Herrmann® Literature Review Addendum 2012

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Addendum (2012) to the Literature Review for the Herrmann
Brain Dominance Instrument® (HBDI®)

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Abstract

A review of the literature relating to the Herrmann Brain Dominance Instrument® (HBDI®) was conducted in 2005 by the EduMetrics Institute and is documented in Barclay (2005), Literature Review of the Herrmann Brain Dominance Instrument®. The literature review contains important studies available at the time of publication and is available from Herrmann International to assist interested researchers and practitioners. This addendum to the literature review contains some of the more significant studies that have been subsequently published. As with the original literature review, the studies in this addendum are discussed in terms of (a) usability, appeal, and positive expectations and (b) the validity of the HBDI®, according to the aspects of construct validity proposed by Messick (1995, 1998) and described in the Standards for Educational and Psychological Testing (American Educational Research Association, American Psychological Association, and National Council on Measurement in Education, 1999).
Addendum (2012) to the Literature Review for the Herrmann Brain Dominance Instrument® (HBDI®)

The purpose of this addendum is to sample and summarize significant literature relating to the usability and validity of the Herrmann Brain Dominance Instrument® (HBDI®) from the years 2005 through 2011. This addendum is organized as follows: (a) Method, (b) User-Centered Aspects of Validity, (c) External Validity, and (d) Conclusion.

Method

Initial research was conducted online through the Harold B. Lee Library at Brigham Young University. All relevant hits were recorded for the following search terms: brain dominance, hemisphericity, Herrmann Brain Dominance Instrument® (including variants: Herrman and Hermann), and Herrmann Brain Dominance. Searches were also performed on Google and Google Scholar with the same search terms. All relevant hits were similarly recorded, with the exception of hundreds of websites advertising HBDI® assessment services. More recent dissertations and journal articles were also scanned for related citations, which were then located online or physically in the Harold B. Lee Library. These references were also recorded and full texts were obtained.

These files and collections are available from Herrmann International to assist interested researchers and practitioners. For information, contact Herrmann International at info@hbdi.com. The aforementioned files and resources involve bibliographies in the following areas:

- **General**, which includes publications that refer to the HBDI®, hemisphericity (left- and right-brain), and brain physiology;
• Referenced, which lists documents that were included in the Addendum to the initial Literature Review;

• Journal articles; and

• Dissertations.

User-Centered Aspects of Validity: Usability, Appeal, and Positive Expectations

This section deals with literature relating to the overall appeal, perceived value, and usability of the HBDI®. Herrmann International’s commitment to validity of interpretation and use of the instrument is reflected in the information, tools, and activities provided for users. These materials can influence profoundly the way people see themselves and the way organizations function. Herrmann International’s commitment to excellence is reinforced through the exclusive use of certified practitioners who can capably present these materials.

Over the last 6 years, which included significant international expansion, Herrmann International has made continuous efforts to improve the appeal and usability of the instrument for different audiences. The improvements include more comprehensive profile packages and debriefing workshops. In addition, Herrmann International has created the Fundamentals eLearning course, making it easier to bring the fundamentals of Whole Brain® Thinking to learners and easier to prepare learners to receive their HBDI®Profile results. Learners are also able to develop skills in applying Whole Brain® Technology in simulations using the Thinking Accelerator®, which features HBDIinteractive®.

Many studies identified in this literature review credit the Coffield report (Coffield, 2004) with their choice of the HBDI®. Coffield noted that one of the appealing aspects of the HBDI®, as compared to the other instruments, was that the theoretical basis of Whole Brain® Technology
“incorporates growth and development, especially in creativity” and recognizes that Thinking Styles™ are not fixed personality traits but, to a large extent, learned patterns of behavior.

**Usability**

Literature pertaining to interpretation and use validity appears in this section (i.e., Usability) and the following section (i.e., Face Validity). Usability goes beyond the ease of completing the instrument itself and includes both understanding the results and applying the results personally and professionally in a real-world environment. In this section, I review studies that document the usability of the HBDI®.

Scarfino and Roever (2009) reported on the benefits of using the DIVERSITY Game, a tool made available through Herrmann International. The authors reported that the game used in classroom settings was fun and less intimidating than other inventories (e.g., the Myers-Briggs Type Indicator) that require students to provide a large amount of information and then wait for a report. In the authors’ assessment, playing the DIVERSITY Game helps the students more easily grasp the concepts of thinking preferences and makes them more aware of how they and others process information. The authors found the game to be easy to play and manage as a tool for the classroom. The game enabled them to build teams of students they knew little about based on the students’ thinking preferences. When the DIVERSITY Game was used, a “higher level of participation among whole-brain teams and less social loafing” was observed in the classes. Overall, the authors noted, “Our classes have experienced higher quality outcomes when the DIVERSITY Game was used to form teams than when the game was not used.” The authors acknowledged, however, that using the game is not a substitute for the depth of analysis and clarity that the HBDI® profile provides.
Trembley (2007) used the HBDI® as a cornerstone in her class in which the students built web pages that investigated critical and contemporary issues in ways that could interest and educate a broad and inclusive audience. As a foundation, students learned their own HBDI® profiles, then practiced understanding and using multiple thinking preferences—including ones they did not prefer—in communication, teamwork, and relationship development. The class used the Thinking Styles™ concepts to review contemporary critical issues. The review included analyzing arguments, identifying facts and biases, and determining the types of information that each thinking preference would consider as valid proof. Finally the students applied their knowledge of thinking preferences in the design of their web pages. Trembley credits the instrument with generating student ownership and enthusiasm by providing the students with a model and language for understanding themselves and their modes of thinking.

Ann Herrmann-Nehdi (2008) contended that research over the last 30 years has proven that using a brain-based approach to understanding how people learn can provide the principles for creating effective learning materials. Herrmann-Nehdi’s white paper demonstrates how knowledge about and awareness of thinking preferences can be translated into what she terms return on intelligence. Key concepts presented for using learning preferences to enhance learner engagement and increase retention of material are:

- Thinking preferences form the foundation of mental maps that learners use to link new information to previous experiences and patterns.
- Data indicates that 90 percent of people studied have two or three learning preferences.
- Modeling and visualization prime the brain by activating mirror neurons which cause the learner to replicate the experience as if it were happening to them.
Retention research indicates training designers should clearly identify the critical learning points they need to convey, focusing the learners’ energy on acquiring those and making sure the learners have multiple ways to access them.

Learning materials should take into account the generational style differences of learners.

**Self-help literature.** The usability and popularity of the HBDI® is demonstrated by its use as a tool in several popular books. In *Motivation for Dummies*, Burn (2011) introduces the Herrmann model and suggests that the reader stimulate motivation for a project by approaching the project using a particular thinking preference. In *Who’s that Woman in the Mirror?*, Smedley (2012) introduces the Herrmann model and suggests using thinking preferences as a way to enhance communication and teamwork with coworkers.

**Face Validity**

The topic of face validity relates to the overall appeal and perceived value of the HBDI®, including the effectiveness of using Whole Brain® Technology to create effective groups, improve communication, and solve problems. Further, face validity refers to the extent to which an instrument *appears* to measure what it purports to measure. A number of studies have explored this aspect of the HBDI®. These studies are grouped as follows: (a) enhanced productivity through teamwork, (b) enhanced teaching and learning, (c) better management, and (d) building effective learning groups.

**Enhanced Communication and Productivity through Teamwork**

Desphande and Baxi (2011) reported the successful use of the HBDI® as part of a larger project to help Demag India function effectively in a competitive local market. Demag India is a wholly owned subsidiary of Demag Cranes and Components, which is a German engineering
company. The larger project—named ST-IM (Strategy to Implementation)—was implemented to involve people at all levels of the organization, capitalizing on individuals’ strengths and making cross-functional teams more effective. The authors found “a high degree of acceptance of the WBT (Whole Brain® Technology) concept and the HBDI® profiles.” All managers participated in the program and had HBDI® profiles generated. Participants found that accepting their thinking preferences, as well as the thinking preferences that they avoid, led to increased flexibility in their thinking. This flexibility allowed them to use different styles of thinking when the situation required and helped them experience a visibly higher degree of success in implementing projects.

**Enhanced Teaching and Learning**

Based on Herrmann Brain Dominance Theory, Alkhatib et al. (2011) discussed the use of thinking preferences to facilitate the integration of new agile software development with conventional System Engineering practices. Conventional engineering practices were based on the SE Capability Maturity Model Integration (CMMI) of the Software Engineering Institute at Carnegie Mellon University. The researchers identified the steps necessary to develop software using an integrated model and then mapped the Thinking Styles™ required for each step. The study determined that using the CMMI model requires individuals, teams, and organizations who are strong in Quadrants A and B of the Whole Brain® model, while using agile methods requires individuals who are strong in Quadrants C and D. To integrate the two methods, the researchers suggested alternating the team leader for different steps in the process. The selection of the team leader would be based on the Thinking Styles™ required for each step.

Smith (2010) researched the effects of a Whole Brain® teaching strategies course administered to teachers who develop curriculum. In the study, 31 teachers at a small
community college participated in an online course about developing curriculum using Whole Brain® strategies. The teachers’ hemispheric preferences were measured using the McCarthy Hemispheric Mode Indicator (HMI). An Instructional Strategies Questionnaire completed before taking the online course affirmed Ned Herrmann’s assertion (Herrmann, 1996) that a faculty member develops curriculum based on his or her own hemispheric preferences. An Instructional Strategies Questionnaire completed after taking the online course revealed that awareness of thinking preferences and Whole Brain® strategies resulted in a significant difference in the teachers’ choices of instructional strategies. The findings are consistent with a cornerstone of the Herrmann Whole Brain® theory: A person’s awareness of his or her own thinking preferences and other people’s thinking preferences can lead to increased understanding, enhanced communication, and in this case more effective educational materials.

**Better Management**

Reiss (2006) studied the correlation between the brain dominance of lead nurses and their leadership styles and effectiveness. The expected outcome of the study was to develop training programs for prospective lead nurses. The aim of enhanced training programs was to balance brain functioning and leadership styles to improve the effectiveness of nursing managers. The study found:

- A correlation between brain dominance, cognitive style, and leadership styles.
- Most participants utilized the lower, limbic mode (Quadrants B and C in the HBDI® profile).
- Participants dominant in Quadrant B showed greater leadership and managerial orientation than participants with Quadrant C dominance.
• Participants with high scores in the B and D Quadrants were characterized by frequent use of the transformational leadership style, which was found to be effective in achieving outcomes.

• Participants with low Quadrant C scores were characterized by more frequent use of transformational leadership techniques than high Quadrant C scorers.

Scheepers, De Boer, Bothma, and Du Toit (2011) describe the process in which the Navigating Information Literacy class taught at the University of Pretoria was redesigned by incorporating Whole Brain® Technology. In Phase 1 of the project, an analysis revealed that the class was not meeting expectations based on low class attendance and limited application of skills taught in the class. This phase established a baseline effectiveness of the course. In Phase 2, assistant lecturers completed the HBDI® and were debriefed on their thinking preferences. The assistant lecturers were then given training in diverse thinking preferences and offered regular training interventions with a staff development professional to assist them in developing Whole Brain® activities. An evaluation of the materials and activities produced in Phase 2 revealed that they addressed primarily students with preferences in Quadrants A and B, without taking into consideration students with preferences in Quadrants C and D. Hence, the objective of Phase 2 was not met.

Phase 3 implemented a project team based on Whole Brain® Technology. The profile of each team member was plotted and training in the Whole Brain® Creative Process was implemented. Each step of the development process was analyzed for the thinking preferences needed to make that step successful. Team members with the appropriate thinking preferences were assigned to each step. Measures were taken to minimize potential gaps in thinking preferences. The course delivered in Phase 3 successfully met the objective of addressing the
diverse range of thinking preferences. Benefits of using Whole Brain® Technology and Whole Brain Creativity® included sustainability of the project, enhanced creativity, displays of spontaneous responsibility, and acts of ownership by team members during the project.

**Building Effective Learning Groups**

Lumsdaine (2007) described the 2006-2007 Capstone Design course at Michigan Technological University in which 121 students were assigned to 24 project teams. The teams were formed based on HBDI® results, sponsor requirements, student grade point average (GPA), and special qualifications. The first semester of the course emphasized creative problem solving, team building, and learning the 12-step design process, including all associated documentation and thinking skills. Lumsdaine deemed the course to be a success on many levels. During the first semester, course participants showed “marked improvement in written and oral communication and understanding of team development and dealing with conflict or language barriers.” All teams were found to be well functioning—a contrast with teams from past years and an achievement noted by Mechanical Engineering staff involved with the design teams. Also, all project sponsors were satisfied with the progress of their teams. One team expressed the value of the new approach: “We now see that our final design solution is far superior to what we would have accomplished with our initial concept and limited range of thinking modes.”

**Criticisms of Brain Dominance Theories**

Lindell and Kidd (2011) stated “there is no evidence to suggest (1) that traditional teaching neglects the right hemisphere, (2) that people favor one side of the brain, or (3) that any educational tool or strategy can selectively activate one hemisphere.” They cited research (e.g., Beaumont, Young, & McManus, 1984) that attempted to disprove the theory of hemispheric
dominance. The premise of their article was that specific brain processes are not linked to specific physical locations in the brain.

It is important to note that the Herrmann theory of brain dominance is predicated not on the physical location of activity within the brain, but rather on the notion of four thinking preferences, which are depicted metaphorically as four brain quadrants to facilitate understanding. An integral part of Herrmann’s Thinking Styles™ is the philosophy that a person’s innate brain dominance at birth leads to preference or avoidance of certain activities and of certain ways of approaching people and situations. According to the Herrmann theory, preference leads to interests, thus resulting in motivation toward those interests. The resultant motivation leads a person to spend more time and effort in an area, inevitably developing competence and promoting further use. Competencies in less preferred areas may be less developed than those in areas of high motivation due to neglect or avoidance. Experienced HBDI® practitioners understand this interplay well; they use the physical locations metaphor to enhance understanding.

**External Validity**

Validity is generally recognized as being the most important consideration when evaluating an instrument. Validity has been defined as follows:

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\text{Validity is an overall evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of interpretations and actions on the basis of test scores or other modes of assessment. Validity is not a property of the test or assessment as such, but rather of the meaning of the test scores.}
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(Messick, 1995, p. 741)
According to this comprehensive definition of validity, the burden is on those who promote an instrument to ensure that the interpretations people give to their scores have meanings that are supported by both evidence and good theory. This section covers aspects that influence external validity: (a) generalizability, (b) external relationships, and (c) testing consequences.

**Generalizability**

Lees (2009) analyzed and compared the International English version of the HBDI® with the American English version to examine the extent to which differential item functioning (DIF) occurred between the two versions of the instrument. DIF is present when examinees who have the same level of a trait (or attribute) have a different probability of correctly answering an item intended to measure that trait (Shepard & Averill, 1981). Because no language translation is required between the two versions, potential DIF would be the result of cultural adaptation.

Lees (2009) used the POLYSIBTEST procedure to carry out the DIF analysis. Lees found that, overall, the adaptation of the HBDI® into the International English language version was successful. DIF analysis found 11 out of 105 items were manifesting a sufficient amount of DIF to warrant flagging for further review. As part of his work, Lees suggested that DIF could be reduced by encouraging those completing the instrument to use the glossary. Other suggestions regarding the adaptation of the instrument included avoiding idioms and for adaptors and translators to conduct an internal validity analysis followed by judgmental content reviews where DIF studies demonstrate that items are not measuring intended constructs.

Vrugtman (2009) developed an instrument called Dimensions of Intuition (DOI), which purportedly measures an individual’s intuition. Vrugtman used the HBDI® for two purposes: (a) to quantify the relative contributions of each brain quadrant to determine whether intuition is
right-brained, left-brained, or whole-brained, and (b) to quantify the relative contributions of each brain hemisphere to each DOI factor to determine whether intuition is right-brained, left-brained, or whole-brained. Vrugtman also used the Personal Style Inventory (PSI) to cross-validate the DOI.

Whole Brain® Technology recognizes two main types of intuition: intuitively arriving at solutions and intuitively interpreting the feelings of another person. These and other aspects were studied in Vrugtman’s (2009) DOI study. Both C and D Quadrants were predicted to have the highest correlations with intuition. Intuitions for solutions are associated with additional types of thinking, including checking the fit and practical advantages of the proposed solution, which require processing in the A and B Quadrants. Thus, processes in the A and B Quadrants can lead to a solution being discovered by intuition.

**External Relationships**

An important aspect of Messick’s (1998) conceptualization of validity is external relationship validity. This aspect emphasizes convergent and discriminant validity by looking at predictive studies that “provide converging or diverging evidence, depending upon what was predicted” (Martinez, Bunderson, & Wiley, 2000, p. 14). Discriminant validity studies use other tests and instruments—including those on thinking preferences, learning styles, thinking styles, learning strategies, and personality—that are predictably different from the HBDI®. Convergent validity studies use other instruments that measure similar constructs, and that are predictably similar to the HBDI®.

**Discriminant validity.** Clayton and Kimbrell (2007) studied 20 practicing auditors from six large public accounting firms in the Midwest, examining the behavioral aspects of the auditors’ thought processes. The 20 subjects consisted of 6 partners, 10 managers, and 4 senior
accountants. Each subject was tested for hemispheric preference using both the HBDI® and the Myers-Briggs Type Indicator (MBTI). Based on research confirming the validity of the HBDI® as a valid measure of cognitive Thinking Styles™ (Bunderson, 1987; Schkade & Potvin, 1981), the HBDI® was used as the preferred method for measuring thinking preferences in this study. The MBTI was selected to support HBDI® results.

Using results from the HBDI®, 12 of the 20 subjects were classified as having Whole Brain® thinking preferences: five partners, four managers, and three senior accountants. Inconsistent with the authors’ expectations, three of the four participating seniors used Whole-Brain® thinking. HBDI® theory and experience suggests that CEOs and other top-level officers of wide experience often have a thinking style that encompasses all four quadrants, allowing them to more easily manage people with different preferences or to see the broader picture than those with more limited thinking styles. (The typical senior profile would be left-brained.) For these same individuals, the MBTI varies with a mix of five “ST” combinations (i.e., left-brain preferences) and only one “NT” combination, which suggests Whole Brain® thinking. None of the participants were classified as having right-brained thinking preferences.

It is important to note that in the MBTI, a profile demands a choice between opposites. Variations in Thinking (T) versus Feeling (F; which is strongly correlated with A vs. C in the HBDI®) and Sensing (S) versus Intuition (N; which is strongly correlated with B vs. D in the HBDI®) are put aside in the final result. You must be either an S or an N (not both), and you must be either a T or an F (not both). In the HBDI®, you can have certain levels of both A and C Quadrants and certain levels of both B and D Quadrants—both of which represent polar opposites. Thus, it is possible to assess people as using thinking styles from all four quadrants in the HBDI®, but not in the MBTI without deeper analysis.
Ultimately, this study looked at the level of consensus reached among auditors according to their thinking preferences. Results suggested that even though a level of consensus existed among all auditors in evaluating internal controls, auditors with Whole Brain® profiles exhibited greater consistency than those who were left-brained and who had low right-brain preferences.

**Convergent validity.** Wilson (2007) investigated the relationship between the HBDI® and the Extended DISC®—a behavior preference assessment tool. DISC® is an acronym standing for Dominance (Directive), Influence (Interactive), Steady (Supportive), and Conscientious (Compliant, Correct). Wilson found a relationship between the theoretical models of the HBDI® and the Extended DISC®, providing support for the external validity of both tools. Wilson had experts on the HBDI® evaluate the Extended DISC® for similarities with the HBDI® and experts on the Extended DISC® evaluate the HBDI® for similarity with that instrument. Both HBDI® and Extended DISC® experts perceived the two instruments to similar, but not the same. Wilson states that these results help support the conclusion that thinking and behavior are distinct phenomenon with a definable relationship. Wilson also concluded that it is apparent that individuals have preferred Thinking Styles™ and preferred behavior styles, and they are not synonymous.

Wilson’s (2007) study lends support for the external validity of each tool, and supports the categorization of each instrument—the HBDI® as a thinking preference assessment tool and the Extended DISC® as a behavior preference assessment tool. Convergent validity was demonstrated by showing a functional relationship between certain quadrants of the theoretical model for each tool, and discriminant (divergent) validity was demonstrated by showing a lack of relationship between aspects of the theoretical models that were not supposed to relate.
The research is consistent with the Herrmann model in that once an individual understands his or her thinking style preferences, the door is open to improved teamwork, leadership, customer relationships, creativity, problem solving, and other aspects of personal and interpersonal development; however, the HBDI® is not necessarily predictive of ability, behavior, or skill level.

Szirony, Burgin, and Pearson (2008) used the Human Information Processing Survey® (HIPS®) instrument to compare hemispheric laterality with musical and mathematical ability. The HIPS® was administered to 101 participants who were then asked to assess their mathematical and musical abilities using Likert-type scales. Scores from the HIPS® and from the Likert-type scales were compared through canonical correlation to test the hypothesis that those with strong mathematical ability would have a left-brain hemisphere preference and those with musical ability would have a right-brain hemisphere preference. The study found a relatively strong correlation between musical ability and right-brain hemisphere preference. A marginal relationship was found between left-brain hemisphere preference and mathematical ability or integrated brain preference and mathematical ability.

Oliver (2009) used the Style of Learning and Thinking Questionnaire (SOLAT) to correlate the methods used to solve an opened-ended mathematics problem with a student’s area of brain dominance. Results indicated that students with left-brain processing preferences generally preferred written, logical explanation strategies to solve complex mathematical problems. Conversely, students with a right-brain processing preference generally preferred to draw diagrams. Oliver also found that general characteristics associated with each hemisphere of the brain apply to solving complex mathematical problems. Oliver suggested that teaching
strategies associated with both hemispheres could be used to develop mathematical problem solvers who use more Whole Brain® approaches.

Meneely and Portillo (2005) compared 39 design students’ projects with the students’ creative personality traits and cognitive styles. The students completed the Adjective Check List (ACL) to assess personality traits. The ACL was scored using Domino’s Creativity Scale (ACL-Cr) to identify creative personality traits. The students also completed the HBDI® to assess cognitive style and to identify participants with multidominant cognitive styles. A premise of the study was that multidominance indicates flexibility across styles—namely, the ability to fluidly move from one cognitive style to another. The design task was evaluated for creativity using the Consensual Assessment Technique (CAT). Findings indicated that participants showing flexibility between cerebral, limbic, right, and left modes of thinking had significantly higher mean scores on creative personality than did those who exhibited a less flexible cognitive style. Creative personality traits (ACL-Cr) significantly predicted creative performance on the design task. Cognitive style (assessed using the HBDI®) did not predict creative performance; however, flexibility between HBDI® Thinking Styles™ was significantly correlated to the creative personality.

**Correlational Studies with Criteria External to the HBDI®**

There are a number of external factors that have been studied in relation to the HBDI®, including business and military management, instructional presentation preference, and improved retention of educational material. It should be noted that the HBDI® identifies only preferences and does not predict behavior. The following studies indicate how the HBDI® can be used to improve productivity in a number of areas.
**Business and military management.** Amadi-Echendu (2010) described the results of a 2005 survey of 190 practicing engineers used to ascertain the thinking preferences most beneficial for managers of engineering physical assets. The purpose of the study was to provide a strategic view of engineering asset management (EAM), focusing on behavioral alignment relative to innovation, knowledge, and learning economy. Amadi-Echendu et al. asserted that the study confirmed previous results from cognitive theory and psychology based on ranking the top 10 Thinking Styles™ by survey respondents. The study found 6 of the top 10 important Thinking Styles™ belonged to the left-brain quadrants, thus validating the HBDI® proforma profile of engineering and related occupations. The other 4 of the top 10 Thinking Styles™ belonged to the right-brain quadrants, with 3 in the upper right mental processing mode, supporting the increased shift in emphasis towards behavioral preferences generally referred to as soft skills.

Voges (2005) evaluated the implementation of training to accommodate thinking preferences in the Special Forces Basic Learning Programme. An evaluation of the program in 2000 revealed a high failure rate and the loss of many candidates who were unable to pass the course, many of whom were otherwise considered to be viable candidates for consideration in the Special Forces. The HBDI® was used to assess the learning preferences of Special Forces members and compile a profile of a Special Forces operator. The program was modified based on the Herrmann Whole Brain® model, particularly taking into consideration the learning preferences of a typical Special Forces operator. Follow up over a 4-year period revealed the modified program had a significantly higher learner success rate.

Deardorff (2005) researched how leaders determine, describe, and use innovation to create and implement novel ideas. The study was conducted among leaders and change agents at
PLAY, an innovation and creativity consulting company. The study used the HBDI® to determine the thinking preferences of the leaders and change agents. A case study was created using data from the HBDI®, another case study was created without the HBDI® data. Deardorff sought to verify a relationship between innovation and the thinking preferences associated with the D quadrant. Research revealed that change agents utilized upper-brain functionality and balanced right- and left-brain modes in blending analysis and synthesis. Innovation was linked with a C- and D-quadrant split, indicating right-brain thinking preferences that balance passion and synthesis.

**Instructional presentation preference.** Churchill (2008) evaluated the effectiveness of the traditional teaching methods of the University of Minnesota’s College of Veterinary Medicine. The traditional teaching methods were categorized as the MBTI learning preference ISTJ and the Kolb’s Learning Style Model of Type 2. Both of these learning styles are those of introverted, reflective thinkers, who prefer information presented in a logical, organized fashion that focuses on the details and facts. An assessment of the veterinary graduates showed they lacked competence in nontechnical or life skills, particularly those relating to teamwork, communication, and professionalism. Based on the assessment, teaching materials and curricula for the small-animal clinical nutrition course were revised using the Herrmann Whole Brain® Model. The objective was to achieve balance by teaching to all learning modes. The revised course partially retained materials in the preferred Thinking Styles™, increasing the student’s comfort and receptiveness to the material. New material in their less preferred modes was added, allowing the students to learn and practice skills and problem solving through different ways of thinking. The result was a lesson plan for small-animal clinical nutrition that helped to develop the mental dexterity required of practicing veterinarians. To ensure the course goals
were met and to verify that the students had the necessary practical skills required of veterinarians, the students completed a final project or an examination exercise in which they were presented with a clinical case and asked to perform a complete nutrition assessment using all of the skills required of a practicing veterinarian.

Mahnane, Trigano, Tayeb, and Benmimoun (2011) made the distinction between 

*learning style*, which was measured using the Index of Learning Styles (ILS), and *Thinking Style™*, which was measured using the HBDI. The researchers stated that their hypermedia educational model “is inspired by HBDI, because HBDI is the only instrument that quantifies a person’s preference for thinking in four different modes” and, further, it is “a tool to encourage a person to understand his or her strengths and weaknesses, preferences and avoidances” (Mahnane et al., 2011, p. 670). In the hypermedia educational model, information about the learner’s learning style and Thinking Style™ was collected. The architecture of the hypermedia program contained a component referred to as a “probabilistic model of adaptation” that adapted the presentation of the concepts to the learner.

In a recent study, le Roux (2011) analyzed the preferred ways of learning with the thinking preferences of 646 out of 800 students enrolled in an introductory Business Management course. The purpose of the study was to determine the effect of introducing Whole Brain® methods of learning. The Business Management course was chosen because of the limited ability of the instructor to interact with individual students based on the having such a large class size. The majority of students were accounting and investment management students and the remaining students (approximately 13%) were from other areas of study. Consistent with the relationship between area of study and thinking preference, over 77% of the students had left-brain (Quadrant A, A and B, or B) thinking preferences. The study found that most
Quadrant A and Quadrant B thinkers disliked mind maps, group activities, and case studies. This finding is consistent with their substantive thinking preferences as measured by the HBDI®. For 72% of the respondents, working on their own, making summaries for memorization, and memorization that did not involve critical thinking was the preferred learning style. However, the study found that implementing instruction that included mind maps, working in groups, and case studies, significantly improved class attendance and pass rates from the previous year. Online communication increased from the previous year and was associated with the different teaching styles and course activities that were introduced.

**Improved educational material.** Lee (2005) found that students who were taught using Whole Brain® methods had higher retention rates than students who were taught using conventional methods. The retention rates improved among those students within the median scoring level. The methods used to teach the material included reflection skills, such as mind mapping, which helped the students rehearse their learning. The study also found that in a school whose entrance examination scores were 20 or more points lower than those in other schools, students showed significant improvement in academic achievement when Whole Brain® teaching methods were used. The improvement was seen when the students were compared with other students in the same school who were taught using conventional methods.

Bawaneh, Zain, and Saleh (2011) conducted a series of international studies and found that low performance among Jordanian students in science education was due to the prevalence of scientific misconceptions, especially physical concepts. The purpose of the study was to determine the best method for correcting the misconceptions and improving students’ understanding of science. Bawaneh et al. randomly selected 273 students to participate in the study. An experimental group consisting of 63 male students and 72 female students were taught
lessons based on the Herrmann Whole Brain® Model. A control group consisting of 76 male students and 62 female students were taught lessons based on conventional teaching methods. A conceptual pretest was administered to all students. Analysis revealed that both groups were statistically equivalent in performance on the pretest. Results from the statistical analysis of a conceptual posttest found that students who were taught based on Whole Brain® Technology were more successful than students who were taught using the conventional teaching method.

**Improved creativity and innovation.** Liebenberg and Mathews (2012) documented the success of changes to the first-year engineering course at the University of Pretoria. The course was redesigned to simulate a real-world environment in which prospective engineers worked in teams to solve real-world problems. The course used results from the HBDI® profiles to create teams, increase team communication, and develop innovative products. Analysis of students’ course evaluations from the original course and from the revised course revealed that students believed the new course (a) had greater career value, (b) was more relevant regarding practical work and theory, and (c) increased confidence in communicating. Additional findings regarding the revised course include:

- Student teams responded positively to the usefulness of the HBDI® regarding conceptual design.
- Heterogeneous teams (teams using Whole Brain™ Thinking Styles™) developed more advanced and creative concepts that had greater potential for invention and market exploitation.
- Lecturers who taught the students the second year and/or in subsequent classes found “a marked rise in the students’ passion for problem solving and improved group
working skills as well as increased preparedness for performing effective design
work based on solving open-ended problems.”

Schar (2011) explored the effectiveness of teams based on the teams’ preferences for
convergent versus divergent problem solving, including the impact of a team leader who was a
pivot thinker—namely, a person with the ability to shift between convergent and divergent
problem solving. Based on Herrmann International’s descriptions of Thinking Styles™ and
occupational data, the Quadrant A Thinking Style™ aligned with convergent problem solving;
the Quadrant D Thinking Style™ aligned with divergent problem solving. Selection for the
study was based on a difference of scores between A and D of .30 (or higher) for convergent
problem-solving style and a difference of scores between D and A of .30 (or higher) for the
divergent problem-solving style. Pivot thinkers were selected on the basis of a difference of A
and D scores falling at .10 or less. The study found that having a pivot thinker as the group
leader positively influenced the effectiveness of the group. Specifically, a pivot thinking leader
was able to help the team come to a more Whole Brain® solution in the following ways:

- Team members shared unique information earlier.
- Discussions more thoroughly explored information affecting the outcome.
- Options for a solution were explored for a longer period of time.
- Team members were able to focus on relevant solutions faster.

Al-Humaidi (2005) examined the performances of 81 teams at the Al-Jubail
Petrochemical Company in Saudi Arabia. The teams were involved in a tower building problem-
solving activity to increase creativity and innovation. Before participating in the study, the team
members completed the HBDI®, had training on Thinking Styles™, and participated in exercises
to enhance creativity. In analyzing the effectiveness of the teams, Al-Humaidi found:
• The highest performing teams had dissimilar group profiles and different approaches in tower building design.

• The highest performing teams had members with higher quadrant scores, regardless of which quadrants were dominant.

• Heterogeneous groups with higher quadrant scores were more easily directed by a team leader.

• The lowest performing teams had HBDI® profiles that showed no high bias in any one quadrant.

Conclusion

In conclusion, the majority of research studies reviewed herein support the validity of the HBDI® in all of the aspects of validity suggested by Messick (1998). It is important to note that validation work is never complete, because the uses and meanings of words in any instrument change, and new people with different backgrounds begin to use it. Furthermore, even the extensive files of references located in this study deserve further mining. Continuing research can and should be done to further validate the HBDI® and to keep its validity argument current.
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