, affective, and social constructs each purports to measure. This study will also show if the constructs purportedly measured by one instrument correlate with related and unrelated constructs on the other instrument as expected. The task-specialized functioning of the brain highlighted by the HBDI may indicate additional strengths and weaknesses for each of the LOQ orientations suggesting possible remedies for more intentional or successful learning.

Research Questions

1. Based on the judgments of experts in the HBDI constructs and items, and the judgments of educational psychologists familiar with different psychological domains, how do the HBDI items distribute across the psychological domains of cognition, conation, affect, values, social, and physical?
2. Based on the judgments of experts in the LOQ constructs and items, and the judgments of educational psychologists familiar with different psychological domains, how do the LOQ items distribute across the psychological domains of cognition, conation, affect, values, social, and physical?
3. How consistent (in relation to other LOQ experts) and accurate (in relation to the

observed correlations) are experts in the LOQ constructs in predicting the correlation of the HBDI items and scales scores with the LOQ scale scores where there is a substantive process reason to expect a correlation?

4. How consistent (in relation to other HBDI experts) and accurate (in relation to the observed correlations) are experts in the HBDI constructs in predicting the correlation of the LOQ items and scales scores with the HBDI scale scores where there is a substantive process reason to expect a correlation?

5. How are the LOQ items and scales correlated with the HBDI items and scales? Are these correlations consistent with expectations derived from the thinking styles construct of the HBDI and the learning orientation construct of the LOQ?

It is well known that the creative human mind can invent seemingly plausible explanations ex-post-facto for any correlation that is revealed by data analysis. Therefore an attempt was made to hypothesize in advance, on the basis of construct meaning for the two instruments, where correlations were likely to occur. Although it is unusual to include both research questions and hypotheses, I have done so to inform the reader of my own preconceptions about how the two instruments will correlate. Hypothesis 1 and 2 are based in apparent content and purpose features of the two instruments that have never been examined empirically. Hypotheses 3, 4, and 5 have a different focus. They predict the direction of correlations, positive and negative, thought to be important to construct meaning. Hypotheses 3, 4, and 5 deal with the best hypotheses the author, in consultation with colleague experts in the HBDI and LOQ constructs, could construct prior to conducting this study.

Hypotheses

1. The HBDI will have a broader scope across different domains than the LOQ, but will emphasize cognitive and social constructs.
2. The LOQ will focus on learning situations and as a result not span as many domains, but will emphasize conative and affective constructs and de-emphasize cognitive, physical, social, and values.
3. LOQ scores are more likely to correlate with multiple quadrant combinations (3 or 4) as they approach HBDI "whole brainedness" rather than with single quadrant scores.
4. LOQ scores are more likely to positively correlate with Upper Right scores than any other single quadrant score.
5. LOQ scores are likely to correlate negatively with the Lower Left score.

Transforming learners have the highest score on the LOQ composite and primary factors. The learning orientation construct which underlies the LOQ suggests that transforming learners can synthesize and "see the big picture", looking ahead to assess where they would be as a result of intentional, sometimes risky, but always self-managed learning engagements. In the HBDI, the Upper Right has the same synthesizing, holistic, future-seeing, and risk taking aspects without an emphasis in effort and independent control. Transforming learners dislike sequential, step-by-step learning, especially when they have no other choice. Since risk-control, and sequential, step-by-step learning are features of Lower Left and Lower Left has a strong negative correlation with Upper

Right, it was hypothesized that Lower Left would negatively correlate with LOQ scores even though careful planning (Lower Left feature) is also a part of the LOQ effort factor.

Given what was known about the learning orientation construct, it was not known if there would be any other significant and interesting correlations that would emerge from the data. These five hypotheses were the only ones generated in advance. The study design itself, however, generated many other mini-hypotheses. These came in the form of predicted correlations. HBDI experts predicted correlation of HBDI sub-scores with LOQ items. LOQ experts predicted correlation of LOQ sub-scores with HBDI items.

Overview

In this dissertation, Chapter 1 provides a brief introduction to why this research study is necessary, a statement of purpose, and the research questions which drive the study. Also included are the researcher's tentative hypotheses. However, the main focus of this dissertation is on answering the broader research questions so that more sophisticated hypotheses can be developed in future research.

Chapter 2 reviews the relevant literature beginning with a discussion of validity with an emphasis on construct validity. This is followed by an historical overview of individual difference research, including the difference between cognitive and conative constructs of individual differences in learning, and problems in accounting for individual differences. The literature review will also address how the HBDI was chosen for comparison to the LOQ and the existing validation evidence for both the LOQ and HBDI.

Chapter 3 explains the methodology used in the study. The overall design addresses how and why expert judgments of psychological domains were used, and how the LOQ and HBDI instruments were correlated. The subject sample design, instrumentation, and statistical analysis are also discussed.

Chapter 4 presents and discusses the results of the study as they shed light on the five research questions identified in chapter one. These questions address issues of expert judgment of constructs on the LOQ and HBDI, specifically how consistent and accurate are their predictions. However, the main focus of this dissertation is how the items and scales on both instruments actually correlate, and how reasonable their correlations are in relation to the theories of construct meaning behind the two instruments as we look for evidence of convergent and discriminant validity.

Finally, Chapter 5 will summarize the findings for each research question, identify practical implications, discuss the limitations of the study, and suggest areas for future research.

Chapter 2

Literature Review

The review of literature is divided into four sections. The first section introduces (a) the six kinds of construct validity, and (b) shows how the process of developing a validity argument can be used to direct research design. The second section includes (a) a brief historical overview of individual difference research in learning, (b) a short discussion of the differences between cognitive and conative approaches to learning, and the (c) problems associated with accounting for individual differences. The third section covers (a) the rationale behind the selection of the HBDI for comparison to the LOQ, and (b) briefly describes each instrument and the existing validation evidence for them. The Fourth, and final section is a glossary of terms.

Construct Validity

The Joint Committee on Standards for Educational and Psychological Testing (1999) describe validity as "The process of . . . accumulating evidence to provide sound scientific basis for the proposed score interpretation" (AERA, APA, NCME, 1999, p. 9). Ho (1988) adds, validity is the "meaningfulness, usefulness and appropriateness of inferences . . ." about the constructs the tests are trying to measure derived from the test scores rather than the actual validity of the tests themselves (p. 2).

Six Aspects of Construct Validity. The concept of validity has matured greatly over the past 35 years (Angoff, 1988; Messick, 1980, 1988, 1995). Under the currently

accepted unified concept of construct validity, Messick (1995, 1998) suggests that there are "six aspects of construct validity [which] apply to all educational and psychological measurement" (1998, p. 12). They are content, substantive process, score structure, generalizability, external relationships, and testing consequences. Cronbach (1988) reminds us that the validity "argument must link concepts, evidence, social and personal consequences, and values" (p. 4). The six aspects of validity are used jointly in constructing the validity argument and prove useful in "linking the evidence to the inferences drawn" (Messick, 1998, p. 12). However, "different sources and mixes of evidence" are needed in every argument to support the variety of possible inferences (Messick, 1998, p. 3). When "taken together, they provide a way of addressing the multiple and interrelated validity questions that need to be answered in justifying score interpretation and use" (Messick, 1998, p. 12).

The first aspect of validity is content. This involves delineating the "boundaries of the construct domain to be assessed . . . determining the knowledge . . . and other attributes to be revealed by the assessment" (Messick, 1995, p.745). Concept mapping and expert judgment are two ways to establish content validity (Validity Issues, 2000).

Substantive process is the second aspect of validity and it "emphasizes the role of substantive theories and process modeling in identifying the domain processes to be revealed in the assessment"(Messick, 1995, p. 745). Martinez, Bunderson, & Wiley (2000) suggest that the "instrument blueprint and material traditionally found in an excellent 'test manual' [could] constitute the documentation for this phase of the validity argument" (p. 9).

The third aspect is structural validity. According to Messick (1995), "the theory of the construct domain should guide . . . the selection . . . of relevant assessment tasks . . . [and] the rational development of construct-based scoring criteria and rubrics" (p. 746). In other words it is "the degree to which the score scales are consistent with the structure of the domain being measured"(Messick, 1998, p. 8). Martinez, Bunderson, & Wiley (2000) suggest that the "dimensionality and boundaries of the domain can be confirmed through factor analytic and other studies" (p. 10).

Generalizability is the fourth aspect of validity. It is concerned with ensuring that the sample of items are constructed broad enough to be representative of (or generalizable to) the construct domain intended to be measured (Messick, 1998, p. 10). "Reliability and G-theory studies are commonly used to provide evidence of this aspect of the validation argument" (Martinez, Bunderson, & Wiley, 2000, pp 13). Differential Item Functioning (DIF) studies with samples that include different sub-groups may also be helpful.

The fifth aspect is external validity which emphasizes convergent and discriminant validity. "The constructs represented in the assessment should rationally account for the external pattern of correlations" with "both convergent and discriminant correlation patterns [being] . . . important" (Messick, 1995, p. 476). "Measures of the same construct should converge to provide triangulated evidence for the construct . . . Predictive studies [such as correlational studies,] provide converging or diverging evidence, depending on what was predicted" (Martinez, Bunderson, & Wiley, 2000, pp 14).

Consequential validity is the sixth and final aspect which "includes evidence and rationales for evaluating the intended and unintended consequences of score interpretation and use in both the short- and long-term" (Messick, 1995, p. 476). Martinez, Bunderson, & Wiley (2000) remind us that issues of fairness and test bias are important while trying to achieve the positive consequences for which the instrument was designed at the same time avoiding any negative consequences for groups or individuals as a result of invalidity of the test (pp 15).

In this study content, substantive process, and external (convergent and discriminant) validity are of specific interest in the comparison of the LOQ and the HBDI.

Construct Validity as a Design Process. Many people do not strongly associate construct validity with research design processes. They "have not recognized [it because] the idea has been couched in a logical empiricist (or even an operationalist) conceptual framework" (Martinez, Bunderson, & Wiley, 2000, pp 5). They point out that "construct validation has been seen as obtaining good operational measures, rather than using multiple methods and multiple measures or experimental situations to confirm interpretation of results based on the operation of an invisible causal factor–the theoretical construct" (Martinez, Bunderson, & Wiley, 2000, pp 6). Hence understanding the validity of the measure becomes a manifestation of the theoretical underpinnings. "The theory about the construct is confirmed or disconfirmed equally and simultaneously with the success of the measurement instrument" (Martinez, Bunderson, & Wiley, 2000, pp 5).

The six aspects of validity can be used as a heuristic "to plan the schedule and details of efforts to collect evidence and prepare argument for the validity of the theory, instruments, and prescriptions in a system"(Martinez, Bunderson, & Wiley, 2000, pp 8). In this study three of the aspects of validity; content, substantive process, and external validity, were used to inform the research design process.

Individual Difference Research

Historical Perspective. Understanding individual differences in learning has been a research interest since World War I when the United States government sought faster, more efficient ways to train soldiers. In the fifties, Cronbach (1957) optimistically challenged the field to "find for each individual the treatment to which he can most easily adapt", however, perhaps due to the systematically cognitive approach used by researchers of the time, this challenge proved to be more complex than they had originally anticipated.

In the early sixties Guilford proposed the Structure-of-Intellect (SOI) model with three cognitive dimensions and one behavioral dimension to account for individual differences (1967). Glaser's (1972) new aptitudes and Sternberg's (1982) process-orientation model of intelligence also added a considerable amount of insight into how people differ in their cognitive processing of information. The computer was seen by many as an ideal metaphor for the human mind as researchers looked at how learners input-process-output information but there still remained many unanswered questions.

The seventies were a frustrating time for many researchers in this field as they clung tenaciously to a predominantly cognitive approach to understanding how individuals learn. Cronbach (1975) expressed frustration that he and Snow had been thwarted by the inconsistent findings from similar inquiries–studies employing the same treatment variable found different outcome-on-aptitude slopes. Around the same time Merrill (1975) argued that student performance was too dynamic to be supported by the permanence and pervasiveness of primarily cognitive aptitude-treatment-interactions and worried that students, without flexible structure systems and learner control, would become system dependent on prescribed solutions.

However, it wasn't until the eighties and into the nineties that more balanced, or whole-person, perspectives of learning were popularized including Bandura's (1986) social learning theory and Gardner's (1984, 1993) multiple intelligences. These theories tried to incorporate affective, conative and social influences into their explanations for how individuals learned.

More than any other theory on individual difference, Gardner's descriptive ideas gained widespread popular acceptance during the early nineties. They are believed by many, in education and society in general, to be intuitively appealing, having considerable face validity. However, Gardner (1999) cautions that the lack of prescriptive instruction as to how to apply his theory of different intelligences to educational settings has lead to many erroneous applications of the theory in categorizing learners. Recently, Gardner (1999) re-framed his original seven *intelligences* to include additional modalities by which he believes individual differences in learning can be accounted for, but the theory

still has only a little to offer in the way of prescriptions for adapting instruction to meet these identifiable differences.

Research conducted by Martinez (1998, 1999) in the late nineties suggests that there is a way to determine a more stable predictor of individual difference than by using cognitive measures alone. Her work on conative and affective measures suggests that recognizing the dominant influence of emotions and intentions on learning is a primary factor in understanding why individuals learn differently and how they develop, manage, and use cognitive ability. In other words, it is the emotional response that drives learners as they try to navigate a course, acquire new skills and knowledge, or improve performance. If she is correct, the LOQ has the potential to become a powerful tool in accounting for individual learning orientation differences and in providing necessary prescriptive solutions.

Cognitive and Conative Constructs. Cognitive aptitude relates to mental processes of easily acquired as well as complex knowledge or knowing. Much of what we now refer to as the cognitive domain was specifically organized in Bloom's taxonomy and includes knowledge, comprehension, application, analysis, synthesis, and evaluation. (Bloom, Engelhart, Frost, Hill & Krathwohl, 1956). Anderson and Krathwohl (in press) have recently worked with a committee of theorists in conjunction with K-12 practioners to revise Bloom's original framework for more practical application "in planning curriculum, instruction, assessment and the alignment of these three." The revisions include several changes in emphasis, terminology, and structure although most of the essential elements are still present in some form. The revised taxonomy framework

includes remember, understand, apply, analyze, evaluate, and create. Revisions in terminology were made for practitioner clarity and to be consistent in the noun-verb agreement with the way good objectives are framed. Anderson and Krathwohl (in press) believe that teachers need "an organizing framework that increases precision and, most importantly, promotes understanding" of cognition.

Bloom (1956) originally contended that cognitive ability is the mechanics of thinking and learning based on the assumption of a logically organized process. Researchers following in this vein have given preeminence to cognitive ability, although it is acknowledged that "outside influences" (usually conative or affective impulses) can cause temporary fluctuations in cognitive performance (Gredler, 1997). However, the current rhetoric in the education arena has popularized many conative phrases like learning engagement, life-long learner, self-regulated learner, asynchronous learner, just-in-time learning needs, self-motivated, and self-directed to describe successful learners. These phrases incorporate both conative and affective dimensions indistinguishably with cognitive ability to learn. Bereiter and Scardamelia (1993) summarize these uniquely human attributes of emotion and desire for action as *intentionality*. However, they still assign intentionality to a secondary role in learning and focus primarily on cognitive ability. Anderson and Krathwohl (in press) briefly deal with intentionality but in relation to a teacher's purpose for teaching rather than a learner's reason for learning.

Martinez (1999a, 1999b, 1998, 1997) goes beyond the work of Bereiter and Scardamelia to provide an elaborated view of intentional learning by elevating intentionality to a primary or dominant position as an influence on learning. This

perspective includes the combination of beliefs, control, enjoyment, effort, and intentions at three distinct levels (transforming, performing, and conforming) as they relate to learning at each level of orientation. She believes that such a model when used to determine learner orientation can provide relevant information on how to mass customize and dynamically personalize instruction to meet the needs of individual learners.

Problems in Accounting for Individual Differences. Over the years there have been many attempts to account for individual differences in learning. However, the problems associated with getting a stable measure of these differences have caused many to conclude that they are indeterminable. Without the necessary consideration of the dominant influence of emotions and intentions on learning, both Cronbach (1957, 1975) and Snow (1987; Snow et al., 1990) were unable to find stable cognitive/aptitude treatment interactions.

Both Snow and Cronbach found more stable attribute/treatment interactions at the conative level (Cronbach, 1975). In the late eighties, Snow (1987) described how in cognitive psychology conation as a learning factor has been demoted, and, since it seems not really to be a separable function, it is merged with affect. Together these factors are viewed as mere associates or products of cognition, and then ignored. He warned that individual difference constructs or aptitude complexes needed greater consideration of the joint functioning between cognitive, conative, and affective processes. Snow was in search of an information processing model of cognition that would include (still as a secondary consideration) possible cognitive-conative-affective intersections.

He was looking for a way to fit realistic aspects of mental life, such as mood, emotion, impulse, desire, volition, and purposive striving into instructional models. According to Snow (1989), the best instruction involves treatments that differ in structure and completeness and high or low general ability measures. Highly structured treatments (e.g., high external control, explicit sequences and components) seem to help students with low ability but hinder those with high abilities (relative to low structure treatments).

By treating individual differences in learning as a predominantly cognitive phenomena, researchers may have unwittingly ignored a key element in the equation. More recent research (Snow & Jackson, 1993; Snow & Jackson, 1997; Jackson, 1998; Martinez, 2000) suggests that may well be the case.

Instrument Selection

Selection of Instrument for Comparison to LOQ.

There are many individual difference instruments available that might be used to profile learning styles or approaches. These include psychometric tests based on Guilford's (1967) Structure of Intellect model, McCarthy's (1987) 4-MAT system synthesized from brain and thinking style research, Kolb's (1984) experiential learning inventory, the Meyers-Briggs (1980) personality type inventory, and the Herrmann (1970) brain dominance instrument. Far from being an exhaustive list, this demonstrates the diversity of personal preference profile instruments currently available–each supposedly different and suitable for different applications.

Selecting a single instrument from the many available for comparison to the LOQ was made on the following criteria: the researchers prior knowledge of the instruments, availability and access to the instrument for research purposes, and a qualitative judgment about degree of similarity with the LOQ. It was particularly important for the comparison instrument to reasonably be expected to overlap with the LOQ in at least one construct domain.

The final selection came down to the two most widely used and recognized style or preference profile instruments: the Meyers-Briggs Type Inventory (MBTI) and the Herrmann Brain Dominance Instrument. The MBTI assigns personality profiles on the basis of eight criteria which combine into 16 different profiles. The four bi-polar dimensions of introversion-extroversion, sensing-intuition, thinking-feeling, and perceiving-judging were developed by Isabel Meyers and her daughter Isabel Briggs and are rooted in Jungian psychological types (Felder, 1996).

Developed and used primarily in instructional settings associated with professional adult learning, the Herrmann Brain Dominance Instrument was designed to profile individual thinking style preferences on a wide range of activities typified by activities found to be associated with certain metaphorical quadrants of the brain to describe an individual's preferred mode of knowing and learning. The Ned Herrmann Group (1989) maintain that the results produce ". . . a metaphoric model of preferred modes of thinking, [with] a highly validated statistical and visual display of Brain Dominance" (p. iii). The Herrmann Brain Dominance Model was heavily influenced by

the research of Roger Sperry (1977), Paul MacLean (Rosenfeld & MacLean 1976; MacLean 1981) and other early brain researchers.

The HBDI based it's initial ideas of thinking style differences in early brain research, and the importance of continual evaluation of the constructs. The HBDI will surely be influenced by the important new findings coming from neuropsychology. The LOQ did not start from a review of neuropsychology and research, but is finding support for it's assertions of the initiating, energizing, and directing influence of affective and conative processes in recent brain research. Research and theory such as that of Ledoux (1996) and Damasio (1999) support this assertion. Thus instruments not well connected to brain research, those based on a strictly cognitive information processing (CIP) view, a theory of psychological types, or other cognitively empirical research were seen to be less relevant to this initial study.

The HBDI is less rigid than the MBTI as it has a greater capacity to allow for degrees of preference. The HBDI has fewer forced-choice items than the MBTI–items which force selection from dichotomous word pairs. The MBTI is almost completely made up of forced choice, dichotomous word pairs. Such forced selection can be frustrating for individuals with a divided or balanced preference in two normally opposed areas such as thinking and feeling on the MBTI. The MBTI has come under some criticism by those not of the Jungian mind-set for it's heavy use of forced choice questions and for misuse in organizational and occupational settings (Boyle, 1995; Gardner & Martinko, 1996). In addition to being developed and refined in instructional settings, another of the HBDI strengths is its ability to measure multiple dominance

instead of forcing individuals to be one way or another. Hypothesis three of this study suggests that the LOQ requires balance between seeming opposites to achieve the transforming learning orientation. For all of these reasons, the HBDI is preferred over the MBTI for comparison to the LOQ.

Existing Validation Evidence for the LOQ and HBDI. The Learning Orientation Questionnaire (LOQ) is a relatively new instrument designed around the Learning Orientation Construct to identify "underlying factors that significantly impact learning and serve as learning-difference variables" (Martinez, online, 2000a). Martinez goes on to explain that the LOQ "is a self-report, diagnostic instrument founded on an agentive psychological three-factor representation called the learning orientation construct"(Martinez, online, 2000b). As used in this study, "the LOQ contains twenty-five items using a seven rating point Likert scale (1 = Not At All True of Me and 7 = Very True of Me) to measure the dimensions that underlie the Learning Orientation Construct" (Martinez, online, 2000b).

The instrument takes approximately 20 minutes to complete in paper and pencil form. Refined through a series of analytic studies including principal component factor analysis, confirmatory factor analysis, Schmidt-Leimen, correlational, and alpha coefficient reliability analyses in the "create, refine, test again, refine, test again" process (Martinez & Bunderson, 1999). The LOQ isolates and measures three primary factors that influence successful learning. These are interpreted as (a) conative/affective learning focus, (b) committed strategic planning and learning effort, and (c) learning independence or autonomy, and are explained below (Martinez, online, 2000b).

a. Learning Focus Domain This factor refers to the individual's will, commitment, intent, drive, or passion for improving , transforming, and setting and achieving goals, taking risks, and meeting challenges. It describes the individual's *general* conative and affective orientation to the process of learning, regardless of content, environments, resources, or course delivery. (Naturally, learners will be more intentional and enjoy or apply greater effort in specific courses, topics, or situations that interest or appeal to them and then motivate them to learn.)

b. Learning Independence Domain This factor refers to the individual's desire and ability to take responsibility, make choices, control, manage, and improve their own learning, self-assess, and self-motivate (i.e., make choices independent of the instructor or prescribed sequences) in the attainment of learning and personal goals.

c. Committed Strategic Planning and Learning Effort Domain This factor refers to the degree that learners commit deliberate, strategic effort to accomplish learning. Successful learners place great importance on the act of striving or commitment to applying focused, strategic planning and hard-working principles to learn. Less successful learners generally lack insight that strategic planning and committed effort is a contributing factor for achievement.

d. Composite Factor (Learning Orientation) A second order factor was discovered in construct validation studies using the LOQ. High scores in the composite score indicated transforming learners. Low scores in the composite score indicated conforming learners and where learning is avoided, resisting learners. Since the three

primary factors correlate at about the same level with this 2nd order factor, a composite score is obtained by summation of the primary factor scores.

The Herrmann Brain Dominance Instrument (HBDI) has been used for approximately 30 years and was designed to measure dominant mental preferences, or thinking styles in learners to predict behavior. It grew out of brain-related research synthesized by Ned Herrmann to create an instrument for use in adult learning settings while he worked as head of management education at GE in the 70's. Currently, it consists of 120 questions using a variety of question types. Like the LOQ, the HBDI was originally administered in paper and pencil form and is also available for on-line administration and scoring. It is a self report instrument which takes approximately 30 minutes to complete.

Over the years the HBDI has been refined through practical experience and research. Bunderson (1988) reviewed five validity studies dealing with external and internal construct validation. Numerous dissertations have used the HBDI in their research (Herrmann, 1988, p 72). The four quadrant model of brain dominance is metaphorical in nature rather than strictly literal as it attempts to represent an individual's preferences for certain types of activities by (a) upper left /cerebral left, (b) lower left /limbic left, (c) lower right /limbic right, and (d) upper right /cerebral right.

a. Upper Left /A Quadrant. Those characterized as representing the upper left quadrant typically analyze, dissect, and solve problems logically by getting facts in the here-and-now. For them, thought is reality. They are logically efficient with the ability to perceive, verbalize, and express things precisely. They are adept at reducing the

complex to the simple and they reject ambiguity, seeking control of their environment and themselves.

b. Lower Left /B Quadrant. Those characterized as representing the lower left quadrant typically are verbal, use linear logic, and are interested in what has worked in the past. They also seek control of their environment and themselves but through tried and tested rules. They have the ability to sequentially and systematically sift through large amounts of information to create sense and order. They are punctual, procedural, and detail-oriented by focusing on one thing at a time. They reject ambiguity and often have difficulty with change.

c. Lower Right /C Quadrant. Those characterized as representing the lower right quadrant typically are socially intuitive and are aware of mood, atmosphere, attitudes, and energy levels of others. They are emotional, spiritual, empathetic, nurturing, and musical. For them, experience is their reality. They can be undisciplined, impractical, and sentimental due to an aversion to facts, goals, time, and money. They value communication and connection to others. They see comfort and inspiration in traditions.

d. Upper Right /D Quadrant. Those characterized as representing the upper right quadrant typically thrive on new ideas, possibilities, incongruities and are often considered visionary and holistic by others. They are largely nonverbal, imaginative, colorful, artistic, fanciful individuals, preferring metaphors and pictures. They seldom make a deadline or take a task through to completion. They favor original nonlinear thinking, resist structure, and are often impersonal, choosing to focus on internal processes.

e. Other Composite or Derived Scores. Other scores such as right, left, cerebral, and limbic can also be obtained by the Herrmann. The whole-brain score and quadrant specific whole-brain scores were generated independently from the Herrmann scoring program but were derived from the Herrmann scores as described in the glossary of terms.

Convergent and discriminant validation studies are needed for the LOQ. There is a need to examine issues of overlap and redundancy with these two instruments. A convergent and discriminant validity study highlights common areas in accounting for individual learning differences while drawing attention to distinctly different constructs for further consideration by both instrument authors. Out of such research we can hope for improved understanding of the substantive process constructs that define each instrument.

Glossary of Terms

Affective: Influenced by or resulting from the emotions or feelings. This includes aspects such as passion, frustration, satisfaction, distress, joy, fulfilment, gratitude, comfort, arrogance, or disinterest.

Cerebral: (Neocortex) Accounts for about 80% of the total brain and is involved in processes such as vision, hearing, motor control, reasoning, purposeful behavior, language and non-verbal ideation. In the HBDI model, these processes are represented by the upper left and upper right quadrants of the brain, a metaphorical relation of the two cerebral hemispheres which directly connect to each other through the corpus callosum.

A total cerebral score is generated by the HBDI scoring program by adding the cerebral left and cerebral right scores.

Conforming Learners: As learners they prefer structured environments that provide simple, explicit solutions that guide them in achieving comfortable, low-risk learning goals. With a tendency to be compliant, they focus their intentions cautiously and routinely as directed. Conforming learners assume little responsibility and manage learning as little as possible. They use learning to conform to easily achieved group standards.

Cognitive: Of or relating to mental processes for achieving knowledge or knowing. The techniques which describe how people become aware of, gain, and build complex new knowledge through reasoning, integration, synthesis, analysis, judgment, evaluation, creativity, perception, goal setting, and progress monitoring. This includes application of complex rules, rule generation, and problem solving.

Conative: Of or relating to the mental processes directed toward action. This includes aspects such as intent, inclination, determination, deliberateness, resolve, drive, desire, will or striving. This desire or striving is usually thought of as directed toward some goal, but it may also be directed toward avoiding certain actions.

Extravert: Those more interested in people and things outside of themselves. They quickly and easily reveal themselves to others.

Intentional Learner: See transforming learner.

Introvert: Those directed toward internal reflection and understanding and are slow to reveal themselves to others.

Limbic: Strongly involved in emotional reactions and behaviors, storing and transforming memories, learning processes and dealing with survival issues such as feeding, fighting, fleeing, and sexual reproduction. In the HBDI, limbic processes are represented by the lower left and lower right quadrants of the brain. In the brain, the limbic system has two halves directly connected to each other by the hippocampal commissure. A total limbic score is generated by the HBDI scoring program by adding the limbic left and limbic right scores. Because the empirical connection between preference scores of the HBDI and indicators of limbic processing is weak, and evidence for physiological connections is lacking, this terminology is fading from use among HBDI experts.

Lower Left /B Quadrant: Those characterized as representing the lower left quadrant typically are verbal, use linear logic, and are interested in what has worked in the past. They also seek control of their environment and themselves but through tried and tested rules. They have the ability to sequentially and systematically sift through large amounts of information to create sense and order. They are punctual, procedural, and detail oriented by focusing on one thing at a time. They reject ambiguity and often have difficulty with change. A lower left score is generated by the HBDI scoring program.

Lower Right /C Quadrant: Those characterized as representing the lower right quadrant typically are socially intuitive and are aware of mood, atmosphere, attitudes, and energy levels of others. They are emotional, spiritual, empathetic, nurturing, and musical. For them, experience is their reality. They can be undisciplined, impractical, and sentimental due to an aversion to facts, goals, time, and money. They value

communication and connection to others. They see comfort and inspiration in revered traditions. A lower right score is generated by the HBDI scoring program.

Performing Learner: As learners they prefer semi-structured environments that offer task-oriented, interactive solutions, promote benefits, and provide details, creative interaction, and coaching relationships. They focus their emotions and intentions on learning selectively or situationally. Performing learners situationally assume learning responsibilities in areas of interest but willingly give up control in areas of less interest. They use learning to perform to above average group standards.

Physical: Influenced by bodily action.

Resistant Learner: As learners they avoid formalized learning if at all possible. They do not believe that traditional learning institutions can help them achieve their personal goals. Resistant learners are comprised of two different groups of learners. The first group are transforming learners who are frustrated by the system and rebel against traditional education. The second group are individuals who do not value new knowledge and/or do not believe themselves capable of attaining new knowledge.

Social: Interpersonal interactions and group relationships such as collaboration, community, and participation.

Total Left Brained: Double dominance in the left hemisphere. These people tend to feel internally integrated as both upper left and lower left profiles are verbal and structured in their thinking, efficient, time orientated, linear, and precise. A total left score is generated by the HBDI scoring program.

Total Right Brained: Double dominance in the right hemisphere. These people tend to also feel internally integrated as both upper right and lower right profiles are intuitive, non-linear, experientially orientated, and sensitive to beauty. A total right score is generated by the HBDI scoring program.

Transforming Learner: As learners they prefer loosely structured, flexible environments that provide sophisticated solutions and promote challenging goals, discovery, self-managed learning, and mentoring relationships. They focus strong passions and intentions on learning, and assume responsibility for their learning success. A transforming learner is likely to experience frustration if given little learning autonomy. They use learning to transform themselves to high personal standards.

Upper Left /A Quadrant: Those characterized as representing the upper left quadrant typically analyze, dissect, and solve problems logically by getting facts in the here-and-now. For them, thought is reality. They are logically efficient with the ability to perceive, verbalize, and express things precisely. They are adept at reducing the complex to the simple and they reject ambiguity, seeking control of their environment and themselves. An upper left score is generated by the HBDI scoring program.

Upper Right /D Quadrant: Those characterized as representing the upper right quadrant typically thrive on new ideas, possibilities, incongruities and are often considered visionary and holistic by others. They are largely nonverbal, imaginative, colorful, artistic, fanciful individuals, preferring metaphors and pictures. They seldom make a deadline or take a task through to completion. They favor original nonlinear

thinking, resist structure, and are often impersonal, choosing to focus on internal processes. An upper right score is generated by the HBDI scoring program.

Values: Internally held beliefs about what is important. A personal principle, standard, or cluster of qualities considered worthwhile or desirable.

Whole-Brained: Demonstrating an ability to integrate all the preference quadrants of the brain with no aversion to any operating mode. People with a whole-brained preference usually have a balanced view of any given situation. They communicate easily with people who favor one of the other quadrants and may act as a translator among people with different mental preferences. The more quadrants a person has as primary or secondary, and do not avoid, the higher the possible whole-brained score out of a possible 8 points (2 points for each of the four quadrants). A person could also be whole brained with a strong preference in one quadrant (Upper Left Whole-Brained, Upper Right Whole-Brained, Lower Left Whole-Brained, Lower Right Whole-Brained).

Whole Person: Considers the deep-seated psychological influences that govern behavior in relation to learning. Including the dominant power of emotions, intentions, and social influences on learning and recognizes their impact on guiding and managing cognitive processes.

Chapter 3

Method

Previous research has begun to build a validity argument for the LOQ, but convergent and discriminant studies have been lacking (Martinez, Bunderson, & Wiley, 2000). This study incorporates aspects of the validity argument that provide additional content and substantive process validation evidence, in addition to the examination of convergent and discriminant patterns between the LOQ and the HBDI. Future research can build on the findings from this study as the case for validity of the LOQ, and it's application and interpretation are strengthened.

In this chapter, after a brief review of validity and the validity argument as a design process, data methods are discussed specific to each of the five research questions.

Validity

Definitions evolve over time as theorists in a field refine their thinking. Whereas, it was once thought that there were separate and distinct categories or kinds of validity (APA, 1954; APA, AERA, NCME, 1974) it is now more common to talk about validity as a single unitary concept with different forms of evidence which illuminate different aspects and contribute toward the case for validity of an instrument (Cronbach, 1980; Rock, 1983; Messick, 1989, 1995; APA, AERA, NCME, 1985; AERA, APA, NCME, 1999; Martinez, Bunderson, & Wiley, 2000).

Cronbach (1988) introduced the term *Validation Argument* to describe the process of establishing validity, which he described as an argument that "must link concepts, evidence, social and personal consequences, and values . . . The 30-year old idea of three types of validity, separate but equal, is an idea whose time is gone . . . validation is never finished". Building on Cronbach (1988), Martinez, Bunderson, & Wiley (2000) propose that "the verification procedure in design experiments is a *design process* to establish the various aspects of construct validity and other aspects of a validity argument", thereby taking the idea of "constructing construct validity" proposed by Messick (1998) one step further.

The Validity Argument as a Design Process

In designing the series of investigations that make an increasingly convincing and through validity argument, we are engaging in another kind of design process. In addition to instrument design and experimental design, we are "constructing construct validity". Under the unified concept of validity, Messick (1995, 1998) suggests that there are "six aspects of construct validity [which] apply to all educational and psychological measurement" (1998, p. 12). They are content, substantive process, score structure, generalizability, external relationships, and testing consequences. However, "different sources and mixes of evidence" are needed in every argument to support the variety of possible inferences (Messick, 1998, p. 3). When the six aspects are "taken together, they provide a way of addressing the multiple and interrelated validity questions that need to be answered in justifying score interpretation and use" (Messick, 1998, p. 12).

This study has used three of Messick's (1995) aspects of validity; content, substantive process, and external validity as a heuristic "to plan the schedule and details of efforts to collect evidence and prepare argument for the validity of the theory, instruments, and prescriptions" (Martinez, Bunderson, & Wiley, 2000, pp 8).

Messick's (1995) first aspect of validity is content. This involves delineating the "boundaries of the construct domain to be assessed . . . determining the knowledge . . . and other attributes to be revealed by the assessment" (p.745). In this study expert judges are used to elaborate on existing content validity evidence. Having a small panel of expert judges attempt to judge the placement of instrument items and scores in domains was designed to add depth to this study, and to highlight the reliability of expert opinion in identifying psychological domains. Clearer content information could prove useful in future convergent and discriminant studies and in early identification of instruments designed to measure the same construct.

Substantive process is Messick's (1995) second aspect of validity. Substantive process "emphasizes the role of substantive theories and process modeling in identifying the domain processes to be revealed in the assessment" (Messick, 1995, p. 745). Expert judges were asked to look at the LOQ and HBDI items and scores and then predict correlations between them based on their understanding of the similarity or conflict between substantive processes in each domain. Experts must use their substantive process understanding of the individual items and subscores on each instrument to perform this task.

Lastly, Messick's (1995) fifth aspect–external validity; also known as convergent and discriminant validity, was used to guide the design of this study. It is important to look at "both convergent and discriminant correlation patterns" in how "the constructs represented in the assessment should rationally account for the external pattern of correlations" (Messick, 1995, p. 476). It is understood that "measures of the same construct should converge to provide triangulated evidence for the construct" (Martinez, Bunderson, & Wiley, 2000, pp 14). However, substantive processes can be used to predict and explain how items or scores from two instruments should or should not converge with each other. These theory-based predictions by experts should be bourn out in the actual correlation patterns.

Using three of Messick's (1995) aspects of validity to inform the design process of this study provides a useful heuristic. It demonstrates that finding "relationships among different methods of measuring the construct can be especially helpful in sharpening and elaborating score meaning and interpretation" (AERA, APA, NCME, 1999, p. 14). This study attempts to use the validity argument design process to discover how the LOQ and the HBDI are related and if their items measure similar or distinctly different constructs in an attempt to sharpen and elaborate their respective score meanings and interpretations.

Design for Research Questions 1 and 2

Research questions one and two are based on the judgments of LOQ experts, HBDI experts, and educational psychologists concerning how the two instrument's items

and subscale scores distribute across predefined psychological domains. In order to be able to answer research questions one and two, careful consideration had to be given to the selection of psychological domains, the selection of expert judges, rater training, and what would constitute rater agreement.

Selection of Psychological Domains. Prior to the selection of experts, much thought was given to how the items on both instruments could be classified. An expert in both the LOQ and the HBDI tried to classify each of the items on both instruments. After reading through each item on both instruments, he began with the constructs the LOQ claimed to measure as the basis for the first round of classifications. To the LOQ list of cognitive, conative, affective he added the constructs of values, social, and physical as the HBDI was reviewed because there were some items on the HBDI which did not fit well in any of the LOQ constructs. For example on the HBDI, selecting the hobby of playing golf (Appendix B, Question 60) appeared to be mostly physical and partly social in nature with only a minor affective component. Two levels of cognition were also considered (simple and complex), but these were deemed not especially useful to this study and were combined into a single domain.

Over the course of a couple of weeks the items on both instruments were classified and re-classified until it was agreed upon that cognitive, conative, affective, values, social, and physical represented a suitably broad range of construct domains to be informative in considering content coverage in a convergent and discriminant validity study. These six construct domains were then used in the creation of expert judgment

instruments to be given to LOQ experts, HBDI experts, and educational psychologists for evaluating the LOQ and HBDI (See Appendix C and D).

Selection of Expert Judges. A total of ten experts (Intentional Learning (3), the Herrmann Brain Dominance Model (5), and educational psychologists (2)) were used in determining the distribution of the items for both instruments over psychological domains. Originally, the plan was for there to be three experts in each group. However, it was challenging to identify educational psychologists familiar enough with learning taxonomies who were willing to act as experts. So that group of experts shrank from three to two. Finding HBDI experts was expected to be equally challenging but was not. The Ned Herrmann Group were able to provide four experts in addition to one we had already identified, which meant that we ended up with a total of five HBDI experts. With no obvious reason to exclude any one of the identified HBDI experts we decided to use all five. The three identified LOQ experts agreed to participate in this study.

Table 1 outlines the assignment of expert judges by profile and evaluation instruments. Experts in three areas (LOQ construct meaning, HBDI construct meaning, and learning taxonomies) made predictions based on predefined definitions of construct categories, of how the items on the LOQ and HBDI could be classified by domain and how they expected them to correlate with the other instrument's psychological domains.

Table 1

Assignment of Expert Judges by Personal Profile and Evaluation Instruments

Profile Instruments	Evaluation Instruments	
	Judging Psychological Domains	Predicting Correlations with
		LOQ Factors
HBDI Items & Scores	• 5 HBDI Experts • 2 Educational Psychologists (learning taxonomy experts)	• 3 LOQ Experts
		HBDI Scores & Introversion
LOQ Items & Scores	• 3 LOQ Experts • 2 Educational Psychologists (learning taxonomy experts)	• 5 HBDI Experts

Rater Training. The ten raters used in the study were geographically located in Utah, Arizona and North Carolina. Due to time and budget constraints, in-person training of raters was not conducted. Appendix C and D show the detailed written materials the raters were provided. Definitions of each domain construct were given in the instructions in an attempt to standardized the raters' categorization of items.

The experts were told to review carefully each of the construct descriptors listed on their sheet to make sure they understood the constructs and then were to assign each item on the attached spreadsheet to the appropriate psychological domain. In the case where there might be items which applied to more than one domain, they were instructed to assign a 1, 2, 3, or 0 according to the strength of the match. However, each item could not belong to more than three domains and no number, except zero, could be used more than once for each item.

Rater Agreement. The nature of opinion varies between individuals, hence, it was unlikely that there would be many items where all experts agreed on the categorization of any single item. Therefore, given the expected variation in expert judgment concerning which items belong in which domain and in order to look at rater agreement separately for the three groups of experts, it was deemed necessary to consider only the questions where two or more experts agreed that the item belonged in that domain for the LOQ and the educational psychologists. However, since there are five HBDI experts, three out of five experts agreeing on an item being in a given domain was considered a more appropriate measure of agreement for that group of experts.

Another important aspect of rater consistency is agreement among expert judges that the item does not belong in the domain. Hence percent agreement should be calculated using the total number of questions two (three depending on the group of experts) or more experts agreed were in the domain, plus the number of questions all experts in that group agreed were not in the domain as a percentage of the total number of items rated. From rater agreement information the author hoped to be able to determine how many judges classified the items in the same domain and the degree of variation between judges by domain.

Determining Distribution of Items and Scores. To establish how many items and scores fell into a specific domain the total number of nominations (1, 2, or 3) for each domain for each instrument were tabulated. A zero or a blank would be considered to mean either not applicable or not in the domain. The strength of domain membership could then be determined from expert ratings of each instrument as described in Figure 1.

From the total strength points for each domain, the percentage of total strength points in each domain could be calculated to show the distribution of expert judgments of domain membership across domain.

Figure 1.

Expert Rating Transformations for Strength of Domain Membership

Expert Rating	Rating Interpretation		Transformed Rating	Transformed Rating Interpretation
1	Primary	⇒	3	Strong in the domain
2	Secondary	⇒	2	In the domain
3	Tertiary	⇒	1	Weak in the domain
0	Not applicable	⇒	0	Not in the domain

Design of Research Questions 3 and 4

Research Questions 3 and 4 focus on consistency (in relation to other experts) and accuracy (in relation to the observed correlations) of experts predicting the correlation of the items and scales scores between instruments.

Assignment of Experts. Three experts in the LOQ predicted the degree to which the items and subscores on the HBDI could be expected to correlate with the LOQ constructs. A second set of five experts (HBDI) predicted the degree to which the items and subscores on the LOQ could be expected to correlate with the HBDI constructs. The third set of experts skilled at classifying learning taxonomies, classified both instruments items and score by domain, but were not asked to predict correlation between the LOQ

and the HBDI items and subscores as they were deemed not sufficiently knowledgeable about either instruments to be able reasonably to complete the task.

Analyzing Rater Predictions. Expert predictions of how the items of one instrument correlate with the other instrument's psychological domains were analyzed using simple correlation by instrument domain for each rater in comparison to the observed correlations for each domain. In this manner the study could determine how accurate experts in the LOQ constructs were in predicting the correlation of the HBDI items and scales scores with the LOQ scale scores, and how accurate experts in the HBDI constructs were in predicting the correlation of the LOQ items and scale scores with the HBDI scale scores.

Design for Research Question 5

Research question five focused on how the LOQ items and scale scores are correlated with the HBDI items and scale score. The design for research question five includes defining LOQ and HBDI subscores, choosing a method for subject sampling, describing the instrumentation to be used, reviewing subject instructions, and discussing the statistical analyses in relation to the hypotheses.

Defining LOQ and HBDI Subscores. In an attempt to understand the convergent and discriminant patterns of relationship between the LOQ and the HBDI correlations of the four scores on the LOQ with the four profile composite-scores on the HBDI were calculated. These correlations used data from a cumulative augmented quota sample of approximately 200 high school and college-age respondents. Bivariate

correlations were run using the Pearson product-moment correlation coefficient based on the thirteen scores from the HBDI (Upper Left, Lower Left, Lower Right, Upper Right, Total Left, Total Right, Total Whole-brained, Cerebral, Limbic, Cerebral-Left Whole-brained, Limbic-Left Whole-brained, Cerebral-Right Whole-brained, Limbic-Right Whole-brained) and the four scores from the LOQ (Intentions, Effort, Learning Focus, and composite score of Learning Orientation).

Four whole brained scores (Cerebral-Left Whole-brained, Limbic-Left Whole-brained, Cerebral-Right Whole-brained, Limbic-Right Whole-brained) were specifically created from the HBDI to test hypothesis 3. Hypothesis 3 states that LOQ scores are more likely to correlate with multiple quadrant combinations (3 or 4) as they approach HBDI "whole brainedness" rather than with single quadrant scores. The results from the HBDI can be discussed in terms whole brainedness but the instrument does not generate such a score.

A simple rubric was created to determine general whole brainedness and whole brainedness with an stronger emphasis in one quadrant. Computing a whole-brained score depended on the ranges shown in Table 2 and other calculations discussed later in this section.

Table 2.

Quadrant Range for Whole-Brained Scores

Classification	Range	Whole-Brained Score
Avoidance	0-33	-1
Occasional Use	34-49	0
Secondary	50-67	1
Primary	68+	2

Ned Herrmann describes avoidance being in the range of 0-33, a secondary preference being from 34-67 and a primary preference as 68 and above. However, a low secondary score suggests that it is seldom used, but not avoided. For purposes of this study a whole-brained score was computed by following the rubric in Table 2 to determine the whole-brained score for each quadrant. The individual shown in Table 3 has a whole-brained score of 5. This score is not generated by the HBDI scoring program.

Table 3

Quadrant raw score conversion to whole-brained score

Quadrant Scores	Cerebral Left	Limbic Left	Cerebral	Limbic Right	Total Right Score
Raw	80	60	40	102	282
Whole-brained	2	1	0	2	5

Example 1. Whole-brained Score

CL (2) + LL (1) + LR (0) + CR (2) = 5

1. Cerebral Left Whole-Brained: Those who demonstrate the ability to harmoniously integrate up to four preference quadrants of the brain, but have an overall preference for the cerebral left. A left whole-brained score is not generated by the HBDI scoring program but was computed by taking the whole-brained (WB) score multiplied by two and adding it to the cerebral left (CL) score divided by ten, with a two point bonus (#) given only if cerebral left quadrant is the highest of the four quadrant scores.

$$(WB*2) + (CL/10) + 2\# = CLWB$$

Example 2. Cerebral Left Whole-Brained Score (Data from Table 2.)

$$(5 * 2) + (80/10) + 0 = 18$$

2. Cerebral Right Whole-Brained: Those who demonstrate the ability to harmoniously integrate up to four preference quadrants of the brain, but have an overall preference for the right. A right whole-brained score is not generated by the HBDI scoring program but was computed by taking the whole-brained (WB) score multiplied by two and adding it to the cerebral right (CR) score divided by ten, with a two point bonus (#) given only if cerebral right quadrant is the highest of the four quadrant scores.

$$(WB*2) + (CR/10) + 2\# = CRWB$$

Example 3. Cerebral Right Whole-brained Score (Data from Table 2.)

$$(5 * 2) + (102/10) + 2 = 22.2$$

3. Limbic Left Whole-Brained: Those who demonstrate the ability to harmoniously integrate up to four preference quadrants of the brain, but have an overall preference for the cerebral left. A left whole-brained score is not generated by the HBDI scoring program but was computed by taking the whole-brained (WB) score multiplied by two and adding it to the limbic left (LL) score divided by ten, with a two point bonus (#) given only if limbic left quadrant is the highest of the four quadrant scores.

$$(WB*2) + (LL/10) + 2\# = LLWB$$

Example 4. Limbic Left Whole-brained Score (Data from Table 2.)

$$(5 * 2) + (66/10) + 0 = 16.6$$

4. Limbic Right Whole-Brained: Those who demonstrate the ability to harmoniously integrate up to four preference quadrants of the brain, but have an overall preference for the right. A right whole-brained score is not generated by the HBDI scoring program but was computed by taking the whole-brained (WB) score multiplied by two and adding it to the limbic right (LR) score divided by ten, with a two point bonus (#) given only if limbic right quadrant is the highest of the four quadrant scores.

$$(WB*2) + (LR/10) + 2\# = LRWB$$

Example 5. Limbic Right Whole-brained Score (Data from Table 2.)

$$(5 * 2) + (40/10) + 0 = 14$$

Subject Sampling. An incrementally augmented quota sampling design was used for selection of 200-250 high school, college, and young-adult (20-35 years old) workforce participants from a variety of backgrounds. Over the course of seven months 250 participants were administered both surveys. Some instruments were incomplete or erroneously filled out and as a result unscoreable resulting in a final sample of useable data for both instruments of 192 subjects.

Bailey (1982) describes quota sampling as "the nonprobability sampling equivalent of stratified sampling" (p. 97). Although in the traditional application of quota sampling "each stratum is generally represented in the sample in the same proportion as in the entire population," equal representation is not always possible (p. 97). The population proportions for those measured by the LOQ as Transforming, Performing, Conforming, and Resistant was estimated by an acknowledged LOQ expert. The population proportions for those measured by the HBDI as scoring the highest in Upper Left, Lower Left, Upper Right and Lower Right quadrants was calculated by The Herrmann group from their extensive data base complied over more than 20 years. A concerted effort was made to approximate the LOQ proportions and a secondary effort was made to approximate the HBDI proportions. Table 4 describes how the sample of 192 were distributed across the four LOQ learning orientations and Table 5 describes how they were distributed across the four quadrants of the HBDI.

Table 4

Learning Orientation Questionnaire (LOQ) Quota Matrix

Sample	No.	Percentage Transforming	Performing	Conforming	Resistant
High School	67	0	50.75	29.85	19.40
Undergraduates	33	21.21	51.52	24.24	3.03
Masters	50	42.00	48.00	6.00	4.00
Ph.D.	5	80.00	20.00	0	0
Other	37	18.92	37.84	40.54	2.70
	198				
Overall					
Quota %		15.00	45.00	30.00	10.00
Observed %		19.60	48.24	23.62	8.54

Table 5

Herrmann Brain Dominance Instrument (HBDI) Quota Matrix

Sample	No.	Percentages Upper Left	Lower Left	Upper Right	Lower Right
High School	67	10.45	26.87	16.42	46.27
Undergraduates	33	12.12	27.27	15.15	45.45
Masters	50	28.00	16.00	32.00	24.00
Ph.D.	5	20.00	20.00	60.00	0
Other	37	8.11	18.92	21.62	51.35
	198				
Overall					
Quota %		30.00	23.00	25.00	14.00
Observed %		15.10	22.40	22.40	40.10

Much effort was expended prior to beginning this study to predict key hypotheses based on construct meaning and correlations among construct valid subscores. Despite this, many questions remained making this a partially exploratory study. Due to the nature of this research project there was some concern that a convenience sample might restrict the range of representation of each of the variables. It is understood that a nonrandom sample gives up the probable assurance of being representative of the population. However, in this study it was deemed more important to assure that enough people with each main subscore were represented. A quota sample design was chosen intentionally to ensure that a full range of learning orientations were represented in the sample. After both the LOQ and the HBDI had been administered to several college classes, high school students were deliberately sought out in an attempt to get additional resistant learners included in the sample. The learning orientation construct suggests that resistant learners tend to avoid formal, compulsory learning environments if at all possible. Since high school is not optional it seemed like a good place to look for resistant learners. Initial administrations of the LOQ to high school students did show a higher percentage than had been present in the earlier college age samples..

The sample continued to be added to until there was approximately equivalent representation of the eight variables (four LOQ scores and four HBDI quadrant scores) as they are represented in the general population. No one was dropped from the sample unless they had incorrectly completed one or both of the instruments.

An unexpected confirmation of the learning orientation construct is found in Table 4. The percentage of transforming learners rises from 0 (high school) to 80 (Ph.D.

candidates) percent with those who intentionally pursue higher education. Conversely, the percentage of conforming and resistant learners decreases to zero at the Ph.D. level.

Babbie suggests that "quota sampling begins with a matrix" which includes the optimal quota proportions for each subgroup or variable (p. 175). Such a matrix helps the researcher to approximate the proportions for each variable in order to provide reasonable representation for–in this case the four learning orientation scores on the LOQ and the four quadrant scores HBDI. From all the research gathered to date by Performance Solutions (personal communication, September 25, 2000) they estimate that the general workforce is comprised of 15% transforming, 45% performing, 30% conforming, and 10% resistant learners. The Herrmann Group (personal communication, September 26, 2000) calculated from a database exceeding 500,000 respondents that the general workforce is comprised of 30% Upper Left, 23% Lower Left, 14% Lower Right, 25 % Upper Right. This information was used to guide the quota sample collection although more weight was given to balancing the LOQ constructs categories. Table 5 shows that the sample in this study has an over-representation of Lower Right and an under-representation of Upper Left. However this was not considered to be a major limitation to the study since the HBDI permits secondary dominance in any quadrant so a meaningful range of left and all other quadrants scores existed to reduce the likelihood of restricted range effects in the correlations.

The sample of 192 participants can be summarized as consisting of 88 males and 104 females. Table 4 and Table 5 both indicate the numbers of high school students, undergraduates, Masters, Ph.D. students, and young-adults (20-35 years old) from the

general workforce. The sample began with a class of undergraduate pre-service teachers and was incrementally augmented until it approximated the proportions of people in the general population for the LOQ and HBDI. Table 3 and Table 4 also contain the quota and actual percentages for the LOQ and the HBDI in the last two rows.

Instrumentation. The two instruments used in this study were the 25-question Learning Orientation Questionnaire(LOQ) and the 120-question Herrmann Brain Dominance Instrument (HBDI) and can be found in Appendix A and Appendix B respectively. Both instruments were administered in paper-and-pencil format and individuals were asked to respond to items about the occurrence of particular behaviors, thoughts, and feelings. For each subject, both item scores and construct sub-scores were recorded for each instrument.

Gall et al. (1996) reminds us that "the major limitation of personality inventories [and other self-report instruments] is that they depend on the truthfulness and diligence of the individual's self-report" (p 269). Hence, subjects were assured that their responses would be kept confidential and could not be used to influence their class grades in order to encourage genuine and honest responses.

Subject Instructions. Subjects were asked to voluntarily participate in a study comparing two measures of assessing learning preferences; the LOQ and the HBDI. Assurances were made that all data collected would be kept confidential and their responses would in no way affect their class grades. Both considerations being important in getting accurate self-report information. Participants were reminded to be honest and

then given the LOQ and the HBDI to complete. After the instruments were collected a short debriefing seminar on learning styles was given to participants.

Statistical Analyses. The Pearson product-moment correlation coefficient is one of the most stable measures of correlation with a small standard error (Gay, 1996, p 462). Using the Pearson product-moment correlation is appropriate because the data collected from the LOQ and the HBDI were a series of continuous sub-scores for each respective instrument with no reason to assume that any relationship between the instruments could not be approximated closely enough with linear correlations.

Correlations with item scores were based on a continuous score for the LOQ items, as they consisted of Likert-Scale ratings from 1 to 7. Some HBDI items were represented by Likert-Scale ratings from 1 to 5, others number from 0 to 2 or 3, and others by dichotomous scores (0 for did not select and 1 for did select the hobby, adjective, etc.). Calculating Pearson-product moment correlations between a continuous and a dichotomous score produces a point-biserial correlation coefficient. Some of the correlations between the subscores of the LOQ with HBDI item scores were of this form. No attempt was made to interpret these coefficients in a different manner due to the largely exploratory nature of the item correlations.

The data obtained from Pearson product-moment correlations are displayed in three tables in chapter four. The first table, Table 12, is a 4x13 containing correlations of the four LOQ construct scores (Learning Focus, Learning Independence, Strategic Planning and Effort, and Learning Orientation) vs 13 HBDI construct scores (Upper Left,

Lower Left, Lower Right, Upper Right, Total Left, Total Right, Total Whole-brained, Cerebral, Limbic, Cerebral-Left Whole-brained, Limbic-Left Whole-brained, Cerebral-Right Whole-brained, Limbic-Right Whole-brained). For definitions of these construct scores and how they were obtained, see the glossary of terms.

The second table, Table 13, is 4x120–the 4 LOQ constructs as columns and the 120 HBDI items as rows. The third table, Table 15, is 13x25, the 13 HBDI subscores vs 25 LOQ items. Table 12 shows subscore correlations. Table 13 is used to determine how the HBDI items correlate with the LOQ profile and total scores, how strongly they correlate and which LOQ items do not correlate. Table 14 is used to determine how the LOQ items correlate with the HBDI subscores represented by the HBDI constructs, how strongly they correlate and which LOQ items do not correlate.

Summary of Methods

Figure 2 provides a summary representation of the previous discussion for the methods associated with each of the five research questions and their associated hypotheses.

Research questions one and two are best answered based on the judgments of LOQ experts, HBDI experts, and educational psychologists concerning how the two instrument's items and subscale scores distribute across predefined psychological domains. Questions 1 and 2 and hypothesis 1 and 2 were addressed by looking at rater agreement and the actual distribution of items across domains. In order to be able to answer research questions one and two, careful consideration had to be given to the

selection of psychological domains, the selection of expert judges, rater training, and what would constitute rater agreement.

Figure 2.

Methods Summary

	Methods		
	Domain Judgments	Predicted *r*'s	Actual *r*'s
Research Question 1	x		
Hypothesis 1	x		
Research Question 2	x		
Hypothesis 2	x		
Research Question 3		x	
Research Question 4		x	
Research Question 5			x
Hypothesis 3			x
Hypothesis 4			x
Hypothesis 5			x

Research Questions 3 and 4 focus on consistency (in relation to other experts) and accuracy (in relation to the observed correlations) of experts predicting the correlation of the items and scales scores between instruments. The methods used for addressing research questions three and four included the selection and assignment of experts, and analyzing their predictions of correlations.

Research question five focused on how the LOQ items and scale scores are correlated with the HBDI items and scale score. The methods used for addressing research question five included defining LOQ and HBDI subscores, using a quota matrix

for subject sampling, describing the instrumentation to be used, reviewing subject instructions, and finally running a statistical analyses on the data gathered using the Pearson product-moment correlation.

Chapter 4

Results and Discussion

The purpose of this study was to discover areas of convergence and divergence in terms of the construct meanings of scores obtained from the LOQ and the HBDI. This chapter presents the results of the study. The evidence is organized in terms of the five research questions proposed in chapter 1. Questions 1 and 2 are based on the judgments of experts and asks how the items and scale scores on both instruments distribute across the defined psychological domains. Questions 3 and 4 query how accurate are experts in predicting observed correlations and what are their expectations. Lastly, question 5 addresses to what extent the two instruments are correlated statistically.

The author expected to find some correlation, although the exact pattern of correlations was not known in advance. It was anticipated that the HBDI would have a broader scope across different domains than the LOQ, but would emphasize cognitive and social constructs. In addition, that the LOQ would not span as many domains, but would emphasize conative and affective constructs and de-emphasize cognitive, physical, social, and values. Research questions 1 and 2 look at how well experts agree on what the instruments purport to measure and what content domains the experts think each instrument addresses.

Research Question 1

The first research question asked, based on the judgments of experts in the HBDI constructs and items, and the judgments of educational psychologists familiar with different psychological domains, how do the HBDI items distribute across the psychological domains of cognition, conation, affect, values, social, and physical?

HBDI Experts. Five individuals very familiar with the HBDI acting as HBDI experts had moderate agreement about how the HBDI items distributed across the psychological domains of cognition, conation, affect, values, social, and physical. Table 6 summarizes the HBDI expert percentage agreement scores by domain.

Table 6

HBDI Expert Agreement on Placement of HBDI Items by Domain

	Domain					
	Cognitive	Conative	Affective	Values	Social	Physical
Number of questions three or more experts agreed were in the domain.	83	8	22	6	16	4
Number of questions all of the experts rated as not in the domain.	16	60	67	54	81	94
Total*	99	68	89	60	97	98
% of agreement	79.2	54.4	71.2	48.0	77.6	78.4

*As opposed to the total number of questions rated (125)

Considerable variation in expert judgment as to which items belonged in which domain was found. In order to look at rater agreement for the HBDI experts, it was deemed appropriate only to consider the questions where three or more experts agreed that the item belonged in that domain. For the HBDI, since the number of items where all five experts agreed on the placement of any item were so few, three out of five experts agreeing on an item being in a given domain was considered sufficient. An important aspect of agreement is agreement among the expert judges that the item does not belong in the domain. Hence the percent agreement in Table 6 for the HBDI experts was calculated using the total number of questions three or more experts agreed were in the domain, plus the number of questions all five HBDI experts agreed were not in the domain as a percentage of the total number of items rated.

The cognitive, affective, social, and physical domains all have approximately the same percentage agreement for the HBDI experts being 79.2, 71.2, 77.6, and 78.4 respectively. The conative and values domains appear to be the most unclear for these experts with percentage agreement at 54.4 and 48 respectively.

Psychological Domain Experts. The two educational psychologists acting as psychological domain experts also had relatively high agreement about how the HBDI items distributed across the psychological domains of cognition, conation, affect, values, social, and physical as shown in Table 7.

In order to look at rater agreement for the psychological domain experts, only the questions where both experts agreed that the item belonged in that domain were considered. The percent agreement in Table 7 was calculated using the total number of

questions both experts agreed were in the domain, plus the number of questions both experts agreed were not in the domain as a percentage of the total number of items rated.

Unlike the HBDI experts the social and physical domains had very high percentage agreement with 82.75 and 92.24 respectively. Cognitive and affective agreements more closely mirror the HBDI expert judgments and were also quite high with percentage agreement at 72.41 and 71.55 respectively. The conative and values domains also appear to be the most unclear construct domains for these experts with percentage agreement at 62.93 and 56.89 respectively.

Table 7

Psychological Domain Expert Agreement on Placement of HBDI Items by Domain

	Domain					
	Cognitive	Conative	Affective	Values	Social	Physical
Number of questions both experts agreed were in the domain.	49	9	29	12	9	15
Number of questions both experts rated as not in the domain.	35	64	54	54	87	92
Total*	84	73	83	66	96	107
% of agreement	72.41	62.93	71.55	56.89	82.75	92.24

*As opposed to total questions rated by the psychological domain experts (116)

Research Question 2

The second question asked, based on the judgments of experts in the LOQ constructs and items, and the judgments of educational psychologists familiar with different psychological domains, how do the LOQ items distribute across the psychological domains of cognition, conation, affect, values, social, and physical?

LOQ Experts. Three individuals very familiar with the LOQ, acting as LOQ experts, had relatively high agreement on how the LOQ items distributed across the domains of cognition, conation, affect, values, social, and physical as shown in Table 8.

Table 8

LOQ Expert Agreement on Placement of LOQ Items by Domain

	Domain					
	Cognitive	Conative	Affective	Values†	Social	Physical
Number of questions (including scale scores) two or more experts agreed were in the domain.	22	29	25	0	7	0
Number of questions all experts rated as not in the domain.	3	0	0	0	16	25
Total*	25	29	25	0	23	25
% of agreement	86.21	100	86.21	0	79.31	100

* As opposed to the total number of questions, including scale scores, rated (29)
† Two experts didn't rate this domain, claiming it was present in everything and therefore had no discriminant ability.

Considerable variation was found among the LOQ expert judgments as to which items belonged in which domain. In order to look at agreement for the LOQ experts, it was decided to consider only the questions where two or more LOQ experts agreed that the item belonged in that domain. For the LOQ, since the number of items where all three experts agreed on the placement of any item were so few, two out of three experts agreeing on an item being in a given domain was considered sufficient. An important aspect of agreement is agreement among the expert judges that the item does not belong in the domain. Hence the percent agreement in Table 8 was calculated using the total number of questions two or more experts agreed were in the domain, plus the number of questions all experts agreed were not in the domain as a percentage of the total number of items rated.

The LOQ experts agreed 100% that all the items had some conative aspect to them and that there were no items on the LOQ which had a physical component. This is not surprising since the instrument was intended to measure conation and not intended to measure physical aptitudes or interests. Cognitive and affective domains both measured percentage agreement at 86.21, with social receiving 79.31 percent agreement among the three.

It is interesting to note that initially two of the LOQ experts chose not to rate the values domain, claiming it was present in everything and therefore had no discriminant ability. After further discussion between the LOQ experts they concluded that values had been a perplexing issue for them because they had struggled to differentiate between the values and affective categories. Each LOQ expert received instructions, as outlined in

Appendix C, that they should only assign a given item to three or fewer domains. Given these constraints, two LOQ expert judges chose to ignore values, claiming it was present in everything and therefore had no discriminant ability. However, one LOQ expert did choose to use the values domain to classify six items on the LOQ.

Psychological Domain Experts. The two educational psychologists acting as psychological domain experts also had moderate agreement about how the LOQ items distributed across the psychological domains of cognition, conation, affect, values, social, and physical as shown in Table 9

Table 9

Psychological Domain Expert Agreement on Placement of LOQ Items by Domain

	Domain					
	Cognitive	Conative	Affective	Values	Social	Physical
Number of questions both experts agreed were in the domain.	2	14	7	12	0	0
Number of questions both experts rated as not in the domain.	19	1	17	0	22	25
Total*	21	15	24	12	22	25
% of agreement	84	60	96	48	88	100

*As opposed to the total number of questions rated (25)

In order to look at rater agreement for the psychological domain experts as in research question one, it was decided to consider only the questions where both experts agreed that the item belonged in that domain, since there were only two raters. The percent agreement in Table 9 was also calculated using the total number of questions both experts agreed were in the domain, plus the number of questions both experts agreed were not in the domain as a percentage of the total number of items rated.

The social and physical domains have very high percentage agreement with 88 and 100 respectively as could be expected. The psychological domain experts saw only a few LOQ questions with any social aspect to them but had difficulty agreeing on which items. Cognitive and affective also had relatively high percentage agreement at 84 and 96 respectively. Again, the conative and values domains appear to be the most unclear constructs for these experts with percentage agreement at 60 and 48.

Integrating the Results of Research Questions 1 and 2. In determining percentage agreement, not all judge's ratings were used, only the 2 or 3 who agreed. This look at the data shows which domains have a high percentage agreement. To answer the question, however, "how do the items of each instrument distribute across the domains of cognitive, conative, affective, values, social, and physical," a different look at the data was desirable where all the judges rating were considered.

To establish how many items and scores fell into a specific domain the total number of nominations (1, 2, or 3) for each domain by all judges are recorded in Table 10 and Table 11 for the HBDI and LOQ respectively. A zero or a blank was considered to mean either not applicable or not in the domain. The strength of domain membership was

determined from expert ratings of each instrument after a numeric transformation as described in the methods section. From the total strength points for each domain, the percentage of total strength points in each domain have been calculated to show the distribution of expert judgments of domain membership across domains. The percentage of strength points was regarded as a more accurate metric and is discussed below. The percentage of nominations shown in table 10 shows a similar pattern across domains.

Table 10

Distribution by Domain of Items and Scores for the HBDI for All Five Experts

	Domain					
	Cognitive	Conative	Affective	Values	Social	Physical
Items (116)						
Nominations	396	98	130	83	81	53
% of nominations	47	12	15	10	10	6
Sum of strength points	1071	225	310	207	205	130
% of total strength points	50	10	14	10	10	6
Scores (6)						
Nominations	17	2	7	6	5	0
% of nominations	46	5	19	16	14	0
Sum of strength points	29	4	17	13	9	0
% of total strength points	40	6	24	18	12	0

The HBDI experts determined the HBDI items to be primarily cognitive in focus. Fifty percent of the total HBDI item strength points were cognitive, 10% conative, 14% affective, 10% values, 10% social, and 6% physical. Half the HBDI items were considered to be cognitive. The other five domains are fairly equally represented with affective being the most represented of the other five domains and Physical the least

represented. The HBDI scores followed a similar pattern, but affective and values are more strongly represented in the scores than in the individual items, conative barely, and physical not at all. Therefore we can see that hypothesis 1 was confirmed in part. From Table 10 and Table 11 we can see that the HBDI does have a broader scope across different domains than the LOQ and does emphasize cognitive constructs. Social constructs, however, are not as strongly represented as affect and values.

Table 11

Distribution by Domain of Items and Scores for the LOQ for All Three Experts

	Domain					
	Cognitive	Conative	Affective	Values	Social	Physical
Items (25)						
Total Nominations	52	75	54	6	20	0
% of nominations	25	36	26	3	10	0
Sum of strength points	87	167	142	12	23	0
% of total strength points	20	39	33	3	5	0
Scores (7)						
Total Nominations	9	15	11	0	1	0
% of nominations	29	39	29	0	3	0
Sum of strength points	20	44	15	0	2	0
% of total strength points	25	54	19	0	2	0

According to the LOQ experts, the LOQ items are primarily conatively focused. Twenty percent of the total LOQ item strength points were cognitive, 39% conative, 33% affective, 3% values, and 5% social with no nominations recorded for the physical domain. The reader is reminded that the values domain posed some concern for two of the LOQ judges who chose to ignore it completely, saying it was present in everything.

Hence, the 3% of nominations associated with values may not truly be representative of the judges' actual beliefs. However, distribution of LOQ items among the other domains are not significantly altered by not considering the values domain. The LOQ scores follow a similar distribution pattern with a stronger emphasis in conation. Therefore it appears that hypothesis 2 has also been confirmed. Comparing Table 10 and Table 11 shows that the LOQ does not span as many domains as the HBDI. The LOQ emphasizes conative and affective constructs while de-emphasizing physical, social, and values. However, according to the experts, there appears to be a stronger cognitive aspect, at least in the scores, than previously thought.

Research Question 3

The third research question asked, how accurate were experts in the LOQ constructs in predicting the correlation of the HBDI items and scale scores with the LOQ scale scores?

The LOQ experts were more likely to predict correlation of HBDI items and scores to LOQ construct domains when there was no observed correlation than when there was. From the raw data they appeared most accurate in predicting the correlation between the two HBDI categories of work elements and key descriptors with LOQ construct domains than any other group of HBDI items. However, Table 12 shows that across all items the LOQ experts were not significantly more accurate at predicting correlation between the HBDI items and scores with the LOQ constructs than random chance except for one judge. One expert judge accurately predicted HBDI item

correlations with the LOQ domain of planning and effort at the .05 level. He was also the only expert judge to have a great deal of experience with both instruments.

Table 12

LOQ expert correlation predictions for the HBDI compared with observed correlations

LOQ Expert	Learning Focus	Learning Independence	Planning & Effort	Learning Orientation
Expert 1	.03	.14	-.08	.03
Expert 2	.13	-.09	.08	.16
Expert 3	-.13	-.03	.19 *	-.06

* $p < .05$

Research Question 4

The fourth research question asked, how accurate were experts in the HBDI constructs in predicting the correlation of the LOQ items and scale scores with the HBDI scale scores?

The HBDI expert predictions for items and score correlation were not especially consistent. Each HBDI expert judges' predictions were then compared to the observed correlations to determine the accuracy of that particular judge. Table 13 shows the HBDI experts' predictions of the correlations between the LOQ items and scores with the HBDI constructs. The HBDI experts did better than the LOQ experts at predicting correlations for some HBDI constructs. Lower Left and Upper Right seemed to be the most understood HBDI constructs by these experts in terms of being able to predict

correlations with the LOQ. Predicted correlations above positive .4 should be considered quite good. The author's hypotheses also dealt primarily with these two quadrants.

Table 13

HBDI expert correlation predictions for the LOQ compared with observed correlations

HBDI Expert	Upper Left	Lower Left	Lower Right	Upper Right	Left Whole Brain	Right Whole Brain
Expert 1	-.02	.58 *	.^	.28	.^	.^
Expert 2	-.45 *	.30	-.02	-.03	.16	.^
Expert 3	.^	.53 *	.^	.40 *	-.25	.00
Expert 4	-.15	.41 *	.^	.26	.^	.^
Expert 5	.08	.47 *	.10	.37 *	-.33	.15

.^ not computable for that expert on that domain * $p < .05$

However, the number of zeros for some experts on some of the other domains made it not mathematically computable to determine the correlation for those domains. Although statistically significant, the correlations are small. None of the experts were accurate in predicting correlations in any but two quadrants. However, experts 3 and 5 are more accurate in predicting correlations in the Lower Left and Upper Right domains than the other experts and Expert 2 is the least accurate.

Research Question 5

The fifth and final research question asked, how are the LOQ items and scales correlated statistically with the HBDI items and scales. It was hypothesized that the LOQ was more likely to correlate with multiple quadrant combinations (3 or 4) than with single

quadrant scores. It was expected that the HBDI would correlate with the LOQ more strongly on the cognitive construct of effort, which involves strategies and planning, than on the conative/affective factor of intentions. The actual correlations should provide insight into both the contrast between transforming and conforming learners (LOQ), and whole-brainedness (HBDI).

The data used to answer research question 5 are correlation coefficients. A single asterisk ("*") is used in each of the following tables to designate those correlation coefficients that are statistically significant at the .05 level. A double asterisk ("**") is used to designate correlations that are statistically significant at the .001 level. Those correlations that are not marked with an asterisk are not statistically significant. That is, the observed sample statistic was not sufficiently greater than zero for the researcher to safely conclude that the observed correlation was not due to sample-to-sample variability in the value of a correlation coefficient where the population value is truly zero.

Readers should be cautioned that just because an observed correlation may be statistically significant it should not be interpreted as indicating that the degree of association between the two variables is practically important. In other words, statistical significance is not an indicator of practical utility (Freedman, Pisani, Purves & Adhikari, 1991; Krathwohl,1993; Kirk, 1996; Hildebrand, 1986; Huck, 2000). Results that are statistically significant may or may not be significant in a practical sense. As Hildebrand (1986) has pointed out, it is unfortunate that the common usage of the word "'significance' is synonymous with importance" (p. 337). These low correlations may be of scientific importance however. Research questions 1 and 2 showed that the LOQ and

the HBDI do not overlap very much, but where they do, similar substantive process may lead to small but significant correlations.

Huck (2000) recommends the coefficient of determination as a better criterion for assessing the practical importance of an observed correlation. This statistic is often called "*r*-squared" and can be readily computed by simply squaring the observed value of a correlation coefficient. The resulting value of r^2 ranges between zero and +1.0. Huck (2000) explains that when multiplied by 100 "the value of r^2 indicates how much (proportionately speaking) variability in either variable is explained by the other variable . . . " so that researchers ". . . can talk about the *percentage* of explained variability" (p. 79).

None of the correlations reported here are very strong when you look at their coefficients of determination. The highest correlation coefficient (r) found between the LOQ and the HBDI is .31 with a coefficient of determination (r^2) of .10. Hence only 10 percent of the variation in the LOQ construct can be explained by variability in responses to the HBDI.

It then becomes reasonable to conclude that the LOQ and HBDI measure discriminably different constructs. However, the data do tell a subtle story of how the constructs from the two instruments go together or do not, but complement one another. The correlations that do arise between the two instruments are very interesting. Those that have scientific implications will be discussed as they add insight into our understanding of the substantive processes operating within the constructs.

Correlation of the LOQ Scores with the HBDI Scores. Table 14 is a 13 x 4 matrix showing the correlations coefficients of the four LOQ construct scores with 13 HBDI construct scores. From Table 14 we can see that the HBDI scores for Upper Right, Cerebral, and CRWB have statistically significant positive correlations with all four LOQ construct scores, but specifically with the composite score of learning orientations at the .001 level. Whole Brain, Right-Mode, and CLWB scores are also correlated to the composite score of learning orientation, but at the .05 level. Although these correlations are small, they do indicate that Upper Right and Whole Brain scores correlate with high LOQ scores. They imply that the substantive processes involved as individuals rate the two kinds of items share common aspects.

Table 14

Correlation of the LOQ Construct Scores with the HBDI Construct Scores

HBDI Construct Score	LOQ Construct Score			
	Composite	Con/Affect	Effort	Independence
Upper Left	.06	.05	-.04	.14
Lower Left	-.02	-.07	.05	-.02
Lower Right	.01	.10	.05	-.15*
Upper Right	**.27 ****	.19 *	**.24 ****	.20 *
L-mode	.01	.05	.01	-.06
R-mode	.23 *	.15 *	.21 *	.19 *
Cerebral	**.29 ****	.22 *	.20 *	**.27 ****
Limbic	-.05	-.01	.03	-.14
Whole Brain	.15 *	.12	.10	.13
CLWB	.14 *	.11	.04	.18 *
LLWB	.07	.02	.09	.07
LRWB	.07	.14	.07	-.07
CRWB	**.26 ****	.19 *	.22 *	.21 *

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

Correlation of HBDI Items with the LOQ Scores. Having addressed the correlation of the LOQ construct scores with the HBDI construct score we move to how the HBDI items correlate with the LOQ construct scores. Table 15 includes one column for each of the 4 LOQ scores and one row for each of the 120 HBDI items. The cell entries in Table 15 show how the HBDI items correlate with the four LOQ construct scores and which items do not correlate at all.

Table 15

Correlation of the LOQ Construct Scores with the HBDI Items

HBDI Items	LOQ Construct Score			
	Composite	Con/Affect	Effort	Independence
Handedness				
5a. (Picture 1)	.03	.08	-.01	-.02
5b. (Picture 2)	-.03	.02	-.01	-.08
5c. (Picture 3)	.02	.04	.02	-.02
5d. (Picture 4)	-.02	-.09	-.03	.11
Strength of Handedness				
6a. Primary left	.02	.04	.06	-.06
6b. Primary left some right	.05	.09	.02	-.02
6c. Both hands equal	.07	.07	.02	.07
6d. Primary right some left	.04	-.02	.01	.12
6e. Primary right	-.08	-.04	-.04	-.11
Best/Worst Subject				
7. Math	-.08	-.07	-.01	-.09
8. Foreign Language	.08	.06	.09	.06
9. Native Language	.03	.07	-.04	.05
Work Elements				
10. Analytical	.16 *	.20 *	.09	.07
11. Administrative	.07	-.04	.15 *	.07
12. Conceptualizing	.21 *	.22 *	.13	.12
13. Expressing ideas	-.14	-.09	-.17 *	-.07
14. Integration	.13	.19 *	.02	.07
15. Writing	.23 *	**.26 ** **	.21 *	.05
16. Technical aspects	-.04	-.03	-.03	-.03
17. Implementation	.06	.01	.06	.08
18. Planning	.19 *	.11	.23 *	.10
19. Interpersonal aspects	.04	.14	.03	-.08

table continues

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

Table 15 cont.

Correlation of the LOQ Construct Scores with the HBDI Items

HBDI Items	LOQ Construct Score			
	Composite	Con/Affect	Effort	Independence
Work Elements cont.				
20. Problem solving	.23 *	.16 *	.18 *	.22 *
21. Innovating	.03	.01	.08	-.01
22. Teaching/training	.18 *	**.25** **	.15 *	.01
23. Organization	.23 *	.17 *	.23 *	.13
24. Creative aspects	.06	-.06	-.09	.01
25. Financial aspects	-.06	-.05	-.01	-.08
Key Descriptors				
26. Logical	.09	.02	.01	.19 *
27. Creative	.07	-.08	-.06	-.02
28. Musical	-.04	-.04	.03	-.09
29. Sequential	-.05	-.07	-.08	.05
30. Synthesizer	**.25** **	.18 *	**.24** **	.17 *
31. Verbal	-.07	-.02	-.03	-.12
32. Conservative	.11	.10	.11	.05
33. Analytical	.15 *	.16 *	.06	.11
34. Detailed	-.12	-.15 *	-.01	-.11
35. Emotional	-.16 *	-.09	-.13	-.18 *
36. Spatial	-.04	.01	-.10	-.00
37. Critical	-.04	-.09	-.07	.08
38. Artistic	-.09	-.11	-.10	-.01
39. Spiritual	.08	.08	.08	.03
40. Rational	.14	.18 *	.10	.03
41. Controlled	**-.25** **	-.23 *	-.21 *	-.15 *
42. Mathematical	.04	.01	.02	.08
43. Symbolic	-.11	-.01	-.08	-.17
44. Dominant	-.12	-.10	-.10	-.07
45. Holistic	.14	.11	.12	.10

table continues

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

Table 15 cont.

Correlation of the LOQ Construct Scores with the HBDI Items

HBDI Items	LOQ Construct Score			
	Composite	Con/Affect	Effort	Independence
Key Descriptors cont.				
46. Intuitive	.23 *	.17 *	.18 *	.19 *
47. Quantitative	.09	.04	.04	.13
48. Reader	-.04	.04	-.05	-.10
49. Simultaneous	.10	.05	.13	.05
50. Factual	-.07	-.05	-.02	-.10
Hobbies				
51. Arts/crafts	-.10	-.10	-.12	.00
52. Boating	-.04	-.07	-.07	.05
53. Camping/hiking	-.04	.01	-.04	-.07
54. Cards	.01	.03	.03	-.05
55. Collecting	.06	.04	.12	-.02
56. Cooking	.16 *	.12	.09	.16 *
57. Creative writing	-.01	-.01	.05	-.07
58. Fishing	-.19 *	-.18 *	-.19 *	-.07
59. Gardening/plants	.08	.09	.07	.03
60. Golf	-.04	-.09	-.02	.03
61. Home improvements	.12	.13	.12	.03
62. Music listening	-.08	-.09	-.02	-.08
63. Music playing	.18 *	.18 *	.20 *	.02
64. Photography	.00	-.03	-.03	.07
65. Reading	**.26 ** **	**.31 ** **	.21 *	.06
66. Sailing	.17 *	.10	.16 *	.15 *
67. Sewing	-.03	-.04	-.09	.08
68. Spectator sports	**-.25 ** **	**-.25 ** **	-.18 *	-.15 *
69. Swimming/diving	-.07	-.07	-.01	-.08
70. Tennis	-.09	-.10	-.05	-.05

table continues

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

Table 15 cont.

Correlation of the LOQ Construct Scores with the HBDI Items

HBDI Items	LOQ Construct Score			
	Composite	Con/Affect	Effort	Independence
Hobbies cont.				
71. Travel	.18 *	.08	.17 *	.18 *
72. Woodworking	-.10	-.07	-.16 *	-.01
Energy Level				
73a. Day person	.17 *	.12	.19 *	.10
73b. Day/night person	-.07	-.03	-.10	-.04
73c. Night person	-.09	-.08	-.08	-.05
Motion Sickness				
74a. None	-.00	-.03	-.03	.05
74b. 1-2 times	-.16 *	-.14	-.13	-.11
74c. 3-10 times	.01	.01	-.02	.03
74d. More than 10	.18 *	.18 *	.20 *	.05
Reading in Car				
75a. Yes	.04	.00	-.01	.10
75b. No	-.04	-.00	.01	-.10
Adjective Pairs				
76a. Conservative	-.02	-.05	.03	-.02
76b. Empathetic	.02	.05	-.03	.02
77a. Analyst	.02	.03	-.01	.03
77b. Synthesizer	-.03	-.03	-.00	-.03
78a. Quantitative	.12	.06	.06	.16 *
78b. Musical	-.12	-.06	-.06	-.16 *
79a. Problem solver	.05	.11	-.03	.02
79b. Planner	-.05	-.11	.03	-.02

table continues

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

Table 15 cont.

Correlation of the LOQ Construct Scores with the HBDI Items

HBDI Items	LOQ Construct Score			
	Composite	Con/Affect	Effort	Independence
Adjective Pairs cont.				
80a. Controlled	-.01	-.01	.00	-.02
80b. Creative	.01	.01	-.00	.02
81a. Original	.02	-.02	.02	.06
81b. Emotional	.02	.02	-.02	-.06
82a. Feeling	-.14 *	-.13	-.11	-.10
82b. Thinking	.14 *	.13	.11	.10
83a. Interpersonal	-.04	-.02	-.07	.00
83b. Organizer	.04	.02	.07	-.00
84a. Spiritual	.21 *	.23 *	.22 *	.02
84b. Creative	-.21 *	-.23 *	-.22 *	-.02
85a. Detailed	-.19 *	-.16 *	-.10	-.19 *
85b. Holistic	.19 *	.16 *	.10	.19 *
86a. Originate ideas	-.05	-.06	-.02	-.03
86b. Test and prove ideas	.05	.06	.02	.03
87a. Warm, friendly	-.07	.00	-.06	-.13
87b. Analytical	.07	-.00	.06	.13
88a. Imaginative	-.22 *	-.19 *	-.17 *	-.17*
88b. Sequential	.22 *	.19 *	.17 *	.17 *
89a. Original	-.01	.01	-.01	-.04
89b. Reliable	.01	-.01	.01	.04
90a. Creative	-.15 *	-.13	-.08	-.13
90b. Logical	.15 *	.13	.08	.13
91a. Controlled	.10	.02	.06	.17 *
91b. Emotional	-.10	-.02	-.06	-.17 *
92a. Musical	-.09	-.05	-.02	-.15 *
92b. Detailed	.09	.05	.02	.15 *
93a. Simultaneous	.03	-.03	.06	.05
93b. Empathetic	-.03	.03	-.07	-.05

table continues

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

Table 15 cont.

Correlation of the LOQ Construct Scores with the HBDI Items

HBDI Items	LOQ Construct Score			
	Composite	Con/Affect	Effort	Independence
Adjective Pairs cont.				
94a. Communicator	-.11	-.12	-.07	-.07
94b. Conceptualizer	.11	.12	.07	.07
95a. Technical things	.02	.05	-.03	.02
95b. People orientated	-.02	-.05	.03	-.02
96a. Well-organized	.08	.03	.11	.05
96b. Logical	-.08	-.03	-.11	-.05
97a. Rigorous thinking	.00	.02	.04	-.06
97b. Metaphorical thinking	-.00	-.02	-.04	.06
98a. Like things planned	-.08	-.12	-.00	-.06
98b. Like things mathematical	.10	.13	.02	.07
99a. Technical	.07	.05	.08	.04
99b. Dominant	-.07	-.05	-.08	-.04
Introvert/Extrovert				
100. Introvert scale	.07	.07	.07	.02
Twenty Questions				
101. Step by step method	.16 *	.08	.10	.22 *
102. Day dreaming provides solutions	-.06	-.08	-.09	.03
103. Being sure of one's conclusions	.13	.10	.02	.20 *
104. Prefer reliable to imaginative	.06	.04	.06	.05
105. Best ideas when doing nothing	.13	.08	.05	.20 *
106. Rely on hunches	-.20 *	**-.26 ** **	-.18 *	.00
107. Get a kick out of breaking rules	.09	.13	.06	-.00
108. Cannot express some things in words	-.02	-.08	-.01	.05
109. Competitive with others vs. self	**.28 ** **	.22 *	.17 *	.28
110. Spend day alone with my thoughts	-.22 *	-.21 *	-.27 *	-.03
111. Dislike uncertainty	-.05	-.09	-.06	.05

table continues

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

Table 15 cont.

Correlation of the LOQ Construct Scores with the HBDI Items

HBDI Items	LOQ Construct Score			
	Composite	Con/Affect	Effort	Independence
20 Questions cont.				
112. Prefer team efforts rather than solo	.14 *	.07	.13	.15 *
113. A place for everything; all in place	-.22 *	-.15 *	**-.25** **	-.12
114. Unusual ideas and daring concepts	-.19 *	**-.25** **	-.08	-.08
115. Prefer specific instructions to optional	**.28** **	.19 *	.18 *	**.29** **
116. Know-why more than know-how	-.15 *	**-.26** **	-.06	-.01
117. Planning and organization of time	-.04	-.04	-.09	.05
118. Frequently anticipate solutions	**-.27** **	**-.31** **	-.23 *	-.07
119. Rely on first impressions	.19 *	.11	.07	**.27** **
120. Laws should be strictly enforced	-.08	-.13	-.03	-.02

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

Questions dealing with handedness, strength of handedness, best and worst subjects, ability to read in a moving vehicle, and degree of introvertedness did not correlate with LOQ scores. However, some interesting correlations are found in the work elements and the key descriptors. Under the HBDI category of work elements, writing and teaching both had statistically significant positive correlations at the .001 level to the LOQ scores. This would be expected since the LOQ focuses on teaching and learning situations. In addition, analytical, administrative, conceptual, integration, planning, problem solving, and organization also showed a degree of positive statistical significance (at the .05 level) in relation to the LOQ scores. These too are attributes of a transforming learner.

Under the HBDI category of key descriptors it was unexpected that only the descriptor "synthesizer" had a statistically significant positive correlation at alpha = .001. The ability to synthesize information is crucial in meaningful learning, but, according to the learning orientation construct, logical and analytical abilities, should also have been similarly correlated. Indeed, logical, analytical, rational, and intuitive showed statistically significant positive correlations at the .05 level. It was not surprising that detailed, emotional, and controlled were negative in their correlations to the LOQ scores as they do not describe transforming learners.

Under the HBDI category of hobbies a very subtle story emerges. Only reading had a statistically significant positive correlation to the LOQ scores at the .001 level. Reading and high LOQ scores may be linked to the inquisitive nature of transforming learners as they actively work towards attainment of their personal goals through independent learning from books. It may also be that transforming learners just like to read. Cooking, playing music, sailing, and travel had statistically significant positive correlations at the .05. The negative correlations for the hobbies of fishing, woodworking, and participating in spectator sports suggest no immediate connection to the intentional learning construct and as such provide food for thought for the LOQ experts.

Under the HBDI category of adjective pairs there were no items with statistically significant correlation coefficients at the .001 level. Of the statistically significant correlations at the .05 level, the negative correlations for creativity and imagination are the most interesting. Two out of the three times that creativity appears in the adjective pairs it is as a negative correlation, the third time it is as not significant. The intentional

learning construct would assert that transforming learners are creative and frequently think outside the traditional linear model.

The statistically significant negative correlation for "imaginative" becomes more surprising when you consider that it was paired with the decidedly conforming characteristic of "sequential" which had a statistically significant positive correlation. A preference for sequential methods is not expected to be positively correlated with overall learning orientation or with strong conation and affect. However, it may be understandable in effort and independence as a sequential method would facilitate independent work and require less effort to be successful.

Under the HBDI category of 20 questions (see Appendix B for the HBDI items) are a list of 20 statements to which the respondent can strongly agree, agree, opt to be in between, disagree, or strongly disagree. Because of the way in which these 20 items were scored, a positive correlation indicates disagreement with the statement and a negative correlation indicates agreement with the statement. A positive correlation indicates where a conforming learner would agree and a negative correlation where a transforming learner would favor it. Of these 20 statements dealing with personal attitudes there were seven questions which had no correlation at all with the LOQ scores and yet might have been expected to do so. These questions dealt with issues of day dreaming for inspiration (question 102), preferring to being imaginative vs. reliable (question 104), enjoying breaking rules (question 107), self expression (question 108), ability to deal with uncertainty (question 111), and time management (question 117). This lack of correlation should raise issues for the LOQ experts as some of these attitudes are a part of how they describe transforming learners.

However, it is reasonable to assume that at least a portion of the variability on these items may be due to emotive word triggers imbedded in the items themselves. Hence it may be the word trigger rather than the general concept which contributed to the lack of correlation. In question 117, the word "mandatory" may be operating in this fashion. Question 117 reads "thorough planning and organization of time are mandatory for solving difficult problems." Although transforming learners may strongly believe that careful planning and organization of time contributes to solving difficult problems they are likely to resist making it "mandatory" because they personally dislike being forced to follow another's prescriptive approach.

It was not surprising to see some correlation at the .05 level with the independent nature of transforming learners towards question 101, believing that a step by step method is not best for solving problems. Although they believe, as inferred from question 113, that it is important for everything to have its place. This desire for orderliness would understandably facilitate accomplishing complex learning goals typical of transforming learners.

As inferred from the positive correlation in question 103, people with high independence scores appeared to like people who are less sure of their conclusions and perhaps more open to considering other ideas. A high LOQ independence score also correlated in question 105 with the attitude toward doing nothing as being unproductive for idea generation. Independence correlated at the .001 level with question 115 concerning wanting to leave many details optional, and question 119 concerning caution about trusting first impressions over careful analysis of a situation.

Although careful not to be mislead by first impressions, the negative correlation at the .001 level in question 106 suggests that transforming learners do rely on hunches and the feeling of "rightness" or "wrongness" when moving toward the solution to a problem. On a conative/affective level they appear to have a positive self belief in their intuitive abilities.

The learning orientation construct supports the idea that unusual ideas and daring concepts would interest and intrigue transforming learners. This premise finds some support in the correlation in question 114. Transforming learners would enjoy spending an entire day "alone with their thoughts"(question 110) as this would give them opportunity to explore their ideas further. They seek to understand why things are they way they are. The correlation in question 116 suggests that they may indeed value know-why over know-how. The correlation for question 118 suggests that transforming learners can frequently anticipate the solutions to their problems, that they prefer to work alone rather than on team efforts (question 112), and that they are basically more competitive with self (question 109) than with others.

Overall, the 20 questions at the end of the HBDI provided considerable support for the learning orientation construct. Although the correlations are small, substantive process is able to account for almost all of the statistically significant correlations. Those not accounted for will provide interesting areas for further research.

Correlation of LOQ Items with the HBDI Scores. Now that we have looked at how the HBDI items correlate with the LOQ construct scores, we will address how the LOQ items correlate with the HBDI construct scores. Table 16 is a 13x25 matrix and displays the observed correlations between each of the 13 HBDI construct scores and each of the 25

LOQ items. Table 16 highlights the LOQ items which correlate with the 13 HBDI constructs.

The LOQ consists of 25 statements concerning attitudes and behaviors towards a variety of learning situations rated on a 7 point Likert scale of very uncharacteristic of me to very characteristic of me. Of these 25 statements dealing with personal attitudes and behaviors there were seven LOQ questions which had no correlation at all with any of the 13 HBDI scores. These questions dealt with issues concerning pushing beyond the goals expected by the instructor to accomplish personal learning goals (question 1), relying on the instructor to stay on task and meet the course objectives (question 5), using learning as a vital resource in accomplishing professional or personal goals (question 6), whether personal or educational learning goals have priority over the instructor's objectives (question 9), whether they learn best if they personally manage their learning goals, strategies, and tasks (question 11), if they rely on the instructor to assess learning achievement (question 20), and who they rely to judge if they are doing well in a course (question 24). This group of questions focus on who they believe is responsible for the learning situation and who should have control over that situation. It is not clear why these questions did not correlate when other, similar questions did.

At the .05 level if significance there were four LOQ questions which positively correlated with Upper Right, Right Mode, Cerebral, and CRWB. These questions included, seeking new learning opportunities because they enjoy learning (question 2), not relying on the instructor to monitor and evaluate how well they learn (question 3), relying on themselves, choosing to seek and use supplemental information to help them learn more

about new topics (question 4), and knowing that if they want to do well on a course, they will (question 8).

Figure 3 provides the questions for the Learning Orientation Questionnaire to provide context and aid the reader in interpreting Table 16.

Figure 3.

Intentional Learning Orientation Questions

LOQ Items

1. I avoid pushing myself to accomplish learning goals beyond those expected by the instructor.
2. I seek new learning opportunities because I enjoy learning.
3. I rely on myself (not the instructor) to monitor and evaluate how well I learn.
4. I seek and use supplemental information that helps me learn more about new topics.
5. I rely on the instructor to help me stay on task and meet course objectives.
6. I use learning as a vital resource in accomplishing my professional or personal goals.
7. I avoid learning situations if I can.
8. If I want to do well on a course, I do.
9. My personal or educational goals do not have priority over the instructor's objectives.
10. I like to learn and feel comfortable learning for any reason.
11. I learn best by personally managing my learning goals, strategies, and tasks.
12. I carefully plan out my learning goals, strategies, and expected outcomes before I do a learning task.
13. Learning helps me achieve challenging personal goals.
14. I avoid challenging learning situations if I can.
15. I use learning to improve the quality of my life.
16. Monitoring my own progress helps me manage and improve my learning and professional performance.
17. I accomplish professional learning goals beyond the stated course objectives.
18. I do not set risky or challenging learning goals before I begin a learning task
19. I enjoy exploring new topics that help me achieve personal learning goals.
20. I rely on the instructor to assess my learning achievement.
21. At the end of a course, I assess my progress to determine how to improve my learning ability.
22. The instructor can show me the best way to evaluate achievement of my learning goals.
23. The instructor can plan my best learning approach for accomplishing training objectives.
24. I rely on myself (not the instructor) to judge if I am not doing well in a course.
25. When I learn about new topics, it is not an enjoyable or comfortable process.

LOQ Scores

26. Learning Focus (Conation & affective - intent or drive to improve & achieve goals)
27. Learning Independence (Responsibility & control - self-motivate, take charge & manage)
28. Planning & Learning Effort (Deliberate, strategic effort recognized as key to success)
29. Learning Orientation

Table 16

Correlation of the HBDI Construct Scores (13) with the LOQ Items (25)

LOQ Items	Upper Left	Lower Left	Lower Right	Upper Right	Left mode	Right mode	Cereb.	Limbic	Whole Brain	CLWB	LLWB	LRWB	CRWB
1.	.04	-.02	-.04	.06	-.03	.06	.05	-.02	.01	.04	.01	-.02	.03
2.	-.00	-.09	.11	.19 *	.03	.14	.20 *	-.03	.05	.03	-.04	.10	.15 *
3.	.07	-.07	-.05	.22 *	-.11	.23 *	.21 *	-.08	.14	.15 *	.04	.02	.22 *
4.	-.03	-.07	.12	.22 *	.04	.15 *	.21 *	-.014	.06	.01	-.01	.11	.18 *
5.	.05	.05	-.00	-.03	-.06	.09	.01	.04	.04	.06	.05	.01	.01
6.	-.05	.03	.10	.13	.03	.13	.11	.05	.07	.02	.04	.11	.13
7.	-.04	-.07	.21 *	.12	.00	.16 *	.06	.11	.06	.00	-.02	.20 *	.10
8.	.09	.09	-.12	**.26 ** **	-.04	**.26 ** **	**.28 ** **	-.05	.20 *	.21 *	.17 *	-.02	**.28 ** **
9.	.09	-.09	-.11	.07	-.13	.11	.10	-.11	.05	.10	-.03	-.05	.08
10.	-.04	-.05	.14 *	.09	.04	.08	.09	.03	.04	-.01	-.00	.14 *	.08
11.	-.01	.11	-.00	.08	.03	.08	.07	.05	.08	.04	.11	.04	.10
12.	-.16 *	.21 *	.09	.03	.05	.06	-.08	.21 *	-.03	-.13	.12	.02	.01
13.	-.03	.02	.00	.18 *	.07	.07	.16 *	-.03	.08	.04	.07	.03	.15 *
14.	.26 *	-.10	-.10	.11	.07	.07	.26 *	-.12	.20 *	**.31 ** **	.06	.03	.18 *

Table cont.

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

Table 16 cont.

Correlation of the HBDI Construct Scores (13) with the LOQ Items (25)

LOQ Items	Upper Left	Lower Left	Lower Right	Upper Right	Left mode	Right mode	Cereb.	Limbic	Whole Brain	CLWB	LLWB	LRWB	CRWB
15.	-.01	-.01	.11	.17 *	.01	.18 *	.18 *	.01	.08	.05	.02	.14	.15 *
16.	-.12	.16 *	.12	.09	.09	.08	.02	.15 *	.02	-.08	.10	.10	.06
17.	.03	-.03	-.01	**.25 ** **	.08	.11	**.25 ** **	-.06	.05	.05	.02	-.01	.20 *
18.	.10	-.02	-.14 *	.16 *	.03	.05	**.24 ** **	-.16 *	.13	.15 *	.06	-.08	.20 *
19.	.01	-.10	.04	.18 *	.04	.07	.20 *	-.10	.06	.04	-.04	.05	.16 *
20.	.05	-.04	-.01	.12	.05	.05	.13	-.03	.13	.11	.05	.05	.15 *
21.	-.10	-.02	.17 *	.12	-.11	.22 *	.04	.09	.05	-.04	.00	.16 *	.09
22.	.17 *	.01	-.20 *	.18 *	-.01	.12	**.29 ** **	-.19 *	.06	.15 *	.05	-.16 *	.17 *
23.	.06	-.04	-.09	.18 *	.01	.09	.19 *	-.09	-.00	.04	-.02	-.09	.13
24.	.02	-.04	-.03	-.01	-.02	-.01	.04	-.08	-.00	.02	-.04	.01	-.01
25.	.16 *	-.07	.05	.03	.04	.08	.11	.01	.11	.18 *	.01	.09	.08

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

Congruent with what we currently know about the learning orientation construct, transforming learners do believe that learning can help to achieve challenging personal goals (question 13), improve the quality of life (question 15), help to accomplish professional learning goals beyond stated course objectives (question 17), and provide enjoyment while exploring new topics to help achieve personal learning goals. Hence it is not surprising that these question all correlate with Upper Right, Cerebral, CRWB at the .05 level or better. The Upper Right thrives on new ideas and can see the bigger picture. The integration of this perspective into a whole brained or cerebral approach would make them especially effective transforming learners.

Transforming learners like to learn and feel comfortable learning for any reason (question 10), and at the end of a course they assess their progress to determine how to improve their learning ability (question 21). These two questions both correlated with Lower Right and LRWB at the .05 level with question 21 also correlating with the Right Mode. The Lower Right is very perceptive of change and usually ready to respond in a soothing manner which could explain why liking to learn and feeling comfortable learning would correlate with this score. They also see personal satisfaction as a prime measure of success which would certainly contribute to the correlation for question 21.

However, the correlations in questions 10 and 21 seem to contradict the correlations in question 7. An unanticipated positive correlation emerged at the .05 level with the Lower Right and choosing to avoid learning situations if possible (question 7). Two other composite scores (Right Mode and LRWB) which include the Lower Right also showed a

subtle correlation to avoiding learning where possible. At this time there does not appear to be a strong substantive process explanation for this contradictory correlation. Perhaps further research will illuminate if the Lower Right's aversion for logic and theory which is frequently a part of a learning situation is the reason for this correlation.

Related to this same issue of avoiding leaning, it is interesting to note that while the Lower Right has some correlation with generally avoiding learning it was the Upper Left and not the Lower Right which correlated at the .05 level with avoiding *challenging* learning situations (question 14). Which seems to suggest that those in the Upper Left don't actively avoid learning unless they think it will be too challenging. Several other composite scores (Cerebral, Whole Brain, and CRWB) which include the Upper Left also showed a subtle correlation to avoiding *challenging* learning situations at the .05 level. CLWB correlated with avoiding challenging learning situations (question 14) at the .001 level. Suggesting that even at the whole brain level, a strong Upper Left emphasis can create an avoidance for overly challenging learning situations. Learning about new topics does not appear to be an enjoyable or comfortable process (question 25) for those in the Upper Left and CLWB.

In a similar questioning vein, not setting risky or challenging learning goals before beginning a learning task (question 18), believing that the instructor can show the best way to evaluate achievement of learning goals (question 22), and that they can plan the best learning approach for accomplishing training objectives (question 23) all unexpectedly correlate positively with Upper Right and Cerebral. These don't fit at all with what we know about the learning orientation construct and may be caused by the number of resistant

learners and high school students in the sample reacting in very different ways to these questions. Further research is needed in order to understand the mixed response on these items.

According to the learning orientation construct, successful learners often carefully plan out learning goals, strategies, and expected outcomes before beginning a learning task (question 12). They also have the ability to monitor their own progress to help them manage and improve their learning and professional performance (question16). So it is not surprising then that these two questions would correlate with the Lower Left and Limbic scores from the HBDI as these are areas which tend to be linear and detail focused. The Lower Left is efficient, making sure that things are done on time and correctly. However, there does not seem to be any substantive process explanation for why question 12 would also correlate negatively with the Upper Left.

Summary of Research Question 5. As you can see from the discussion of Tables 15 and 16, although the correlations themselves are small, there is quite an interesting subtle story embedded in the correlations that sheds light on similar substantive processes. Generally, there appears to be a correlation between transforming learners and the Upper Right and CRWB. Hypotheses 3 was confirmed, that LOQ scores were more likely to correlate with multiple quadrant combinations (or whole-brainedness) than with single quadrant scores. Specifically, cerebral scores which combine Upper Left and Upper Right, combined with one or the other of the lower quadrant scores is a consistent finding. Of the four quadrants, the Upper Right was the most likely to correlate with the LOQ scores.

However, LOQ scores are also highly likely to correlate with multiple quadrant combinations (or whole-brainedness) such as CRWB, Hence hypotheses 4 was also confirmed.

Hypothesis 5, that the LOQ scores would correlate negatively with the Lower Left score was the only hypothesis not to be strongly substantiated by the study. However, it is a complex story to unravel. It was expected that a transforming learner's aversion for following a step-by-step method would contribute to a negative correlation between high LOQ scores and the Lower Left. Although there were a total of 17 negative correlations for the LOQ with the Lower Left, none were significant at either the .05 or .001 level. However, there were two positive correlations at the .05 level with LOQ items 12 and 16. They deal with specifically with planning and organization of time which are dominant features of the Lower Left and preferences for Transforming learners. Hence, there is a theoretical explanation as to why there is a positive correlation for those two items and the Lower Left although it conflicts with the original hypotheses.

Overall, the results from research question 5 and its three associated hypotheses add to the credibility of the substantive process propositions from which these hypotheses were generated. However, additional research to further substantiate these assertions would be reasonable.

Chapter 5

Conclusions

This chapter will present conclusions drawn from the findings, discuss practical implications in relation to future theory and instrument development, limitations of this study, and conclude with suggestions for further research.

Research Questions 1 & 2

Based on the judgments of HBDI experts the items on the HBDI are primarily cognitive. Very few HBDI questions were determined to measure aspects of conation. This could be for a variety of reasons. Perhaps it was because conation was hardly even mentioned among researchers around the time that the HBDI was created. At the time, it was considered a difficult attribute to measure as it appeared logical for conation to be a less stable attribute than cognition.

Based on the judgments of LOQ experts and educational psychologists, the items on the LOQ appear to be primarily conative. Whereas the LOQ experts saw more evidence of secondary cognitive and affective elements in the items and only a little social, the educational psychologists did not fully agree. The educational psychologists judged the LOQ to be almost solely conative and value oriented. This may have been in part due to their more general psychological perspective about the constructs. It may have also been due to vague categories. The sometimes unclear differences between conative, affect, and values

seemed to have a confounding effect on the educational psychologist's ability to discriminate between these categories.

Hypothesis 1. *The HBDI will have a broader scope across different domains than the LOQ, but will emphasize cognitive and social constructs.* Expert judgments confirmed that the HBDI is more cognitively oriented, and the LOQ more conative and affective oriented. Based on the judgments of HBDI experts and educational psychologists, the items on the HBDI appear to be primarily cognitive with a much lesser, but not insignificant, emphasis on affective, values, social, and physical. Affect and values were found to score a bit higher than social, which was not hypothesized in advance. Hence, the HBDI can be classified as a broad-based thinking style instrument which looks at how individuals behave at work, socially, and in their spare time.

Hypothesis 2. *The LOQ will focus on learning situations and as a result not span as many domains, but will emphasize conative and affective constructs and de-emphasize cognitive, physical, social, and values.* The LOQ was found to focus primarily on identifying conative processes specific to learning and teaching settings. In the past, by treating individual differences in learning as a predominantly cognitive phenomenon, researchers may have unwittingly ignored a key element in the equation for understanding these differences. Therefore, it is a finding of practical importance of this study that experts found the LOQ to measure different constructs from the HBDI.

Research Questions 3 and 4

Determining the accuracy of expert predictions highlights areas of construct confusion, pushing experts to extend their understanding of the constructs.

The HBDI experts did quite well at predicting correlations for two HBDI constructs. Lower Left and Upper Right seemed to be the most understood HBDI constructs by the HBDI experts in terms of being able to predict correlations with the LOQ. From the raw data, the LOQ experts appeared most accurate in predicting the correlation between the two HBDI categories of work elements and key descriptors with LOQ construct domains than any other group of HBDI items. However, only one LOQ expert accurately predicted HBDI item correlations with the LOQ domain of planning and effort at the .05 level. He was also the only expert judge to have a great deal of experience with both instruments.

Variability among experts is cause to wonder if the definitions of invisible, artificially created constructs may not be as clearly defined as previously thought. As experts are encouraged and given opportunity to sharpen the distinctions between fuzzy constructs, like affect and values, the clarity of expert's theory of substantive processes increases and leads to improvements in the construct validity of the instrument which claims to measure the construct.

Research Question 5

The LOQ and the HBDI appear to overlap to a small extent in the cognitive and affective domains. However, the HBDI and the LOQ do converge slightly around measure

of high intentionality on both instruments. Intentionality appears to include HBDI scores in upper right, right mode, cerebral, whole-brainedness, CLWB, and CRWB as they overlap with the four LOQ scores. Although the statistically significant correlation coefficients are relatively small at the .001 significance level for these scores. However, the correlations do have significance in the scientific story of similar substantive process operating for both instruments. The correlations do support two of the original three hypotheses for question 5, and sheds light on the third.

Hypothesis 3. *LOQ scores are more likely to correlate with multiple quadrant combinations (3 or 4) as they approach HBDI "whole brainedness" rather than with single quadrant scores.* It was confirmed that LOQ scores were more likely to correlate with multiple quadrant combinations (or whole-brainedness) than with single quadrant scores. Specifically, cerebral scores which combine Upper Left and Upper Right, combined with one or the other of the lower quadrant scores was a consistent finding. However, while the role of the cerebral right in combination with the planning appeal of Lower Left is evident, the expectations of the role of Cerebral Left were inconsistent at the item level.

Hypothesis 4. *LOQ scores are more likely to correlate positively with Upper Right scores than with any other single quadrant score.* Of the four quadrants, the Upper Right was the most likely to correlate with the LOQ scores. However, LOQ scores are also highly likely to correlate with multiple quadrant combinations (or whole-brainedness) such as CRWB.

Hypothesis 5. *LOQ scores are likely to correlate negatively with the Lower Left score.* Hypothesis 5 was the only hypothesis not to be strongly substantiated by the study. Even though it was expected that a transforming learners aversion for following a step-by-step method would contribute to a negative correlation with the Lower Left, there were no significant negative correlations for the LOQ with the Lower Left at either the .05 or .001 level. The two positive correlations at the .05 level with LOQ items 12 and 16 are due to the fact that they deal with planning and organization of time. Hence, there is a substantive process explanation as to why there is a positive correlation for those two items and the Lower Left, although it reveals the original hypothesis to have been overly simplistic.

Practical Implications

Convergent and discriminant validation studies have been lacking in the past for both the LOQ and the HBDI. This study has only begun to address the need to examine issues of overlap and redundancy among individual difference instruments seen to be important in teaching and learning situations. By conducting a convergent and discriminant validity study of the LOQ and HBDI common areas in accounting for individual learning differences have been highlighted while drawing attention to distinctly different concepts for further consideration by authors of both instruments.

The LOQ author could consider a broader range of questions which could illuminate the larger context within which learning always occurs to inform the predictive qualities of the instrument. The HBDI authors could consider several revisions. The easiest would be

revising the "20 Questions" section of the HBDI to remove word triggers, balance the number of items for each quadrant, and add items which measure the LOQ constructs.

Ann Herrmann, the CEO for the Ned Herrmann Group, has already mentioned her desire to improve the HBDI during an informal conversation about this study. Based on the results from this study and further guidance from experts, she is considering revising the HBDI items and algorithms for the quadrant scores, and possibly developing a learner-oriented version that would include elements of the LOQ.

Out of research such as this study, we can expect better instructions to the users of the instruments to assist in appropriate use of the instruments, and improved instrumentation to determine individual differences in learning. Among other useful application, these sorts of improvements should lead to more effective computer-based and web-based instruction for all types of learners as these instruments continue to be used to assess individual differences in learning.

Limitations of this Study

Comparing the LOQ to only one other instrument could be viewed as a limitation of this initial study. Future replications of this specific study should be conducted using other reputable preference profiles such as McCarthy's (1987) 4-MAT system, Kolb's (1984), and perhaps even the MBTI, to suggest just a few. So little was known about how the LOQ could be expected to correlate with other instruments that it was not feasible to include the comparison of multiple instruments in this study. Additional studies built on this research

will be able to ask more probing questions while strengthening the case for convergent and discriminant validity of the LOQ.

However, it should be noted that choosing the HBDI as the initial instrument for comparison to the LOQ was extremely fortuitous. Discovering a correlation between the transforming learners and the multiple quadrant Upper Right/CRWB and the reverse relation with Lower Left is not a relationship which could have emerged from comparison to other similar instruments like 4-MAT, or MBTI.

The second limitation noted here are the vague construct categories that experts were asked to use to catagorize the personal profile instruments. An honest attempt was made to select construct categories which were expected to clearly match items on at least one of the instruments. However, the inclusion of the values category without more training for clarification did not prove helpful and inadvertently added to the ambiguity of the task.

The third and final limitation was the absence of a pilot study of the expert judgment instruments themselves. Conducting a pilot study of the expert judgment instrument with an n>1 would have strengthened the study and possibly allowed for a more refined set of construct domains and definitions to have been used. Experts expressed concern about their ability to understand the instrument. A short training session for the experts on how to fill out the instrument could also have remediated this problem. But due to time and geographical spread of experts no such training was conducted.

Suggestions for Further Research

Since this study is the foundation of a much larger research agenda, the results from this study will guide the direction of future investigations into learning orientation by focusing on:

1. Research: (a) identify where the LOQ fits with other established learning constructs, (b) continue developing the validation argument for the LOQ, and (c) develop application models for the LOQ construct.

2. Theory Development: (a) continue refining the intentional learning construct, (b) create prescriptive recommendations for instructional design on the web, and (c) encourage the use of the intentional learning construct to drive needed technology development.

3. Practical Application: (a) encourage the testing and refinement of prescriptions for dynamic delivery of content using personal learning orientation profiles, (b) create prototypes of courses using the theory, (c) evaluate the implementations, and (d) tailor assessment to support the intentional learning construct in web-based environments.

So in summary, the LOQ has been shown in this study to be significantly different from the HBDI in what constructs it measures. Its use can therefore take us one step further in finding new ways to assess individual differences in learning. Based on LOQ scores, those who understand the intentional learning construct claim to be able to tailor learning treatments to that which an individual can most easily adapt. With further research this may be proven valid, and of sound utility. If this is the case then the LOQ may indeed be what

researchers are looking for to more coherently account for and adapt to individual differences in learning.

Although there is more research to be done to complete the validation argument for the LOQ, it is my hope that future research will build on these findings. By providing data for determining and understanding individual differences in learning we have a better hope for creating instruction to meet individual needs. Building another piece in the case for the validity of the LOQ has been important, not only because it is a part of the process of establishing validity for both instruments but because it has the potential to strengthen the learning theory base which underpins instructional psychology and the associated technological learning aids which the field designs and develops.

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Appendix A

Learning Orientation Questionnaire (LOQ)

Intentional Learning Orientation Questionnaire

Name: _____ Date: _____ Class:

Purpose: This survey asks how you personally rate characteristics and reactions which are typical of your GENERAL or usual approach to learning. Think of your favorites types of learning topics and most comfortable learning situations when you answer this survey.

Instructions: For each statement, circle the one number among the seven that best describes your usual learning approach.

Examples:

(1) If you believe the statement is almost always uncharacteristic or untrue of you, circle the number 1 for Very Uncharacteristic of Me.

(2) If a statement is almost always characteristic or true of you, circle the number 7 for Very Characteristic of Me.

(3) Otherwise, select one of the remaining numbers in the range between the 1 to 7 to describe yourself.

Remember, there are no right or wrong answers, simply answer as realistically as possible.

1. I avoid pushing myself to accomplish personal learning goals beyond those expected by the instructor.

   Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

2. I seek new learning opportunities because I enjoy learning.

   Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

3. I rely on myself (not the instructor) to monitor and evaluate how well I learn.

   Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

4. I seek and use supplemental information that helps me learn more about new topics.

   Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

5. I rely on the instructor to help me stay on task and meet the course objectives.

   Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

6. I use learning as a vital resource in accomplishing my professional or personal goals.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

7. I avoid learning situations if I can.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

8. If I want to do well on a course, I do well.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

9. My personal or educational learning goals do not have priority over the instructor's objectives.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

10. I like to learn and feel comfortable learning for any reason.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

11. I learn best if I personally manage my learning goals, strategies, and tasks.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

12. I carefully plan out my learning goals, strategies, and expected outcomes before I do a learning task.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

13. Learning helps me achieve challenging personal goals.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

14. I avoid challenging learning situations if I can.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

15. I use learning to improve the quality of my life.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

16. Monitoring my own progress helps me manage and improve my learning and professional performance.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

17. I accomplish professional learning goals beyond the stated course objectives.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

18. I do not set risky or challenging learning goals before I begin a learning task.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

19. I enjoy exploring new topics that help me achieve personal learning goals.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

20. I rely on the instructor to assess my learning achievement.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

21. At the end of a course, I assess my progress to determine how to improve my learning ability.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

22. I know the instructor can show me the best way to evaluate achievement of my learning goals.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

23. The instructor can plan my best learning approach for accomplishing training objectives.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

24. I rely on myself (not the instructor) to judge if I am not doing well in a course.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

25. When I learn about new topics, it is not an enjoyable or comfortable process.

Very Uncharacteristic of Me 1 - 2 - 3 - 4 - 5 - 6 - 7 Very Characteristic of Me

Learning Profile

Purpose: In this section, you can select a description that describes how you prefer to learn.

Directions: Read each of the six paragraphs (Learner Profile A-G). Check one of the boxes to select the one Learning Profile Description that best describes your general approach to learning.

Learner A Profile

You prefer to do the easy or basic learning tasks first using step-by-step procedures to accomplish the stated course objectives. Once you have a clear idea about what specifically needs to be done, you enjoy being shown how to do the course with plenty of feedback describing how you are doing and what needs to be done next. You enjoy structured learning environments that focus you on specific steps and procedures that help you complete the course satisfactorily. Good instructors and well-developed instruction are necessary to help you enjoy and finish the course. Learning is necessary if it helps you meet stated professional requirements.

Learner B Profile

You usually prefer starting with the more challenging learning tasks first to find out what you don't know and then filling in the medium tasks if necessary. You like the big picture and can quickly explore the new topics and activities that interest you. You usually try to set your own learning pace, goals, and tasks to accomplish personal goals beyond the course objectives. You learn best in minimally structured learning environments that encourage exploratory, self-directed learning, offer challenging, problem-solving tasks, and provide interactive tools for learning beyond the expected norm. Learning is important to you because it helps you accomplish long-term learning goals, personal challenges, and educational aspirations.

Learner C Profile

You typically prefer skipping the easy skills and starting with the medium tasks first to accomplish the course objectives. You learn best in semi-structured learning environments with instructors that tell you the details of what you need to know and do to accomplish the course objectives and to keep focused on completing the course satisfactorily. You like to have the instructor tell you how well you are doing but not how to do it. You usually don't have the interest or time to do any optional tasks, go beyond stated course objectives, or explore other topics along the way. Learning is necessary when it helps you accomplish stated educational requirements and short-term goals and tasks.

Learner D Profile

You prefer to skip learning altogether because you don't enjoy learning or don't think that you are a good learner. You never enjoyed going to school and still prefer to avoid any formal learning situation if you can. If you need to learn something, you learn best in unstructured learning environments that show you how to complete the course quickly and painlessly. You usually don't have the interest to do any optional tasks, go beyond stated course objectives, or explore other topics along the way. Learning is only necessary if it is required for important professional requirements.

Appendix B

Herrmann Brain Dominance Instrument (HBDI)

BIOGRAPHICAL INFORMATION

1. Name _____ 2. Sex: M ☐ F ☐

3. Educational Focus or Major _____

4. Occupation or Job Title _____

Describe your work _____

_____

HANDEDNESS

5. Which picture most closely resembles the way you hold a pencil? Mark box **A**, **B**, **C**, or **D**.

A ☐ 

B ☐ 

C ☐ 

D ☐ 

6. What is the strength and direction of your handedness? Mark box **A**, **B**, **C**, **D**, or **E**.

A ☐ primary left B ☐ primary left, some right C ☐ both hands equal D ☐ primary right, some left E ☐ primary right

BEST/WORST SUBJECTS

Think back to your best/worst elementary and/or secondary school subjects. Rank all three subjects identified below by entering a **1**, **2**, or **3** on the basis of how well you did: **1** = best; **2** = second best; **3** = third best.

7. _____ math 8. _____ foreign language 9. _____ native language or mother tongue

WORK ELEMENTS

Rate each of the work elements below according to your strength in that activity, using the following scale. Enter the appropriate number next to each element. Do not use any number more than four times: **5** = work I do best; **4** = work I do well; **3** = neutral; **2** = work I do less well; **1** = work I do least well.

10. _____ analytical
11. _____ administrative
12. _____ conceptualizing
13. _____ expressing ideas
14. _____ integration
15. _____ writing
16. _____ technical aspects
17. _____ implementation
18. _____ planning
19. _____ interpersonal aspects
20. _____ problem solving
21. _____ innovating
22. _____ teaching/training
23. _____ organization
24. _____ creative aspects
25. _____ financial aspects

KEY DESCRIPTIONS

Select the eight adjectives which best describe the way you see yourself. Enter a **2** next to each of your eight selections. Then change one **2** to a **3** for the adjective which best describes you.

26. _____ logical
27. _____ creative
28. _____ musical
29. _____ sequential
30. _____ synthesizer
31. _____ verbal
32. _____ conservative
33. _____ analytical
34. _____ detailed
35. _____ emotional
36. _____ spatial
37. _____ critical
38. _____ artistic
39. _____ spiritual
40. _____ rational
41. _____ controlled
42. _____ mathematical
43. _____ symbolic
44. _____ dominant
45. _____ holistic
46. _____ intuitive
47. _____ quantitative
48. _____ reader
49. _____ simultaneous
50. _____ factual

Indicate a maximum of six hobbies you are actively engaged in. Enter a **3** next to your major hobby, a **2** next to each primary hobby, and a **1** next to each secondary hobby.

51. _____ arts/crafts
52. _____ boating
53. _____ camping/hiking
54. _____ cards
55. _____ collecting
56. _____ cooking
57. _____ creative writing
58. _____ fishing
59. _____ gardening/plants
60. _____ golf
61. _____ home improvements
62. _____ music listening
63. _____ music playing
64. _____ photography
65. _____ reading
66. _____ sailing
67. _____ sewing
68. _____ spectator sports
69. _____ swimming/diving
70. _____ tennis
71. _____ travel
72. _____ woodworking
_____ other _____
_____

ENERGY LEVEL

73. Thinking about your energy level or "drive," select the one that best represents you. Check box **A**, **B**, or **C**.

A ☐ day person B ☐ day/night person equally C ☐ night person

MOTION SICKNESS

74. Have you ever experienced motion sickness (nausea, vomiting) in response to vehicular motion (while in a car, boat, plane, bus, train, amusement ride)? Check box **A**, **B**, **C**, or **D** to indicate the number of times.

A ☐ none B ☐ 1–2 C ☐ 3–10 D ☐ more than 10

75. Check box **A** or **B** to indicate whether you can read while traveling in a car without stomach awareness, nausea, or vomiting.

A ☐ yes B ☐ no

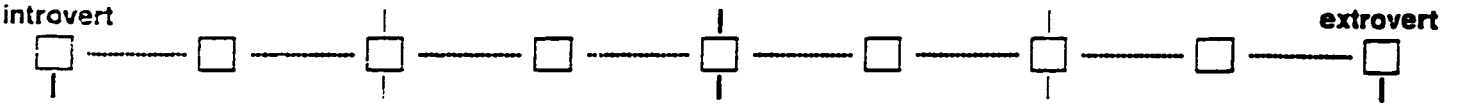
ADJECTIVE PAIRS

For each paired item below, check the word or phrase which is more descriptive of yourself. Check box **A** or **B** in each case, even if the choice is a difficult one. Do not omit any pairs.

	A / B		A / B
76.	..... conservative ☐ / ☐ empathetic	88.	..... imaginative ☐ / ☐ sequential
77.	..... analyst ☐ / ☐ synthesizer	89.	..... original ☐ / ☐ reliable
78.	..... quantitative ☐ / ☐ musical	90.	..... creative ☐ / ☐ logical
79.	... problem-solver ☐ / ☐ planner	91.	..... controlled ☐ / ☐ emotional
80.	..... controlled ☐ / ☐ creative	92.	..... musical ☐ / ☐ detailed
81.	..... original ☐ / ☐ emotional	93.	..... simultaneous ☐ / ☐ empathetic
82.	..... feeling ☐ / ☐ thinking	94.	..... communicator ☐ / ☐ conceptualizer
83.	..... interpersonal ☐ / ☐ organizer	95.	..... technical things ☐ / ☐ people-oriented
84.	..... spiritual ☐ / ☐ creative	96.	..... well-organized ☐ / ☐ logical
85.	..... detailed ☐ / ☐ holistic	97.	.... rigorous thinking ☐ / ☐ metaphorical thinking
86.	.... originate ideas ☐ / ☐ test and prove ideas	98.	like things planned ☐ / ☐ like things mathematical
87.	.... warm, friendly ☐ / ☐ analytical	99.	..... technical ☐ / ☐ dominant

INTROVERSION/EXTROVERSION

100. Check one box only to place yourself on this introvert–extrovert scale.



TWENTY QUESTIONS

Respond to each statement by checking the box in the appropriate column.

	strongly agree	agree	in between	disagree	strongly disagree
101. I feel that a step by step method is best for solving problems.	☐	☐	☐	☐	☐
102. Daydreaming has provided the impetus for the solution of many of my more important problems.	☐	☐	☐	☐	☐
103. I like people who are most sure of their conclusions.	☐	☐	☐	☐	☐
104. I would rather be known as a reliable than an imaginative person.	☐	☐	☐	☐	☐
105. I often get my best ideas when doing nothing in particular.	☐	☐	☐	☐	☐
106. I rely on hunches and the feeling of "rightness" or "wrongness" when moving toward the solution to a problem.	☐	☐	☐	☐	☐
107. I sometimes get a kick out of breaking the rules and doing things I'm not supposed to do.	☐	☐	☐	☐	☐
108. Much of what is most important in life cannot be expressed in words.	☐	☐	☐	☐	☐
109. I'm basically more competitive with others than self-competitive.	☐	☐	☐	☐	☐
110. I would enjoy spending an entire day "alone with my thoughts."	☐	☐	☐	☐	☐
111. I dislike things being uncertain and unpredictable.	☐	☐	☐	☐	☐
112. I prefer to work with others in a team effort rather than solo.	☐	☐	☐	☐	☐
113. It is important for me to have a place for everything and everything in its place.	☐	☐	☐	☐	☐
114. Unusual ideas and daring concepts interest and intrigue me.	☐	☐	☐	☐	☐
115. I prefer specific instructions to those which leave many details optional.	☐	☐	☐	☐	☐
116. Know-why is more important than know-how.	☐	☐	☐	☐	☐
117. Thorough planning and organization of time are mandatory for solving difficult problems.	☐	☐	☐	☐	☐
118. I can frequently anticipate the solutions to my problems.	☐	☐	☐	☐	☐
119. I tend to rely more on my first impressions and feelings when making judgements than on a careful analysis of the situation.	☐	☐	☐	☐	☐
120. I feel that laws should be strictly enforced.	☐	☐	☐	☐	☐

PLEASE COMPLETE NEXT PAGE ➔

DEFINITION OF TERMS

Analytic Breaking up things or ideas into parts and examining them to see how they fit together.

Artistic Taking enjoyment from or skillful in painting, drawing, music, or sculpture. Able to coordinate color, design, and texture for pleasing effects.

Conceptual Able to conceive thoughts and ideas to generalize abstract ideas from specific instances.

Controlled Restrained, holding back, in charge of one's emotions.

Conservative Tending toward maintaining traditional and proven views, conditions, and instances.

Creative Having unusual ideas and innovative thoughts. Able to put things together in new and imaginative ways.

Critical Judging the value or feasibility of an idea or product. Looking for faults.

Detailed Paying attention to the small items or parts of and idea or project.

Dominant Ruling or controlling, having strong impact on others.

Emotional Having feelings that are easily stirred: displaying those feelings.

Empathetic Able to understand how another person feels, and able to communicate that feeling.

Extrovert More interested in people and things outside of self than internal thoughts, and feelings. Quickly and easily exposes thoughts, reactions, feelings, etc to others.

Financial Competent in monitoring and handing of quantitative issues related to costs, budgets, and investments.

Holistic Able to perceive and understand the "big picture" without dwelling on individual elements of an idea, concept, or situation.

Imaginative Able to form mental images of things not immediately available to the senses or never wholly perceived in reality; able to confront and deal with problem in a new way.

Implementation Able to carry out an activity and ensure fulfillment by concrete measures and results.

Innovating Able to introduce new or novel ideas, methods, or devices.

Integration Combining similar but unique pieces and parts or ideas into a harmonious whole.

Intellectual Having superior reasoning powers. Able to inquire and retain knowledge.

Interpersonal Able to easily develop and maintain meaningful and pleasant relationships with many different kinds of people.

Introvert Directed more toward inward reflection and understanding than toward people and things outside of self. Slow to expose reactions, feelings, and thoughts to others.

Intuitive Knowing something without thinking it out-having instant understanding without need for facts or proof.

Logical Able to reason from expectations based on what has gone before.

Mathematical Perceiving and understanding numbers and being able to manipulate them to a desired end.

Metaphorical Able to understand and make use of visual and verbal figures of speech to suggest a likeness or an analogy in place of literal descriptions, i.e., "heart of gold."

Musical Having an interest in or talent for music and/or dance.

Organized Able to arrange people, concepts, objects, elements, etc., into a coherent relationship with each other.

Planning Formulating methods or means to achieve a desired end in advance of taking actions to implement. Problem solving Able to find solutions to difficult problems by seasoning.

Quantitive Oriented to numerical relationships and inclined toward measurement of amounts, proportions, and dimensions.

Rational Making choices on the basis of reason as opposed to emotion.

Reader One who reads often and enjoys it.

Rigorous thinking Having a thorough detailed approach to problem-solving.

Sequential Dealing with things and ideas one after another or in order.

Simultaneous Able to process and make sense of two or more mental inputs such as visual, musical, or verbal inputs, at the same time. Able to attend to two or more activities at the same time.

Spatial Able to perceive and understand the relative position of objects in space, and able to manipulate them into a desired relationship.

Spiritual having to do with spirit or soul as apart from the body or material things.

Symbolic Able to use and understand objects, marks, and signs as representative of facts and ideas.

Synthesizer One who unites separate ideas, elements, or concepts into a unified whole.

Technical Able to understand and apply engineering and scientific knowledge.

Teaching training Able to explain ideas and procedures in a way that people can understand and apply them.

Verbal Having good speaking skills. Clear and effective with words.

Writer One who communicates clearly with the written work and enjoys it.

Appendix C

LOQ Expert Rater Forms

Instructions for LOQ Expert Review of the Learning Orientation Questionnaire for Psychological Domains

Carefully review each of the construct descriptors listed below. Then assign each LOQ item to the appropriate psychological domain, placing your expert predictions in the attached Excel table. There may be items which apply to more than one domain, assign a 1, 2, 3, or 0 according to the strength of the match. However, each item cannot belong to more than three domains and no number (except 0 or blank) can be used more than once for each item.

1	Primary psychological domain	3	Tertiary psychological domain
2	Secondary psychological domain	0 or blank	Not applicable to this domain

Fictitious example: If you believed that item 27 was primarily a part of a value cluster and also applied in a secondary way to the conative domain but was not correlated to any other domain, then your prediction of psychological domain for item 27 would look as follows.

Items	LOQ Items	Cognitive	Conative	Affective	Value	Social	Physical
27	I do well in a course if I rely on the instructor.		2		1		
28	It is my fault if I do not learn the material in a course.						

Brief Descriptors

Cognitive

Of or relating to mental processes for achieving knowledge or knowing. The techniques which describe how people become aware of, gain, and build complex new knowledge through reasoning, integration, synthesis, analysis, judgement, evaluation, creativity, perception, goal setting, and progress monitoring. This includes application of complex rules, rule generation, and problem solving.

Conative

Of or relating to the metal processes directed toward action. This includes aspects such as intent, inclination, determination deliberateness, resolve, drive, desire, will or striving. This desire or striving is usually thought of as directed toward some goal, but it may also be directed toward avoiding certain actions.

Affective

Influenced by or resulting from emotions or feelings. This includes aspects such as passion, frustration, satisfaction, distress, joy, fulfilment, gratitude, comfort, arrogance, or disinterest.

Values

Internally held beliefs about what is important. A personal principal, standard, or cluster of qualities considered worthwhile or desirable.

Social

Interpersonal interactions and group relationships such as collaboration, community, and participation.

Physical

Influenced by bodily action.

IMPORTANT: When you have completed assigning each item on the LOQ to it's appropriate psychological domain, return by mail or **save the Excel file** and **email** it back to **KIWI@cc.ucu.edu** as an attachment.

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Qu #	LOQ Item	Cognitive	Conative	Affective	Value Cluster	Social	Physical
1	I avoid pushing to accomplish learning goals beyond those expected by the instructor.						
2	I seek new learning opportunities because I enjoy them.						
3	I rely on myself (not the instructor) to monitor and evaluate how well I learn.						
4	I seek and use supplemental information that helps me learn more about new topics.						
5	I rely on the instructor to help me stay on task and meet course objectives.						
6	I use learning as a vital resource in accomplishing my professional or personal goals.						
7	I avoid learning situations if I can.						
8	If I want to do well on a course, I do.						
9	My goals do not have priority over the instructor's objectives.						
10	I like and feel comfortable learning for any reason.						
11	I learn best by personally managing my goals, strategies, and tasks.						
12	I plan my goals, strategies, and expected outcomes before I do a learning task.						
13	Learning helps me achieve challenging personal goals.						
14	I avoid challenging learning situations if I can.						
15	I use learning to improve the quality of my life.						
16	Monitoring my progress helps me manage and improve my performance.						
17	I accomplish learning goals beyond the stated course objectives.						
18	I do not set risky or challenging goals before I begin a learning task						
19	I enjoy exploring new topics that help me achieve personal learning goals.						
20	I rely on the instructor to assess my learning achievement.						
21	At the end of a course, I assess my progress to determine how to improve my learning.						
22	The instructor can show me the best way to evaluate achievement of my learning goals.						
23	The instructor can plan my best learning approach for accomplishing training objectives.						
24	I rely on myself (not the instructor) to judge if I am not doing well in a course.						
25	When I learn about new topics, it is not an enjoyable or comfortable process.						
	LOQ Scores						
26	Learning Focus (Conation & affective - intent or drive to improve & achieve goals)						
27	Learning Independence (Responsibility & control - self-motivate, take charge & manage)						
28	Planning & Learning Effort (Deliberate, strategic effort recognized as key to success)						
29	LOQ Scores (Transforming, Performing, Conforming)						

Instructions for LOQ Expert Review of the Herrmann Brain Dominance Instrument (HBDI)

-Estimated Correlations -

Carefully read each of the items then score definitions from the Herrmann brain dominance instrument as listed in the item column of the HBDI Excel spreadsheet. Then attempt to predict the correlation of each HBDI item and score to the constructs you are familiar with from the LOQ. Enter your expert predictions in the attached spreadsheet.

2	High positive correlation	-1	Low negative correlation
1	Low positive correlation	-2	High negative correlation
0 or blank	No correlation		

Fictitious example: If you believed that item 127 has a low positive correlation to learning independence and high positive correlation to the other constructs, then your prediction of correlation for item 127 would look as follows.

Item	HBDI Items	Learning Focus	Learning Independence	Planning & Effort	Learning Orientation
127	Proactive	2	1	2	2
128	Reactive				

Brief Domain Descriptors

Learning Focus Domain This factor refers to the individual's will, commitment, intent, drive, or passion for improving, transforming, and setting and achieving goals, taking risks, and meeting challenges. It describes the individual's *general* conative and affective orientation to the process of learning, regardless of content, environments, resources, or course delivery. *If people high on this scale were more likely to select this item, we would expect a positive correlation and if people low on this scale were more likely to select this item then we would expect a negative correlation.*

Learning Independence Domain This factor refers to the individual's desire and ability to take responsibility, make choices, control, manage, and improve their own learning, self-assess, and self-motivate (i.e., make choices independent of the instructor or prescribed sequences) in the attainment of learning and personal goals. *If people high on this scale were more likely to select this item, we would expect a positive correlation and if people low on this scale were more likely to select this item then we would expect a negative correlation.*

Committed Strategic Planning and Learning Effort Domain This factor refers to the degree that learners commit deliberate, strategic effort to accomplish learning. Successful learners place great importance on the act of striving or commitment to applying focused, strategic planning and hard-working principles to learn. Less-successful learners generally lack insight that strategic planning and committed effort is a contributing factor for achievement. *If people high on this scale were more likely to select this item, we would expect a positive correlation and if people low on this scale were more likely to select this item then we would expect a negative correlation.*

Learning Orientation The sum of the above profile scores provides a total learning orientation score. *If people high on this scale were more likely to select this item, we would expect a positive correlation and if people low on this scale were more likely to select this item then we would expect a negative correlation.*

Transforming learner: (High positive correlation) focuses strong passions on learning; sets and accomplishes short and long term goals that may not align with goals set by others; assumes responsibility for learning; experiences frustration if restricted and denied autonomy.

Performing learner: (Low positive correlation) selectively focuses emotions and intentions on learning; sets and accomplishes short term goals; meets assigned or negotiated standards; willing to assume responsibility for learning in areas of interest; willingly gives up control in areas of less interest.

Conforming learner: (Negative correlation) focuses emotions and intentions cautiously and routinely as directed on learning; tries to accomplish simplistic task-oriented goals assigned by others; tries to please and conform; maximizes efforts in supportive environments with safe standards; assumes little responsibility for learning; wants continual guidance.

HBDI Score Descriptors

Incase the score names at the end of the HBDI spread sheet (rows 121-126) are not clear, more detailed descriptors are provided below for clarification.

Upper Left Those who prefer the upper left quadrant typically analyze, dissect, and solve problems logically by getting facts in the here-and-now. For them, thought is reality. They are logically efficient with the ability to perceive, verbalize, and express things precisely. They are adept at reducing the complex to the simple and they reject ambiguity, seeking control of their environment and themselves.

Lower Left Those who prefer the lower left quadrant typically are verbal, use linear logic, and are interested in what has worked in the past. They also seek control of their environment and themselves but through tried and tested rules. They have the ability to sequentially and systematically sift through large amounts of information to create sense and order. They are punctual, procedural, and detail oriented by focusing on one thing at a time. They reject ambiguity and often have difficulty with change.

Lower Right Those who prefer the lower right quadrant typically are socially intuitive and are aware of mood, atmosphere, attitudes, and energy levels of others. They are emotional, spiritual, empathetic, nurturing, and musical. For them, experience is their reality. They can be undisciplined, impractical, and sentimental due to an aversion to facts, goals, time, and money. They value communication and connection to others. They see comfort and inspiration in revered traditions.

Upper Right Those who prefer the upper right quadrant typically thrive on new ideas, possibilities, incongruities and are often considered visionary and holistic by others. They are largely nonverbal, imaginative, colorful, artistic, fanciful individuals, preferring metaphors and pictures. They seldom make a deadline or take a task through to completion. They favor original nonlinear thinking, resist structure, and are often impersonal, choosing to focus on internal processes.

Left Whole Brained Those who demonstrate the ability to harmoniously integrate all four preference quadrants of the brain, but has an overall preference for the left.

Right Whole Brained Those who demonstrate the ability to harmoniously integrate all four preference quadrants of the brain, but have an overall preference for the right.

Introvert Those directed toward internal reflection and understanding and are slow to reveal themselves to others.

Extrovert Those more interested in people and things outside of themselves. They quickly and easily reveal themselves to others.

IMPORTANT: When you have completed an estimated correlation for each item and score on the HBDI, return by mail or **save the excel file** and **email** it back to KIWI@cc.ucu.edu as an attachment.

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Qu #	HBDI Items	Learning Focus	Learning Independence	Planning & Effort	Learner Orientation
1	**Name**				
2	**Sex**				
3	**Educational Focus** or Major				
4	**Occupation** or Job Title				
5	**Handedness**				
6	Strength of handedness				
7	**Best or worst subject** -- Math				
8	-- Foreign language				
9	-- Native language				
10	**Work Elements** -- analytical				
11	--administrative				
12	--conceptualizing				
13	-- expressing ideas				
14	-- integration				
15	-- writing				
16	-- technical aspects				
17	-- implementation				
18	-- planning				
19	-- interpersonal aspects				
20	-- problem-solving				
21	-- innovating				
22	-- teaching / training				
23	-- organization				
24	-- creative aspects				
25	-- financial aspects				
26	**Key Descriptors** -- logical				
27	-- creative				
28	-- musical				
29	-- sequential				
30	-- synthesizer				
31	-- verbal				
32	-- conservative				
33	-- analytical				
34	-- detailed				
35	-- emotional				
36	-- spatial				
37	-- critical				
38	-- artististic				
39	-- spiritual				
40	-- rational				
41	-- controlled				
42	-- mathematical				
43	-- symbolic				
44	-- dominant				
45	-- holistic				
46	-- intuitive				
47	-- quantitative				
48	-- reader				
49	-- simultaneous				
50	-- factual				

Qu #	HBDI Items cont.	Learning Focus	Learning Independence	Planning & Effort	Learner Orientation
51	**Hobbies** -- arts / crafts				
52	-- boating				
53	-- camping / hiking				
54	-- cards				
55	-- collecting				
56	-- cooking				
57	-- creative writing				
58	-- fishing				
59	-- gardening / plants				
60	-- golf				
61	-- home improvements				
62	-- music listening				
63	-- music playing				
64	-- photography				
65	-- reading				
66	-- sailing				
67	-- sewing				
68	-- spectator sports				
69	-- swimming / diving				
70	-- tennis				
71	-- travel				
72	-- woodworking				
73	**Energy Level** -- day or night person				
74	**Motion Sickness** -- frequency				
75	-- read during vehicle motion				
	Adjective Pairs not duplicated and not already rated in Key descriptors				
76B	-- empathetic				
77A	-- analyst				
77B	-- synthesizer				
79A	-- problem-solver				
81A	-- original				
82A	-- feeling				
83B	-- thinking				
83A	-- interpersonal				
83B	-- organizer				
86A	-- originate ideas				
86B	-- test and prove ideas				
87A	-- warm, friendly				
88A	-- imaginative				
89B	-- reliable				
94A	-- communicator				
94B	-- conceptualizer				
95A	-- technical things				
95B	-- people-oriented				
96A	-- well-organized				
97A	-- rigorous thinking				
97B	-- metaphorical thinking				
98A	-- like things planned				
98B	--like things mathematical				
99A	-- technical				
100	-- Introversion / extroversion				

Qu #	HBDI Items cont.	Learning Focus	Learning Independence	Planning & Effort	Learner Orientation
	Twenty Questions				
101	-- step by step method				
102	-- daydreaming provides solutions				
103	-- being sure of one's conclusions				
104	-- prefer reliable to imaginative				
105	-- best ideas when doing nothing				
106	-- rely on hunches				
107	-- get a kick out of breaking rules				
108	-- cannot express some things in words				
109	-- competitive with others vs. self				
110	-- spend a day alone with my thoughts				
111	-- dislike uncertainty				
112	-- prefer team efforts rather than solo				
113	-- a place for everything; all in place				
114	-- unusual ideas and daring concepts				
115	-- let me leave many details optional				
116	-- know-why more than know-how				
117	-- planning and organization of time				
118	-- frequently anticipate solutions				
119	-- rely on first impressions and feelings				
120	-- laws should be strictly enforced				
	HBDI Scores				
121	Upper Left				
122	Lower Left				
123	Upper Right				
124	Lower Right				
125	Left Whole Brain				
126	Right Whole Brain				

Appendix D

HBDI Expert Rater Forms

Instructions for HBDI Expert Review of the Herrmann Brain Dominance Instrument for Psychological Domains

Carefully review each of the construct descriptors listed below. Then assign each HBDI item to the appropriate psychological domain, placing your expert predictions in the attached Excel table. There may be items which apply to more than one domain, assign a 1, 2, 3, or 0 according to the strength of the match. However, each item cannot belong to more than three domains and no number (except 0 or blank) can be used more than once for each item.

1	Primary psychological domain	3	Tertiary psychological domain
2	Secondary psychological domain	0 or blank	Not applicable to this domain

Fictitious example: If you believed that item 126 was primarily cognitive and also applied in a secondary way to the conative domain but was not correlated to any other domain, then your prediction of **psychological domain** for item 126 would look as follows.

Items	HBDI Items	Cognitive	Conative	Affective	Value	Social	Physical
126	Proactive	2	1				
127	Reactive						

Brief Psychological Domain Descriptors

Cognitive

Of or relating to mental processes for achieving knowledge or knowing. The techniques which describe how people become aware of, gain, and build complex new knowledge through reasoning, integration, synthesis, analysis, judgement, evaluation, creativity, perception, goal setting, and progress monitoring. This includes application of complex rules, rule generation, and problem solving.

Conative

Of or relating to the metal processes directed toward action. This includes aspects such as intent, inclination, determination deliberateness, resolve, drive, desire, will or striving. This desire or striving is usually thought of as directed toward some goal, but it may also be directed toward avoiding certain actions.

Affective

Influenced by or resulting from emotions or feelings. This includes aspects such as passion, frustration, satisfaction, distress, joy, fulfilment, gratitude, comfort, arrogance, or disinterest.

Values

Internally held beliefs about what is important. A personal principal, standard, or cluster of qualities considered worthwhile or desirable.

Social

Interpersonal interactions and group relationships such as collaboration, community, and participation.

Physical

Influenced by bodily action.

IMPORTANT: When you have completed assigning each item on the HBDI to it's appropriate psychological domain, return by mail or **save the Excel file** and **email** it back to **KIWI@cc.ucu.edu** as an attachment.

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Qu #	HBDI Items	Cognitive	Conative	Affective	Value Cluster	Social	Physical
1	**Name**						
2	**Sex**						
3	**Educational Focus** or Major						
4	**Occupation** or Job Title						
5	**Handedness**						
6	Strength of handedness						
7	**Best or worst subject** -- Math						
8	-- Foreign language						
9	-- Native language						
10	**Work Elements** -- analytical						
11	--administrative						
12	--conceptualizing						
13	-- expressing ideas						
14	-- integration						
15	-- writing						
16	-- technical aspects						
17	-- implementation						
18	-- planning						
19	-- interpersonal aspects						
20	-- problem-solving						
21	-- innovating						
22	-- teaching / training						
23	-- organization						
24	-- creative aspects						
25	-- financial aspects						
26	**Key Descriptors** -- logical						
27	-- creative						
28	-- musical						
29	-- sequential						
30	-- synthesizer						
31	-- verbal						
32	-- conservative						
33	-- analytical						
34	-- detailed						
35	-- emotional						
36	-- spatial						
37	-- critical						
38	-- artististic						
39	-- spiritual						
40	-- rational						
41	-- controlled						
42	-- mathematical						
43	-- symbolic						
44	-- dominant						
45	-- holistic						
46	-- intuitive						
47	-- quantitative						
48	-- reader						
49	-- simultaneous						
50	-- factual						

Qu #	HBDI Items cont.	Cognitive	Conative	Affective	Value Cluster	Social	Physical
51	**Hobbies** -- arts / crafts						
52	-- boating						
53	-- camping / hiking						
54	-- cards						
55	-- collecting						
56	-- cooking						
57	-- creative writing						
58	-- fishing						
59	-- gardening / plants						
60	-- golf						
61	-- home improvements						
62	-- music listening						
63	-- music playing						
64	-- photography						
65	-- reading						
66	-- sailing						
67	-- sewing						
68	-- spectator sports						
69	-- swimming / diving						
70	-- tennis						
71	-- travel						
72	-- woodworking						
73	**Energy Level** -- day or night person						
74	**Motion Sickness** -- frequency						
75	-- read during vehicle motion						
	Adjective Pairs not duplicated and not already rated in Key descriptors						
76B	-- empathetic						
77A	-- analyst						
77B	-- synthesizer						
79A	-- problem-solver						
81A	-- original						
82A	-- feeling						
83B	-- thinking						
83A	-- interpersonal						
83B	-- organizer						
86A	-- originate ideas						
86B	-- test and prove ideas						
87A	-- warm, friendly						
88A	-- imaginative						
89B	-- reliable						
94A	-- communicator						
94B	-- conceptualizer						
95A	-- technical things						
95B	-- people-oriented						
96A	-- well-organized						
97A	-- rigorous thinking						
97B	-- metaphorical thinking						
98A	-- like things planned						
98B	--like things mathematical						
99A	-- technical						
100	-- Introversion / extroversion						

Qu #	HBDI Items cont.	Cognitive	Conative	Affective	Value Cluster	Social	Physical
	Twenty Questions						
101	-- step by step method						
102	-- daydreaming provides solutions						
103	-- being sure of one's conclusions						
104	-- prefer reliable to imaginative						
105	-- best ideas when doing nothing						
106	-- rely on hunches						
107	-- get a kick out of breaking rules						
108	-- cannot express some things in words						
109	-- competitive with others vs. self						
110	-- spend a day alone with my thoughts						
111	-- dislike uncertainty						
112	-- prefer team efforts rather than solo						
113	-- a place for everything; all in place						
114	-- unusual ideas and daring concepts						
115	-- let me leave many details optional						
116	-- know-why more than know-how						
117	-- planning and organization of time						
118	-- frequently anticipate solutions						
119	-- rely on first impressions and feelings						
120	-- laws should be strictly enforced						
	HBDI Scores						
121	Upper Left						
122	Lower Left						
123	Upper Right						
124	Lower Right						
125	Left Whole Brain						
126	Right Whole Brain						

Instructions for HBDI Expert Review of the Learning Orientation Questionnaire (LOQ)

-Estimated Correlations -

Carefully read each of the items and scores from the learning orientation questionnaire as listed in the item column of the LOQ Excel spreadsheet. Then attempt to predict the correlation of each LOQ item to the constructs you are familiar with from the HBDI. Enter your expert predictions in the attached spreadsheet.

2	High positive correlation	-1	Low negative correlation
1	Low positive correlation	-2	High negative correlation
0 or blank	No correlation		

Fictitious Example: If you believed that item 34 was positively correlated to Lower Left and negatively correlated to Lower Right but not correlated to any other construct, then your prediction of correlation for item 34 would look as follows.

Item	LOQ Items	Upper Left	Lower Left	Upper Right	Lower Right	Left Whole Brain	Right Whole Brain	Intro-vert
34	I do well in a course if I rely on the instructor.	0	1	0	-1	0	0	0
35	It is my fault if I do not learn the material in a course.							

*** Note for Introversion only: a negative correlation would be the same as a positive correlation to extroversion since they are bipolar. So if you think the item would be picked by an extrovert, indicate a negative correlation.

Brief Description of HBDI Constructs

Upper Left Those who prefer the upper left quadrant typically analyze, dissect, and solve problems logically by getting facts in the here-and-now. For them, thought is reality. They are logically efficient with the ability to perceive, verbalize, and express things precisely. They are adept at reducing the complex to the simple and they reject ambiguity, seeking control of their environment and themselves.

Lower Left Those who prefer the lower left quadrant typically are verbal, use linear logic, and are interested in what has worked in the past. They also seek control of their environment and themselves but through tried and tested rules. They have the ability to sequentially and systematically sift through large amounts of information to create sense and order. They are punctual, procedural, and detail oriented by focusing on one thing at a time. They reject ambiguity and often have difficulty with change.

Lower Right Those who prefer the lower right quadrant typically are socially intuitive and are aware of mood, atmosphere, attitudes, and energy levels of others. They are emotional, spiritual, empathetic, nurturing, and musical. For them, experience is their reality. They can be undisciplined, impractical, and sentimental due to an aversion to facts, goals, time, and money. They value communication and connection to others. They see comfort and inspiration in revered traditions.

Upper Right Those who prefer the upper right quadrant typically thrive on new ideas, possibilities, incongruities and are often considered visionary and holistic by others. They are largely nonverbal, imaginative, colorful, artistic, fanciful individuals, preferring metaphors and pictures. They seldom make a deadline or take a task through to completion. They favor original nonlinear thinking, resist structure, and are often impersonal, choosing to focus on internal processes.

Left Whole Brained Those who demonstrate the ability to harmoniously integrate all four preference quadrants of the brain, but has an overall preference for the left.

Right Whole Brained Those who demonstrate the ability to harmoniously integrate all four preference quadrants of the brain, but have an overall preference for the right.

Introvert Those directed toward internal reflection and understanding and are slow to reveal themselves to others.

Extrovert Those more interested in people and things outside of themselves. They quickly and easily reveal themselves to others.

LOQ Score Descriptors

Incase the score names at the end of the LOQ spread sheet (rows 26-33) are not clear: more detailed descriptors are provided below for clarification.

Learning Focus Domain This factor refers to the individual's will, commitment, intent, drive, or passion for improving, transforming, and setting and achieving goals, taking risks, and meeting challenges. It describes the individual's *general* conative and affective orientation to the process of learning, regardless of content, environments, resources, or course delivery. *If people high on this scale were more likely to select this item, we would expect a positive correlation and if people low on this scale were more likely to select this item then we would expect a negative correlation.*

Learning Independence Domain This factor refers to the individual's desire and ability to take responsibility, make choices, control, manage, and improve their own learning, self-assess, and self-motivate (i.e., make choices independent of the instructor or prescribed sequences) in the attainment of learning and personal goals. *If people high on this scale were more likely to select this item, we would expect a positive correlation and if people low on this scale were more likely to select this item then we would expect a negative correlation.*

Committed Strategic Planning and Learning Effort Domain This factor refers to the degree that learners commit deliberate, strategic effort to accomplish learning. Successful learners place great importance on the act of striving or commitment to applying focused, strategic planning and hard-working principles to learn. Less-successful learners generally lack insight that strategic planning and committed effort is a contributing factor for achievement. *If people high on this scale were more likely to select this item, we would expect a positive correlation and if people low on this scale were more likely to select this item then we would expect a negative correlation.*

Learning Orientation The sum of the above profile scores provides a total learning orientation score. *If people high on this scale were more likely to select this item, we would expect a positive correlation and if people low on this scale were more likely to select this item then we would expect a negative correlation.*

Transforming learner: (High positive correlation) focuses strong passions on learning; sets and accomplishes short and long term goals that may not align with goals set by others; assumes responsibility for learning; experiences frustration if restricted and denied autonomy.

Performing learner: (Low positive correlation) selectively focuses emotions and intentions on learning; sets and accomplishes short term goals; meets assigned or negotiated standards; willing to assume responsibility for learning in areas of interest; willingly gives up control in areas of less interest.

Conforming learner: (Negative correlation) focuses emotions and intentions cautiously and routinely as directed on learning; tries to accomplish simplistic task-oriented goals assigned by others; tries to please and conform; maximizes efforts in supportive environments with safe standards; assumes little responsibility for learning; wants continual guidance.

IMPORTANT: When you have completed an estimated correlation for each item on the LOQ, return by mail or save the **Excel file** and **email** it back to **KIWI@cc.ucu.edu** as an attachment.

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Qu	HBDI Items	Upper Left	Lower Left	Upper Right	Lower Right	Left Whole Brain	Right Whole Brain	Intro-vert
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53	-- camping / hiking							
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57	-- creative writing							
58	-- fishing							
59	-- gardening / plants							
60	-- golf							
61	-- home improvements							
62	-- music listening							
63	-- music playing							
64	-- photography							
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Qu	HBDI Items	Upper Left	Lower Left	Upper Right	Lower Right	Left Whole Brain	Right Whole Brain	Intro-vert
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102	-- daydreaming provides solutions							
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105	-- best ideas when doing nothing							
106	-- rely on hunches							
107	-- get a kick out of breaking rules							
108	-- cannot express some things in words							
109	-- competitive with others vs. self							
110	-- spend a day alone with my thoughts							
111	-- dislike uncertainty							
112	-- prefer team efforts rather than solo							
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