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Effect of Whole Brain Teaching on Student Self-Concept

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College of Social and Behavioral Sciences

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Heather Clark

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Walden University
2016

Abstract

Effect of Whole Brain Teaching on Student Self-Concept

by

Heather Winona Schulte Clark

MA, Webster University, 2001

BA, Webster University, 2003

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Psychology

Walden University

February 2016

Abstract

Sufficient research exists indicating that the brain mechanisms involved with use of whole brain teaching (WBT) techniques will likely lead to improved academic achievement and that academic self-concept (ASC) is both a cause and consequence of academic achievement. However, it is not known if there is a relationship between WBT and ASC. Given the benefits derived from positive ASC, it becomes important to assess WBT as a predictor variable of positive ASC. The purpose of this quantitative study was to examine the relationship between different levels of exposure to WBT techniques and the mean difference in ASC, as measured by the general-school, mathematics, and reading subscores on the Self Description Questionnaire I, between treatment conditions. Self-concept theory as posited by Shavelson et al. and the Marsh/Shavelson revision, the skill development approach to self-concept enhancement, and the reciprocal effect model provide the theoretical foundations of this dissertation. A one-way multivariate analysis of variance (MANOVA) was used to determine if the mean ASC scores differed among 191 second and third grade students exposed to three levels of the WBT factor. Results of the three-group MANOVA failed to support use of WBT techniques to improve ASC. Reconfiguration of the quasi-independent variable into two groups revealed that general-school ASC scores were significantly lower in the group exposed to limited to no WBT techniques. Assessing students at risk for educational problems may reveal more convincing evidence for WBT as an effective ASC intervention. The implications for social change include encouraging WBT practitioners to make more empirically sound claims and decisions regarding their practice, thereby allowing students an educational experience grounded in scientific findings, rather than subjective assumptions.

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Chapter 1: Introduction to Study

Chris Biffle established whole brain teaching (WBT) in 1999 after 25 years of experience in the classroom (Biffle, 2010). Observation of student behavior in the community college setting led him to believe that the lecture model was problematic as the more he lectured, the more disengaged students became. As a result of this observation, and collaborative work with teachers to develop strategies to improve learning in the classroom, WBT emerged as a grassroots educational reform movement (Biffle, 2010). Reportedly based on brain research, WBT is composed of seven core teaching techniques referred to as the Big Seven. Advocates of WBT claim that teacher use of the techniques improves student academic achievement and self-efficacy (Biffle, 2010).

Due to confusion among researchers as to the theoretical differences between the constructs of *self-efficacy*, *self-concept*, and *self-esteem* and the synonymous use of the terms in the literature (Bandura, 1997; Pajares & Schunk, 2001; Shavelson et al., 1976), the term *self-concept* was used in this study. A review of the literature revealed few studies examining the relationship between student academic self-concept and exposure to the core teaching techniques specific to WBT. As will be explored in chapter 2, advances in self-concept theory, self-concept enhancement research and theory, and brain research provided a foundation for examining the relationship between these two variables.

This chapter will explore the gap in the literature, the purpose, the theoretical foundation, the research questions and hypotheses, and the assumptions and limitations of

this study. Chapter 1 will close with an examination of positive professional and social contributions of this study and a brief overview of the remaining chapters.

Statement of the Problem

The WBT website (Biffle, 2014) provided results of a one-question survey that was given to instructors after seminars on WBT. The survey provides inquiry into instructor's perception of the use of WBT compared to other teaching systems. Instructors could pick an answer from six options ranging from much better to much worse. Based on over 2,000 responses, Biffle (2014) claims that "…98% of educators believe WBT is superior to every other teaching system" (Research section, para. 11). With over 18,000 teachers registered on the WBT website and with an average of 1,000 plus views per day on WBT videos via YouTube and TeacherTube (Biffle, 2014), inquiry into this growing interest is important given the responsibility of educators to use scientifically-based research as a guide to intervention implementation (No Child Left Behind Act of 2001, 2002).

A review of the literature, as presented in Chapter 2, reveals several important considerations. First, self-concept research has identified academic self-concept as distinctly separate from other facets of self-concept and worthy of close examination (Marsh & Shavelson, 1988; Shavelson et al., 1976; Shavelson & Bolus, 1982). Second, there is a wealth of brain research providing support for aspects of WBT techniques that may positively impact student academic achievement (Ansari, 2010; Buckingham, 2006; Dehaene, 2010; Devlin, 2010; Immordine-Yang & Damasio, 2007; Immordino-Yang & Faeth, 2010; Jensen, 2005; Lane et al., 2000; Sousa, 2006). Third, research indicates that interventions that target improved academic achievement will indirectly improve

academic self-concept (Craven, Marsh, & Debus, 1991) and a reciprocal relationship between these two variables exists (Cheng, Ching Mok, & Hap Lam, 2012; Ju, Zhang, & Katsiyannis, 2012; Marsh, 1990; Marsh & Yeung, 1999; McInerney; Valentine, DuBois, & Cooper, 2004). Therefore, the problem is that, while there is sufficient research to conclude that the brain mechanisms involved with use of WBT techniques will likely lead to improved academic achievement and that academic self-concept is both a cause and consequence of academic achievement, as seen in the reciprocal effect model ([REM], Marsh & Craven, 2006), we do not know if there is a relationship between WBT and academic self-concept.

Research Question

1. Do the mean academic self-concept scores differ among students exposed to three levels of the WBT factor (those who are not exposed to WBT techniques, those who are exposed to one to four techniques, and those who are exposed to five or more techniques)?

Hypotheses

H_0: The effect of student exposure to WBT techniques, as assessed by the teacher implementation checklist, has no effect on academic self-concept, as assessed by the Self Description Questionnaire I (Marsh, 1992), of second and third grade students.

H_1: Student exposure to WBT techniques, as assessed by the teacher implementation checklist, does affect second and third grade student academic self-concept, as assessed by the Self Description Questionnaire I (Marsh, 1992), in that the mean difference among factors are significantly different.

Purpose of the Study

The purpose of this quantitative study was to examine the relationship between different levels of student exposure to Whole Brain Teaching techniques and the mean difference in academic self-concept scores among second and third grade students after one semester of school. For this study, self-concept was measured by the general-school, mathematics, and reading subscores on the Self Description Questionnaire I ([SDQI], Marsh, 1992) and levels of student exposure to WBT was assessed by a teacher implementation checklist. The purpose of this study was to establish a relationship between WBT techniques and academic self-concept and to assess WBT as a predictor variable of positive self-concept in order to fill a gap in the literature.

Theoretical Basis

Self-concept theory as posited by Shavelson et al. (1976) and the Marsh/Shavelson revision (1985), the skill development approach to self-concept enhancement (Craven, Marsh, & Debus, 1991), and the reciprocal effect model ([REM], Marsh & Craven, 2006) provide the theoretical foundations of this dissertation. Shavelson et al. (1976) were able to identify problems in self-concept research prior to the 1980s and proposed a new definition of self-concept that led to further research and acceptance of the structure of self-concept as multidimensional and hierarchical (Marsh & Hattie, 1996). As research led investigators to examine the multidimensional nature of self-concept more closely, Marsh and Shavelson (1985) found that the academic facet of self-concept could be examined more closely than originally proposed. With advancement in the field of self-concept theory, researchers were able to begin examining interventions that could be used to modify the academic aspect of self-concept. While

some researchers supported a skill enhancement (i.e. improving academic achievement) approach to self-concept development (Marsh, 1993), others supported a self-enhancement approach in which self-concept is targeted directly (Chapman, Cullen, Boersma, & Mauire, 1981; Shavelson & Bolus, 1982). Believing the enhancement of self-concept was more complex than these two approaches, Marsh and Craven (2006) developed the REM, which proposes that academic self-concept is both a cause and consequence of academic achievement. WBT can be conceptualized in terms of a skill development approach. Brain research has identified aspects of the techniques that could directly improve academic achievement, however, the impact of the techniques on academic self-concept is unknown.

Operational Definitions

Self-efficacy and self-concept are principal self-belief constructs that are distinctly separate in terms of their theoretical and empirical bases (Pajares & Schunk, 2001). However, there is a long history of researchers that used the terms synonymously. Some researchers contended that self-concept is a broad form of self-efficacy, while others argued that self-efficacy is a kind of self-concept (Pajares & Schunk, 2001). Self-esteem is another related, however arguably different (Bandura, 1997), construct that has been used interchangeably with self-concept (Pajares & Schunk, 2001). These ill-defined constructs have historically contaminated studies and confused researchers (Haney and Durlak, 1998; Pajares & Schunk, 2001; Shavelson et al., 1976). For the purpose of this study, self-concept, as defined by Shavelson et al. (1976), will be used to examine the self-belief system that WBT advocates purport to be impacted by WBT techniques. Self-concept is defined in this study as: An individual's perception of him/herself within the

world that is fashioned from environmental experience and reinforcement (Shavelson, Hubner, & Stanton, 1976). The construct of self-concept is hierarchal in nature and divided into academic and nonacademic factors. These factors are divided further into academic or nonacademic self-concept facets, which are individual units of self-concept that make up the factor. For example, the academic self-concept factor is made up of the academic self-concept facets of math and reading (Marsh & Shavelson, 1985).

This study examined the academic aspect of self-concept. It is defined as an individual's perception of their academic competence (Marsh & Hattie, 1996). WBT, as proposed by Biffle (2010), is the use of seven core teaching techniques, referred to as *The Big Seven*. These techniques are used during the learning process to stimulate the whole brain in order to improve academic achievement and self-beliefs.

Limitations

First, with the lack of prior research on WBT, as proposed by Biffle (2010), there is a lack of foundation for understanding the research problem under investigation. This limitation, however, is a reminder that further inquiry into this grass roots movement is necessary. Second, using a cross-sectional design does not allow for changes to be observed among participants over time. Therefore, changes in self-concept cannot be determined as it only provides for analysis of the difference in means among factors. In addition, due to time constraints, the longitudinal effects of WBT on student self-concept were not examined. Therefore, if a significant difference was observed among factors, the stability of the difference could not be measured. Third, controlling for previous academic achievement was problematic as students are not randomly assigned to the WBT condition. While an analysis of covariance (ANCOVA) could control for previous

academic achievement, a continuous variable addressing math, reading, and general-school that is consistent among different school districts is not available for second and third grade students. Therefore, it will remain unknown if students started out similar on academic achievement before being exposed to WBT. Fourth, the self-report nature of examining self-concept is limited to the honesty of the individual. If a participant exaggerates their responses in an attempt to please the researcher, then results will not accurately reflect self-concept. However, research indicates that self-report is the most reliable means of assessing self-concept (Keith & Bracken, 1996) and was the method used in this study. Last, there are several definitions of self-concept, self-esteem, and self-efficacy and some researchers continue to use the terms interchangeably. Therefore, this study is limited to the definition and measurement scale of self-concept as proposed by Shavelson et al. (1976).

Assumptions

I assumed that the theoretical model of self-concept, as proposed by Shavelson/Marsh, and that serves as the foundation of this study, was sound and accurately reflects participant self-concepts under investigation. I assumed that the Self-Description Questionnaire-I is a valid and reliable instrument to measure self-concept and that a one-way multivariate analysis of variance was the most appropriate methodology to address the problem and purpose of this research. In regards to the dependent variables, I assumed that the populations were normally distributed as defined by the levels of the factor, the population variances were equal, and the self-concept scores were independent of each other. I assumed that the size of the sample in this research as determined by a statistical power analysis was adequate for identification of significant differences, if they

do in fact exist in the population. I assumed, based on brain research, that WBT techniques positively impacted academic achievement. I assumed that participants were honest in their self-descriptions of self-concept and that they were representative of the general population. Therefore, I assumed that the results of this research were meaningful and generalizable beyond this sample.

Delimitations

Several aspects of this study were limited so as to not go beyond the scope of the research question. Due to the use of convenience sampling, I examined students in the rural, Midwestern part of the United States as using alternative sampling strategies were not appropriate for this current investigation. This limited the sample in that half of the population was in the lower socioeconomic class. I determined that only the academic portions of the SDQ-I were used as examining non-academic factors would not serve to help answer the research question in the current study. The longitudinal effects of WBT on student academic self-concept was not examined due to time restraints. I determined that examining the longitudinal effects of the relationship between the two variables in the current investigation served as a more appropriate follow-up study to the preliminary findings of this study. In addition, I did not find a continuous variable addressing math, reading, and general-school academic achievement among different school districts in the early elementary setting. Therefore, I did not control for previous academic achievement in this study. As a result, it was unknown if students started out similar in their level of academic achievement before being exposed to WBT. Again, this would be more appropriate to explore once this study provides preliminary findings to support further research on WBT and academic self-concept. I targeted students in the second and third

grade population in the general education setting in the current study as the SDQ-I, being one of the most valid and reliable self-concept assessments available, focused on students in the elementary setting. Therefore, this study was limited to this population. Targeting students in the general education classroom limited the ability of this study to examine how WBT impacts student among the at-risk and disabled population.

Study Significance

The proposed study provided objective information to help teachers make more informed, evidence-based decisions regarding their practice, thereby allowing students an opportunity to receive an educational experience that works to enhance their self-concept that is supported by scientific findings, rather than subjective assumptions. This research will prompt further scientific inquiry into the growing practice of WBT and serve to help substantiate or unsubstantiate claims made by WBT advocates.

Summary

There was a need to explore WBT as this grass roots movement appeared to be gaining attention among educators quickly and failing to attend to the development of student self-concept can have serious implications for students. The notion of WBT as a means for improving student self-concept can be directly or indirectly conceptualized in terms of the reciprocal effect model and the skill development approach to self-concept enhancement. This, along with advances in self-concept theory, provided a foundation to explore the relationship between WBT and self-concept. While limitations to this study do exist, this research will fill a gap between these variables in the literature.

The following chapter provides a comprehensive review of the literature as it relates to self-concept and WBT techniques and examines in detail the relationship

between these variables. Chapter 3 examines the research methods of this study and chapter 4 presents research results. Chapter 5 closes this dissertation with an interpretation of research findings, a discussion of implications for social change, recommendations for action and further study, and a reflection of this research experience.

Chapter 2: Literature Review

Introduction

A review of the existing literature on WBT indicated that scientific inquiry into the growing practice of whole-brain teaching (WBT) is absent from current educational and psychological research and established the need for close investigation into its claims. I reviewed research completed prior to 2009, in this chapter because although WBT is currently in use, it was founded on earlier developed theory and research.

Self-concept theory as posited by Shavelson et al. (1976), and the Marsh/Shavelson revision (1985), provided the theoretical framework of this dissertation. I will explore the theoretical structures of self-concept to provide a foundation for understanding the instruments designed to measure self-concept (i.e. Self Description Questionnaire). I will discuss historical problems in self-concept theory, measurement, and research, along with information on advances in the field to remedy such problems. I will also describe WBT techniques and claims found in the literature related to the impact of student exposure to the techniques. I will explore brain research that may serve as a foundation for understanding how the techniques may improve student achievement. I will then present WBT as a skill development approach, one of two approaches to self-concept modification. I will then establish the relationship between academic self-concept and academic achievement so as to reinforce WBT techniques as an indirect self-concept enhancement approach. I will close this chapter with a brief discussion of the limitations of the extant literature related to self-concept and WBT techniques and will discuss how I will fill this gap in the literature.

I identified relevant studies through searches in psycARTICLES, psycINFO, ERIC, and Education Research Complete online databases. Abstracts within these databases were reviewed based on the descriptors including (a) *cooperative learning*, (b) *elementary*, (c) *whole brain teaching*, (d) *direct instruction*, (f) *academic achievement*, (g) *self-efficacy*, (h) *self-concept*, (i) *self-esteem*, and (j) *school-based intervention*. I explored studies in peer-referred journals first so as to support the use of high quality work. Even though theory suggested a difference between the constructs of self-esteem and self-concept (Bandura, 1986), researchers have used the terms interchangeably. Therefore, I used research using the term self-esteem when it was synonymous with self-concept.

Rationale for Improving Self-Concept in the School Setting

Dr. Herbert Marsh, founder and director of the Self-concept Enhancement and Learning Facilitation (SELF) Research Center at Oxford University, and colleagues, have identified outcomes of academic self-concept and provided evidence for efforts to enhance self-concept in the school setting. Self-concept in specific school subjects were significantly linked to student desire and subsequent choice to pursue specific courses of study (Marsh & Yeung, 1997b). Academic self-concept also affected choice related to aggressive school behavior (Marsh, Parada, Yeung, & Healey, 2001). Given the current trend in addressing bully-type behavior in schools, it is essential to identify effective self-concept enhancement strategies, rather than relying on weak interventions. Low self-concept can have devastating consequences as it can inhibit a person from developing desired relationships, impede on feelings of happiness, produce anxiety, and limit personal aspirations and accomplishments (Branden, 1994). Examining more than 800

meta-analyses from 50,000 research articles, John Hattie (2012) identified self-concept as one of the 150 influences on student academic achievement with a medium effect size of 0.47. As explored later in this chapter, research supported a reciprocal relationship between academic achievement and academic self-concept (Marsh, 1990; Marsh & Yeung, 1999; Valentine, as cited in Hattie, 2004).

Theoretical Structure of Self-Concept Historically

The theoretical structure of self-concept was derived from analogous models of intelligence. While a detailed exploration into these models was beyond the scope of this study, it is important to briefly examine the structural models of self-concept so as to understand the instrumentation created to assess this construct. The unidimensional, multidimensional, taxonomic, and hierarchical structural models of self-concept differ in terms of their use and relationship of global self-concept with domain specific areas and process components.

Unidimensional. Central to the unidimensional general factor model is the global self-concept, or overall perception of oneself, at the apex of the model. As seen in Figure 1, various facets or domains of self-concept contribute to ones global self-concept. For example, experience related to academic, social, or physical functioning will feed into persons overall, or global, perception of themselves (Marsh & Hattie, 1996).

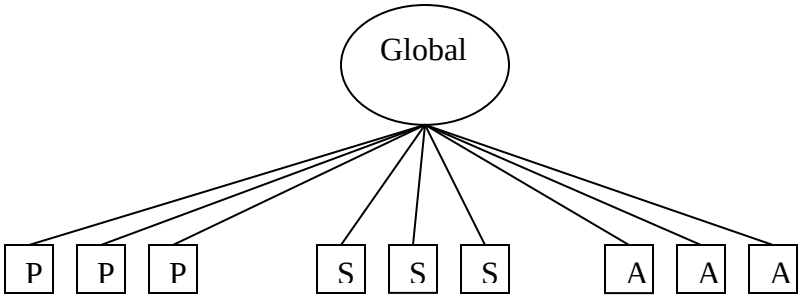

Figure 1. Unidimensional general factor model. From "Theoretical perspectives on the structure of self-concept" by H.W. Marsh & J. Hattie, 1996, in B.A. Bracken (Ed.), *Handbook of self-concept: Developmental, social, and clinical considerations,* p. 40. Copyright 1996; Reproduced with permission of John Wiley & Sons, Incorporated in the format Republish in a thesis/dissertation via Copyright Clearance Center.

Multidimensional. The multidimensional factor models have multiple domains without a global self-concept factor. The multidimensional independent factor model, as seen in Figure 2, has factors that are independent of each other while the multidimensional correlated factor model, as seen in Figure 3, has multiple factors that are correlated. The multidimensional nature of these models was supported by research (Marsh & Hattie, 1996).

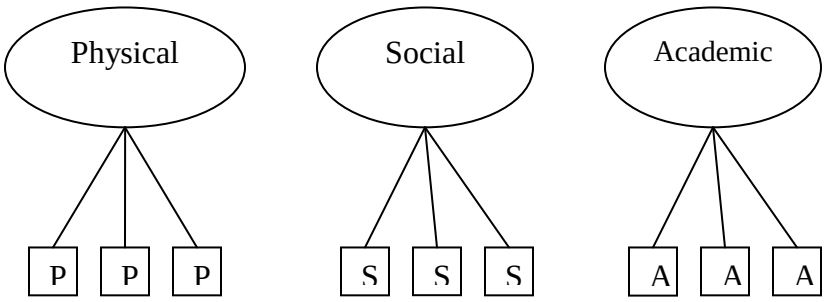

Figure 2. Multidimensional independent factor model. From "Theoretical perspectives on the structure of self-concept" by H.W. Marsh & J. Hattie, 1996, in B.A. Bracken (Ed.), *Handbook of self-concept: Developmental, social, and clinical considerations,* p. 40. Copyright 1996; Reproduced with permission of John Wiley & Sons, Incorporated in the format Republish in a thesis/dissertation via Copyright Clearance Center.

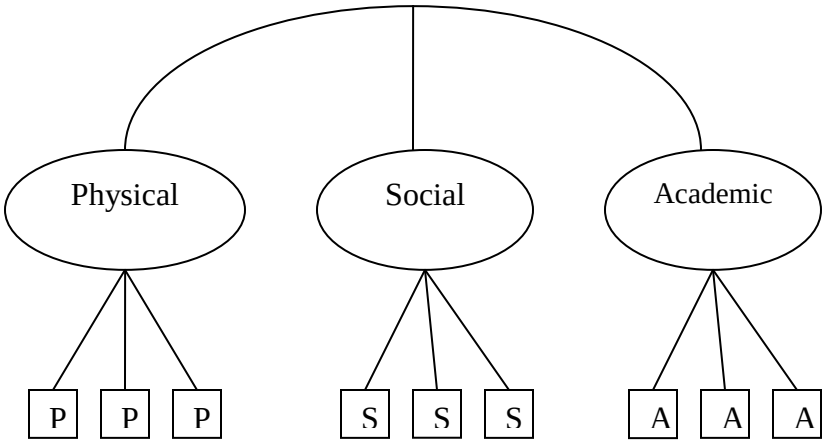

Figure 3. Multidimensional correlated factor model. From "Theoretical perspectives on the structure of self-concept" by H.W. Marsh & J. Hattie, 1996, in B.A. Bracken (Ed.), *Handbook of self-concept: Developmental, social, and clinical considerations,* p. 40. Copyright 1996; Reproduced with permission of John Wiley & Sons, Incorporated in the format Republish in a thesis/dissertation via Copyright Clearance Center.

Taxonomic. The taxonomic model, as seen in Figure 4, is unique in that the structural and process aspects of self-concept are combined. Every combination of various levels of a domain are in the taxonomic model. The domains are combined with additional facets that represent the process component. Instruments have been designed with the taxonomic model in mind and have allowed researchers to examine the self-concept process. Further investigations into the relationship of the scores from the instrument and domain combinations are still needed (Marsh & Hattie, 1996).

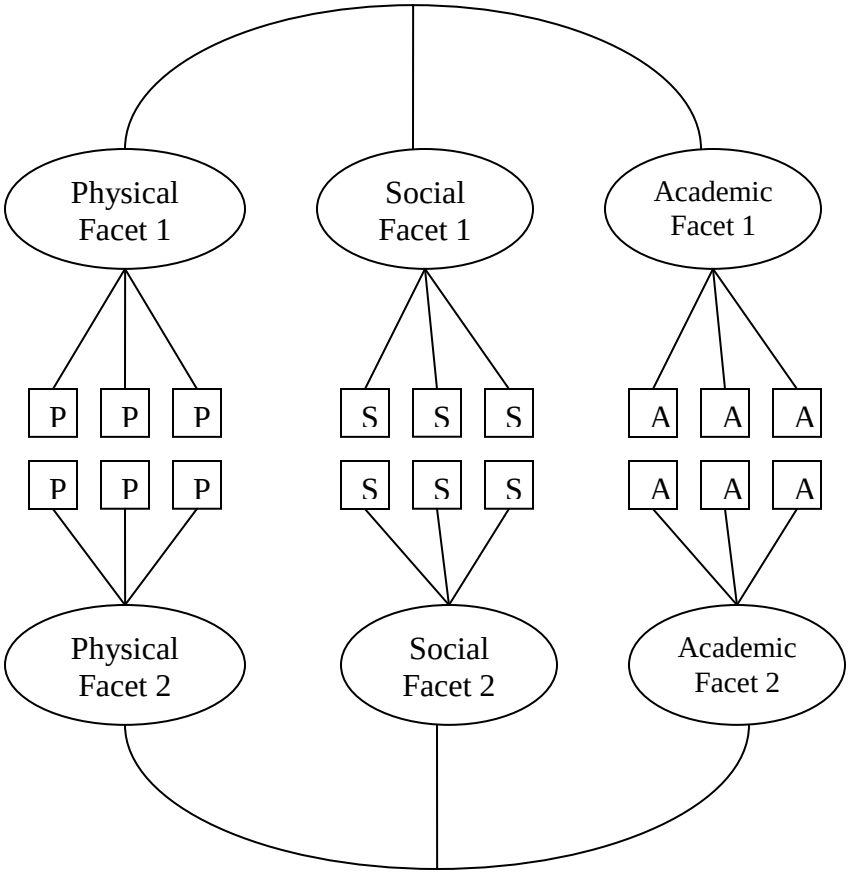

Figure 4. Multidimensional taxonomic multifaceted model. From "Theoretical perspectives on the structure of self-concept" by H.W. Marsh & J. Hattie, 1996, in B.A. Bracken (Ed.), *Handbook of self-concept: Developmental, social, and clinical considerations,* p. 40. Copyright 1996; Reproduced with permission of John Wiley & Sons, Incorporated in the format Republish in a thesis/dissertation via Copyright Clearance Center.

Multidimensional hierarchical. As seen in Figure 5, aspects of the aforementioned models can be found within the multidimensional hierarchical model, as it proposed a global self-concept at the apex and multiple domains with multiple correlated factors. Empirical support for the global factor and the multidimensional correlated factor models would support this model. Empirical support for the multidimensional independent factor model could lend support to the hierarchical nature of this model. The broad nature of this multidimensional hierarchical model allowed

researchers more flexibility in examining the structure of self-concept (Marsh & Hattie, 1996).

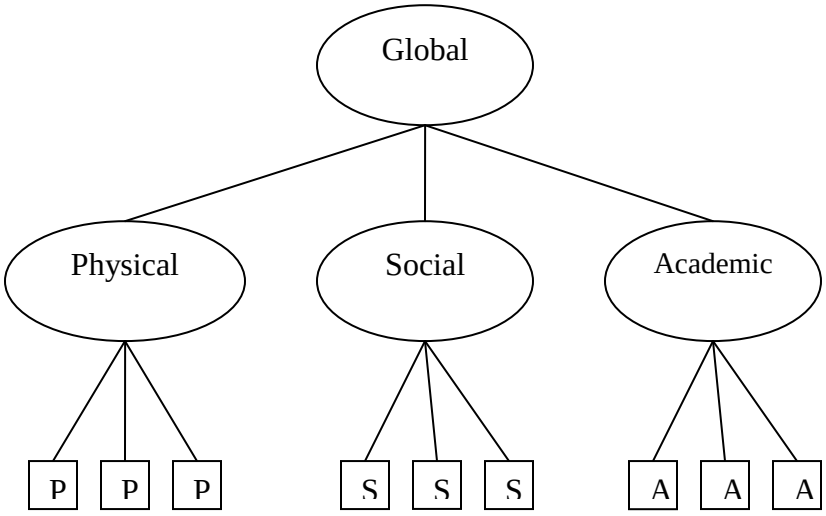

Figure 5. Multidimensional hierarchical factor model. From "Theoretical perspectives on the structure of self-concept" by H.W. Marsh & J. Hattie, 1996, in B.A. Bracken (Ed.), *Handbook of self-concept: Developmental, social, and clinical considerations,* p. 40. Copyright 1996; Reproduced with permission of John Wiley & Sons, Incorporated in the format Republish in a thesis/dissertation via Copyright Clearance Center.

Self-Concept Theory, Measurement, and Research: Historical Problems

Construct validity. Due to the hypothetical nature of self-concept, its construct validity must be explored to determine its usefulness. Within-network studies examine the multidimensional nature of self-concept and seek to lend proof to its theoretical components. Using empirical techniques, between-network studies looked for correlations between self-concept measures and other constructs (Marsh, Barnes, Cairns, & Tidman, 1984). Historically, between-network studies have been in the forefront of research. This is problematic, however due to a lack of consensus among the scientific community as it relates to the internal structure of self-concept (Marsh & Hattie, 1996). This can be attributed to the dearth of within-network studies, especially before the mid-

1970's, that should have preceded any research on self-concept and the wealth of between-network research that has failed to provide necessary advancements in the field.

Research prior to 1980. Research up until the mid-1970's did not provide a specific and consistent definition of self-concept, making the identification of appropriate subjects and self-concept items difficult. Instruments to measure self-concept were created by researchers to satisfy their own studies without regard to empirical evidence on the equivalence between various measurements, leading to problems in generalizing results. Additionally, reliable data to support interpretation of self-report measures were unavailable, making the interpretation of results questionable (Marsh & Hattie, 1996).

Self-Concept Theory, Measurement, and Research: Current Advances

Shavelson et al. (1976) Model. Shavelson et al. (1976) revealed deficits in the definition, measurement, and interpretation of self-concept research and sought to improve these shortcomings by: (a) generating a more definitive definition of self-concept from available definitions in the literature, (b) providing a context for construct validation, and (c) employing this construct validation framework to the examination of five self-report, self-concept instruments used in the discipline of education.

As a result of Shavelson's et al. (1976) examination into the definition of self-concept, a conjectural structure of self-concept was presented. While not intended as a definitive representation at the time and mostly heuristic in structure, it has become known as the Shavelson et al. model and has served as a basis for subsequent investigations into the multidimensional nature of self-concept (Marsh & Hattie, 1996).

With a general self-concept at the apex of Shavelson's et al. (1976) model, as seen in Figure 6, there are two categories, one academic and the other non- academic. This

study focuses on the academic aspect of this model. Below academic self-concept are sub areas defined by other academic sub areas such as math, science, and communication arts. Within the subject sub areas a person's perception of competence will lead to perception of academic competence which will lead to perceptions of global self-concept. A person's evaluation of their behavior in a given situation will trigger this model (Marsh & Hattie, 1996). The Shavelson et al. (1976) model has received a wealth of empirical examination. Critical investigation started with the construct validity of the academic facet of this model, more specifically, its theoretical structure and related instruments of measurement (Byrne, 2002).

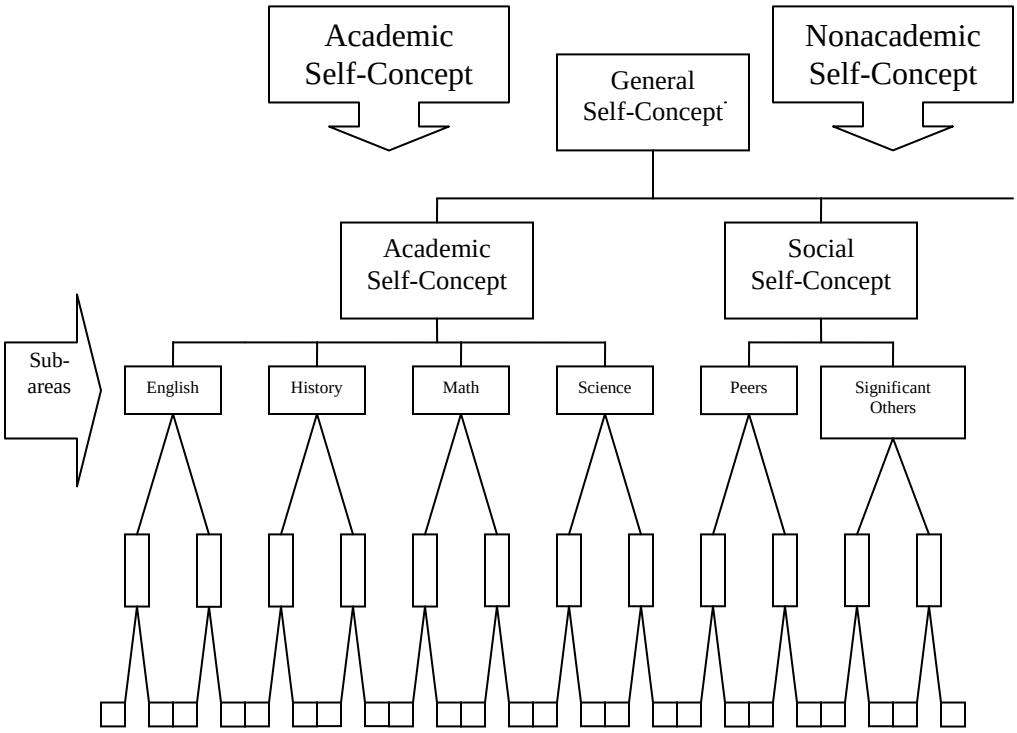

Figure 6. Structure of self-concept as postulated by Shavelson et al. (1976). From "Validation of Construct Interpretations," by Shavelson, Hubner, and Stanton, 1976, *Review of Educational Research, 46*(3), 407-441. Copyright 1976 by the American Educational Research Association; adapted with permission from the publisher.

Marsh/Shavelson Revised Model. Marsh and Shavelson (1985) postulated that the subject specific facets of self-concept are divided further (math and science vs. english) as evidence was found in the Shavelson and Bolus (1982) data that the math and science facets were correlated higher than with English. As seen in Figure 7, the difference between the Shavelson et al. model and the Marsh/Shavelson revised model (1985) is the division of the higher order academic factor into two academic factors to include math/academic and verbal/academic. The Marsh/Shavelson model has become the favored model in hierarchical structure research (Byrne, 2002).

Through analysis of covariance structures, Shavelson and Bolus (1982) examined the causal predominance between achievement and self-concept and the assumption that the structure of self-concept is hierarchical and multifaceted. Multiple measures of the general, academic, and subject (i.e. english, math, and science) self-concepts of 99 seventh and eighth grade students were collected along with their english, math, and science grades. Among the measures of the goodness of fit of structural models to the data, the five factor model, representing the most multifaceted, hierarchical model, fit the data best as it accounted for 80% of the covariation (p = .86) whereas the other two models accounted for 39% and 53% of the covariation. This provided evidence for Shavelson's et al. (1976) assumption on the hierarchical, multifaceted structure of self-concept. Results also provided evidence for self-concept having causal predominance over achievement as subject specific self-concept had the strongest relationships to grades, followed by academic and then general self-concepts. While this research was limited by the small sample size and the lack of subject diversity, it did provide critical evidence for advancement in the field and provided Marsh and Shavelson (1985)

evidence to suggest that the structure of self-concept was in fact even more complex than Shavelson et al. (1976) originally proposed.

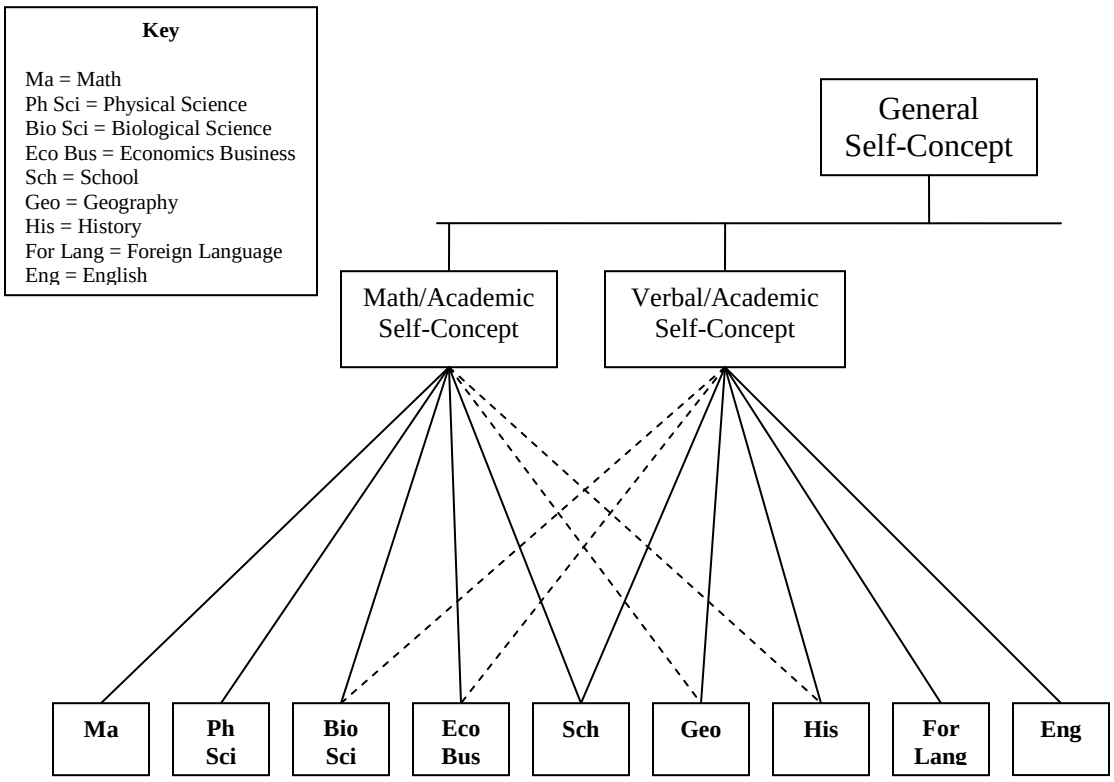

Figure 7. Structure of the Marsh/Shavelson revised model. From "A Multifaceted Academic Self-Concept: Its Hierarchical Structure and Its Relation to Academic Achievement" by H.W. March, B.M. Byrne, and R.J. Shavelson, 1988, *Journal of Educational Psychology, 80*(3), pp. 366-380. Copyright by the American Psychological Association; adapted with permission.

Self Description Questionnaire (SDQ). The need for more empirical support for the multifaceted, hierarchical structure of self-concept prompted Marsh and Shavelson (1988) to conduct a within-network study of the seven self-concept facets in the Self Description Questionnaire (SDQ). Six-hundred and sixty-two elementary students (i.e. Grades 2 to 5) were administered the SDQ. Results reinforced Shavelson's et al. (1976) notion of self-concept structure as the general-school factor was largely correlated with academic factors while nonacademic factors were largely correlated with other

nonacademic factors. This finding was consistent across all grade levels. Correlations were highest in the second grade and consistently decreased with each subsequent year.

The construct validity approach. While Shavelson et al. worked to improve problems in self-concept research, 22 years later Haney and Durlak (1998) asserted that there continued to be confusion between the constructs of self-concept and self-esteem and how they are measured. Researchers did not always provide a theoretical definition of self-concept as they assumed this was common, agreed upon knowledge and studies were plagued with poor construct validity. Research must use measures of self-concept that are domain specific and reflect the goals of the intervention. Using a construct validity approach to self-concept research is essential (Marsh, Richards, & Barnes, 1986).

Guidelines for self-concept enhancement research. Craven, Marsh, and Burnett (2004) proposed the use of several guidelines for research in self-concept interventions including: (a) use of the Shavelson et al. and the Marsh and Shavelson revision as they were the most sound self-concept theories, (b) use of measurement instruments that addressed the multidimensionality of self-concept (e.g. Self-Description Questionnaire), (c) use of strong interventions that focused on feedback, reinforcement, and self-talk, and (d) use of the implications of causal modeling studies.

Developmental Aspects of Self-Concept

From a developmental perspective, as children grow and are exposed to life's experiences, self-concept would become more refined. During preadolescence (grades 2-6), there is a consistent decline in self-concept as children age. This decline is true for both boys and girls. In seventh grade, children's self-concepts increase and then decrease during the eighth and ninth grades and then increase again in the tenth and eleventh

grades. This finding suggested a U-shaped effect in the development of self-concept across the adolescent life span. This effect is consistent among genders. Self-concept continued to increase during late-adolescence and young-adulthood. This trend in self-concept development was generally consistent across the various self-concept domains (Marsh, 1989). Reflective of traditional stereotypes, males exhibited higher physical ability, appearance, and math self-concepts while scores reflected higher verbal/reading self-concepts in females. The most substantial gender difference from preadolescence into early adulthood is appearance (Marsh, 1989).

Alternative Theories of Self-Concept

Venn-diagram. Bracken (1992) provided for the field a Venn-diagram to represent a multidimensional hierarchal model. While the model provided a unique visual structure of self-concept with added domains, it was too big to function effectively as a model for the structure of self-concept. Due to its heuristic nature and the limitations of the visual aspect of the Venn-diagram, the Shavelson, et al. (1976) model was a more practical structural representation (Marsh & Hattie, 1996).

While the multifaceted, hierarchical structure of self-concept was widely accepted in the field, not all researchers (Coopersmith, 1967; Marx & Winne, 1978; Winne, Marx, & Taylor, 1977) agreed. Using initial research on his self-esteem inventory, Coopersmith (1967) asserted that young children cannot differentiate their worth between various experiences because their sense of self is so strongly governed by their general self-concept. This assertion was subject to scrutiny when factor analysis of responses did find multiple factors (Marsh & Smith, 1982).

Social cognitive theory. From the social cognitive perspective, the cause of human behavior is not unidirectional, but an interaction of behavioral, personal, and environmental factors. Bandura's (1986) triadic reciprocality, as seen in Figure 8, provided a model of this reciprocal determinism. Behavioral, personal, and environmental factors were highly interdependent and served as determinants of each other. Human action results from the continuous process of these three variables interacting and influencing each other. The relative influential strength of any one of these factors will vary among activities, people, and situations.

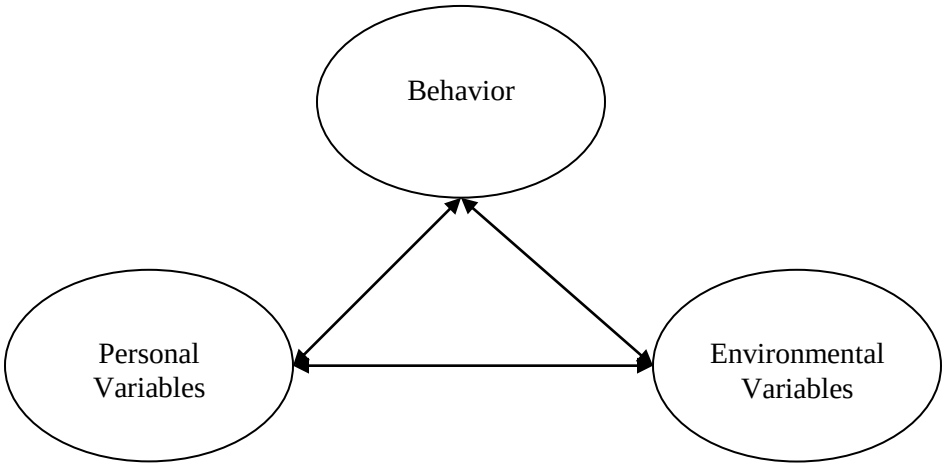

Figure 8. Schematization of the relations between the three classes of determinants in triadic reciprocal causation. From *Social Foundations of Thought and Action: A Social Cognitive Theory, 1st Ed.*, by A. Bandura, p. 24. Copyright 1986; Reprinted by permission of Pearson Education, Inc. New York, New York.

Through an interaction between external and self influences, humans, within the limits of their biological capacity, develop the function of self-regulation. In the social cognitive view, human nature is composed of five capabilities, one of which is the ability to self-regulate behavior. The process of self-regulation, as seen in Figure 9, was made up of three subfunctions that work in subsequent order. Within the subfunction of self-

observation, personal standards were established. The acceptance of personal standards prompted the activation of the judgemental subfuntion in which discrepencies develop between an individuals behavioral performance in any given situation and the personal standard by which the performance is measured against. This discrepancy then triggered the self-reaction subfunction wherein individuals developed evaluative self-reactions that influence behavior. Triadic reciprocality is seen in the process of self-regulatory functioning as self, or personal, factors interacted with external, or environmental, factors to influence behavior, in turn influencing subsequent self and external factors (Bandura, 1986).

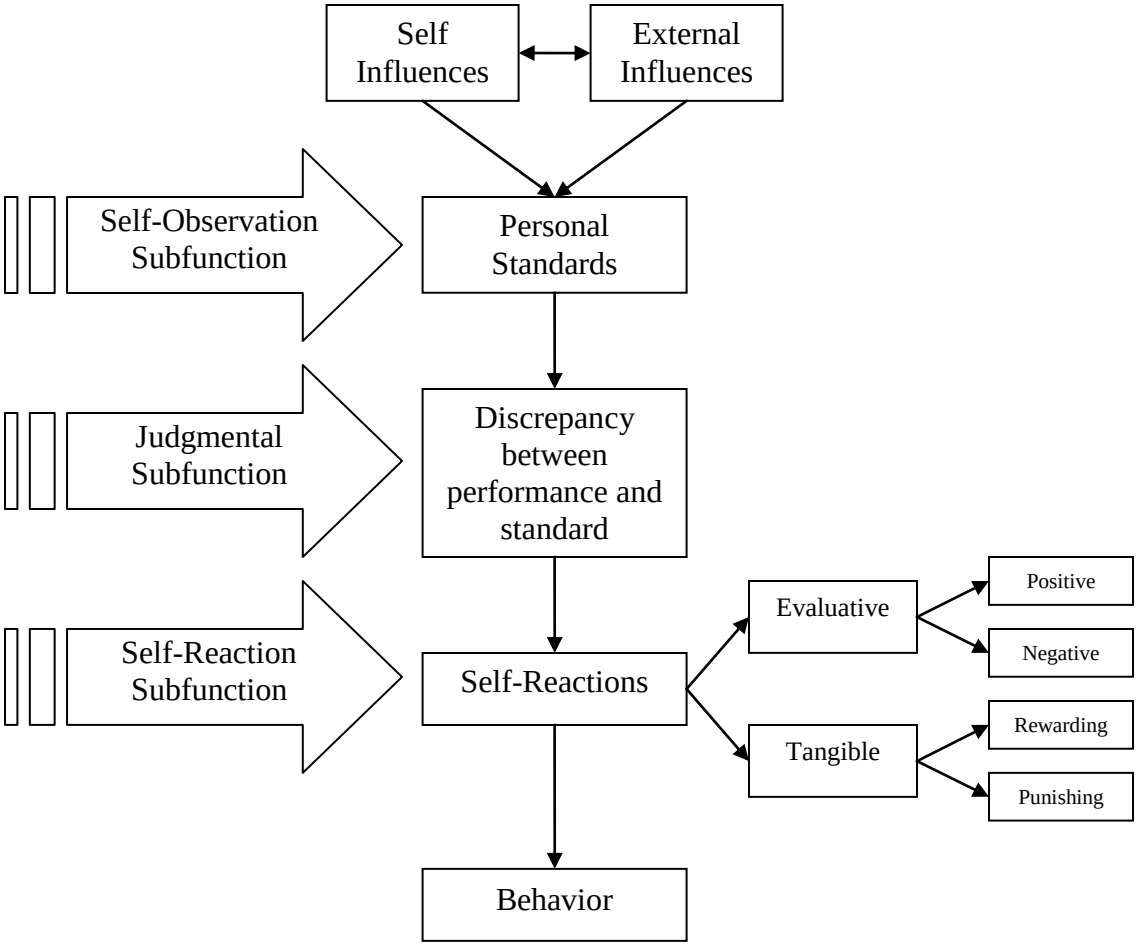

Figure 9. Model of the process of self-regulatory functioning. From *Social Foundations of Thought and Action: A Social Cognitive Theory,* by A. Bandura, p. 337. Copyright 1986 by Prentice-Hall, Inc.

Once the discrepancy develops between an individual's behavioral performance and his or her personal standards, self-reactions ensued. Self-reactions to performance were either evaluative or tangible. Evaluative self-reactions embodied the construct of self-concept and are characterized in terms of self-conceptions that were positive or negative. The propensity to evaluate oneself approvingly denotes a positive self-concept while critical and disdainful evaluation denotes a negative self-concept (Bandura, 1986).

Behavioral theory. Bracken and Lamprecht (2003) argued that self-concept models that were cognitively based did not adequately identify how self-concept was

acquired. Integrating learning theory into its model, Bracken (1992) illustrated how self-concept was obtained through environmental feedback that produced positive or negative perceptions of ones self. As seen in Figure 10, an individual acquired this feedback from their direct experiences in the environment (i.e. Personal Perspective) or indirectly from other people (i.e. Other Perspective). Once feedback was received via the other or personal perspective, standards were used to evaluate the information (Bracken & Lamprecht, 2003).

As seen in Figure 9, Bandura's (1986) conception of self-concept postulated that it developed from the discrepancy between an ideal standard and one's performance. While this ideal standard was a factor in Bracken's (1992) acquision model, Bracken identified additional standards from which self-concept is derived. Self-concept is also hypothesized to be the result of evaluations based on observable outcomes (i.e. absolute standard), the comparison of one's own behavior to that of other people (i.e. comparative standard), and evaluations of one's own behavior as it relates to other personal behaviors (i.e. ipsative standard; Bracken & Lamprecht, 2003). Figure 10 provides a visual representation of how personal and other perspectives come together to develop a child's self-concept.

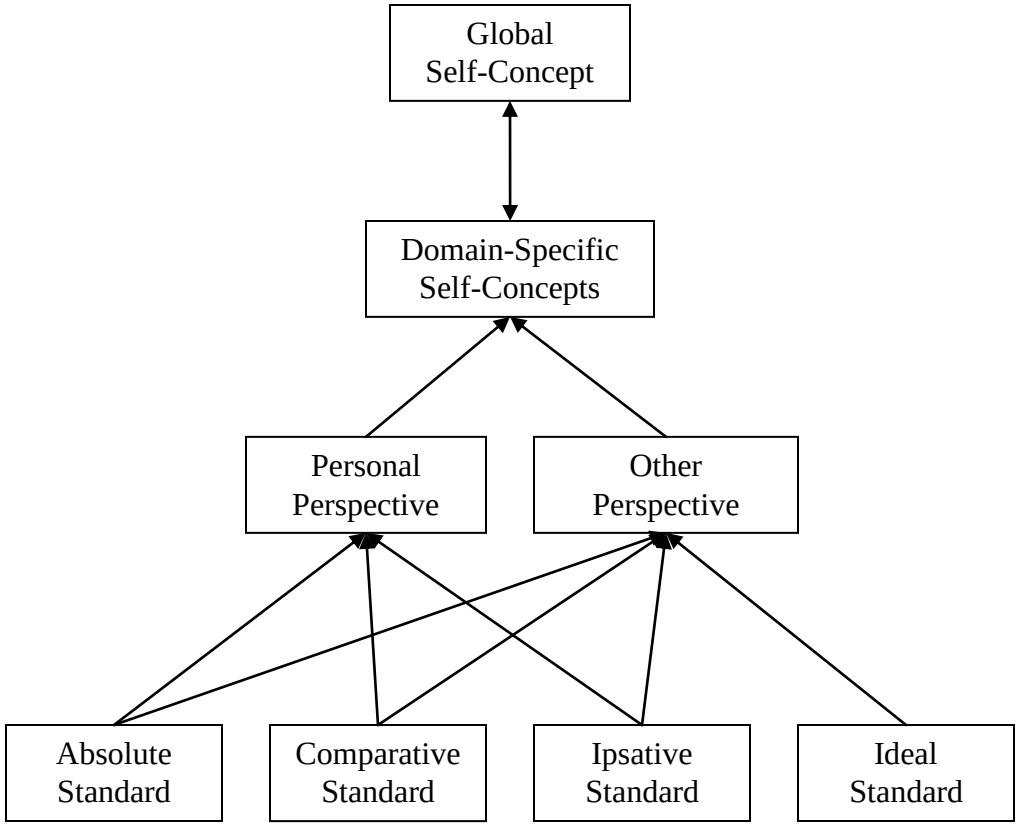

Figure 10. Self-concept behavioral acquisition model. From "Positive Self-Concept: An Equal Opportunity Construct" by B.A. Bracken & M.S. Lamprecht, 2003, *School Psychology Quarterly, 18*(2), pp. 103-121. Copyright by the American Psychological Association; adapted with permission.

Biological theory. In order to address the brain based mechanisms involved in student self-concept, Sousa's (2006) information processing model was explored. This model described the biological process of learning in the classroom and how it relates to student self-concept. It was reminiscent of social cognitive and behavioral models of self-concept in that it was shaped by environmental experiences, was reciprocal in nature, was multifaceted, and changed among different facets of life.

As seen in Figure 11, input from the environment was gathered via the sensory systems. The RAS filtered this input and searched for data that affected survival. Information processed through the RAS then moved in to immediate memory where it

was held for up to 30 seconds. Information affecting physical safety was processed first and then emotional security and then information related to learning (i.e. curriculum). Information of continued importance to the student then moved into working memory. Based on past experience, information that both made sense and was meaningful to the student would move into long-term storage. All other data was lost. Sousa made a distinction between long-term storage and memory in that long-term storage maintained memories, much like a filing cabinet maintains documents, while long-term memory was responsible for the process of storing and retrieving the memories in storage. The memories in storage contributed to the cognitive belief system, or the individual's conception of their environment around them and how it works (Sousa, 2006).

The self-concept was found within the cognitive belief system and was at the apex of the model as it was the driving force behind future behavior. Self-concept was defined as the individual's conception of how they view themselves within the environment. It was continuously changing as a result of past experience and influenced future experience. For example, when failure is experienced in the past, future input related to the experience was most likely dropped as the sensory register blocked the negative input as a form of protection against future failure. This was observed in students that shut down or refused participation in new learning experiences in the classroom (Sousa, 2006).

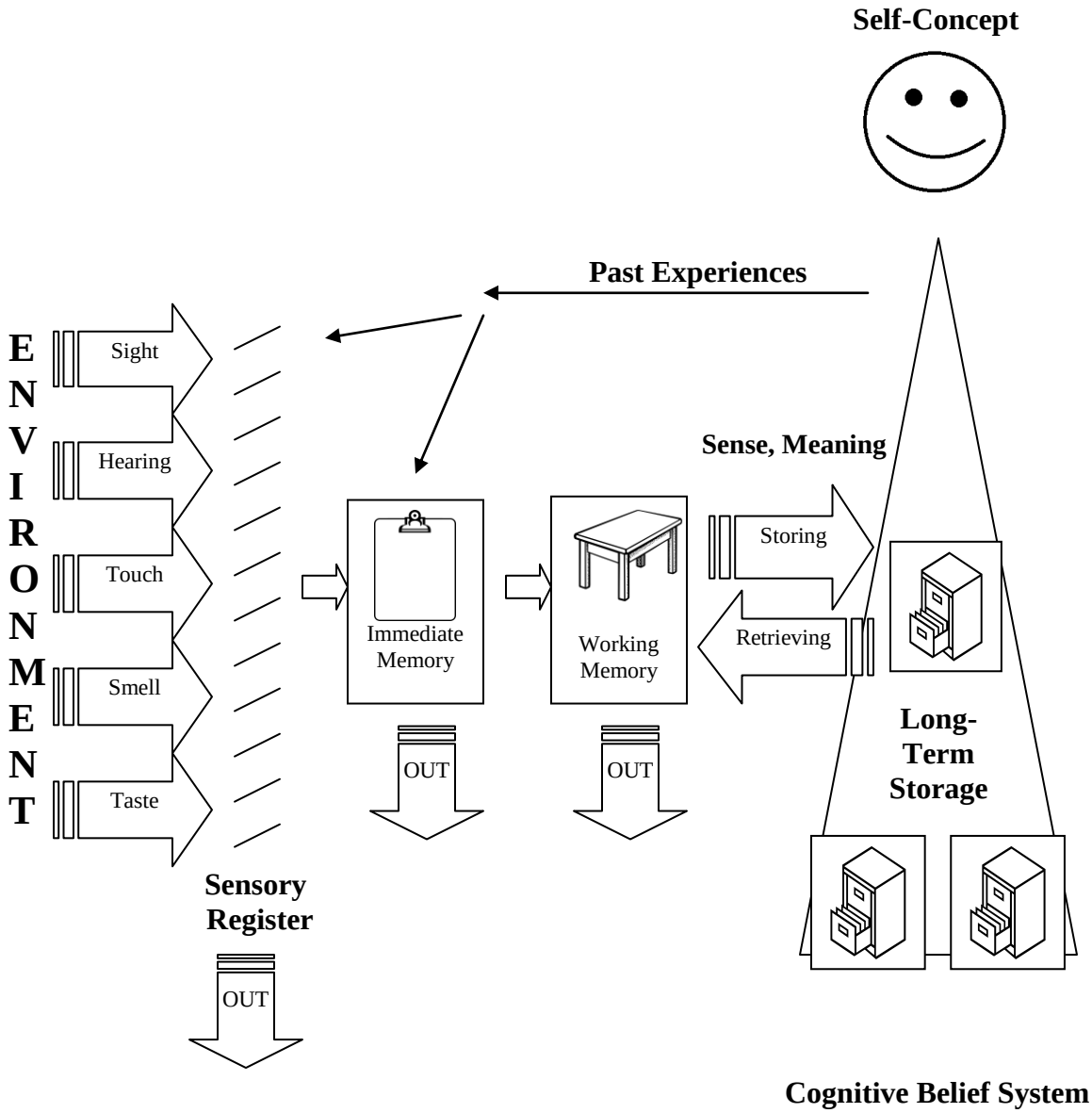

Figure 11. Information processing model. From *How the Brain Learns: Third Edition,* by D. Sousa, p. 41. Copyright 2006; Reproduced with permission of SAGE Publications Inc. in the format republish in a thesis/dissertation via Copyright Clearance Center.

Whole Brain Teaching

The notion of integrating brain science with pedagogy developed around the late 1970's and 80's. At this time, understanding how the brain related to various learning styles in the classroom sparked interest in educators. While models without a cognitive

psychological basis began to emerge to address this link, the classroom experience obtained by educators provided support for further inquiry (Sousa, 2010).

Cognitive neuroimaging technologies developed in the last 30 to 40 years have provided the tools necessary for researchers to examine the brain/education relationship further. The positron emission tomography (PET) allowed researchers to examine changes in the brain while tasks are performced by the individual (Sousa, 2010). Functional magnetic resonance imaging (fMRI) is currently the most used tool in research (Goswami, 2012). It allows for repeated imaging and thus repeated trials as radioactivity is eliminated, providing opportunity for researchers to make simple associations (Sousa, 2010). Noninvasive diffusion tenor imaging (DTI) and fMRI allowed researchers to generate measures of connectivity, examing how neural areas work together as tasks are performed (Posner, 2010) and photo-topography has extended neuroimaging to that of infants (Kobayashi, 2010).

Some of the more significant areas of research that have made lasting impressions on pedagogy include the notions that movement and the social/emotional climate within the classroom improve learning. In addition, the impact of the discovery of neurogenesis (i.e. growth of new neurons in the brain) and neuroplasticity (i.e. brain can rewire itself), along with a better understanding of the longevity of information in short-term memory, has reinforced the importance of attending to brain function as it relates to education (Sousa, 2010).

WBT claims. Biffle (2010) asserted that when the whole brain is stimulated during the learning process, improved self-beliefs and achievement ensued. Biffle (2010) proposed the use of seven teaching techniques, referred to as *The Big Seven*, to address

student need for brain stimulation in the classroom. Before a description of these techniques and related literature are presented, a close examination of the resesarch link on the whole brain teaching website is warranted as caution is expressed among neuroscientists (Coch & Ansari, 2012; Immordino-Yang & Faeth, 2010; Willis, 2010) in the use of brain research for education as its implications were only suggestive. While brain research has been used to help guide educational interventions, it cannot predict the outcomes of these interventions. In addition, brain-based claims found in educational resources often appeared to be based on overgeneralizations and inaccurate interpretations of neuroscientific research (Coch & Ansari, 2012). While Biffle (2010) maintained that the seven teaching techniques were developed as a result of feedback received from WBT conference participants and from teachers via information from the whole brain teaching website, the brain-based claims throughout the WBT approach suggested that a neuroscientific foundation is present. This was seen in Biffle's (2010) claim that use of the WBT techniques in the classroom would activate students prefrontal, motor, and visual cortex's, Brocas' and Wernicke's areas, the limbic system, and the hippocampus.

Wholebrainteaching.com presents Annual Performance Index (API) Growth data from the Victor Elementary School District in California. The principal at 6th Street Prep in the Victor Elementary School District was referenced as attributing improved API scores at the school to the implementation of WBT techniques. The superintendent of Victor Elementary School District is quoted as stating that the district saw an increase in student learning results and teachers routinely using WBT practices were lending support to mastery learning for students. The assessment indicating increased student learning

results is not specified. However, the API scores were implied. While API data indicated growth in student performance in a portion of the district, there was no WBT implementation data providing record as to the WBT techniques used, which schools used them, and how long they were used. It would be appropriate then to question whether other factors contributed to API growth. Without data on the districts implementation of WBT techniques available, a true correlation between API growth and use of the techniques could not be made. These reports were merely informal observations, subject to bias, and hardly sound evidence of a correlation between positive achievement outcomes and the use of WBT techniques. While these outcomes must be considered with caution, as scientific inquiry into the data as it relates to WBT is not apparent, using this information as preliminary data for scientific investigation was warranted.

Wholebrainteaching.com provided links to Science Daily, an online news source, and Scientific American, a popular magazine, as descriptors of research reinforcing the use of gestures within WBT. While these resources may have provided a starting point for further scientific inquiry, their direct value in linking WBT techniques to student self-concept or academic achievement was insufficient. The research link did not present any brain research to support its brain-based claims.

The big seven. The WBT approach was comprised of seven teaching techniques that as a whole aimed to: (a) increase student movement, (b) increase attention to task, (c) create a positive emotional climate in the classroom, (d) provide opportunities for lots of repetition, (e) facilitate emotional connectivity to academic tasks, (f) decrease fear of participation, (g) create a positively charged environment, (h) provide novelty, (i) facilitate positive structured peer

interactions, (j) use formative assessment, (k) improve academic achievement, (l) provide passive and active learning opportunities, and (m) provide positive corrective feedback.

Technique 1: Class-Yes! In order to gain students attention, the teacher in a novel tone of voice said, "Class!" Students responded by saying, "Yes!" in the same tone and pattern of speech used by the teacher (Biffle, 2010).

Technique 2: Classroom Rules. WBT utilized five classroom rules that were rehearsed daily. Each rule cooresponded to its own gesture. The classroom rules were as follows:

Rule #1: follow directions quickly

Rule #2: raise your hand for permission to speak

Rule #3: raise your hand for permission to leave your seat

Rule #4: make smart choices

Rule #5: keep your dear teacher happy

If a student in the classroom broke a rule, the teacher, without drawing attention to the individual announced to the class the number rule that was broken. This was a cue for the students to gesture and verbalize the rule aloud as a class (Biffle, 2010).

Technique 3: Teach/Okay. Once the teacher gained the students attention, the teacher engaged in direct verbal instruction using gestures to represent lesson concepts. After approximately 30 seconds to 1 minute, the teacher prompted a classroom ritual by clapping several times (changes each time) and saying, "Teach" to the students, again in a novel tone of voice. The students then responded with "Okay!" matching the teachers clapping pattern and tone of voice. Students then turned to a predesignated peer partner and one student taught what they just learned from the teacher using verbalizations and gestures (Biffle, 2010).

Technique 4: The Scoreboard. To support attention and motivation in the classroom the teacher created a scoreboard with a happy face on one side to represent the students and a sad face on the other side to represent the teacher. Off task behavior observed in the classroom was addressed with a mark on the teacher side and vice versa for on task behavior. If students earned more points by the end of the day then they were allowed to participate in a reinforcing activity, such as free time at the end of a lesson. When the teacher won, reinforcement was withheld. When marks were made students were prompted with a point of a finger to clap their hands once and exclaim, "Oh yeah!" for student marks or "Awww!" for teacher marks (Biffle, 2010).

Technique 5: Mirror. A key aspect of teaching in the WBT classroom was the use of gestures. Gestures were created to represent various concepts in the curriculum to facilitate retention of the material. In teaching the gestures, the teacher said, "Mirror!" Students responded with, "Mirror!" and modeled the gestures as the teacher spoke (Biffle, 2010).

Technique 6: Hands and Eyes. When critical aspects of the lesson were presented, the teacher said, "Hands and eyes" in the usual novel tone of voice to gain student attention. Students reponded by immediatly folding their hands and looking at the teacher (Biffle, 2010).

Technique 7: Switch. Students were assigned peer partners that they turned to after the "Teach!" command. The students alternated between listening to and mirroring their peers gestures and teaching. The teacher said, "Switch!" in a novel tone of voice. Students responded, "Okay!" and then gesture their hand up in the air to pull down an

imaginary switch. This prompted students to change roles with their partner (Biffle, 2010).

WBT and Related Brain Research

The conception of a muscle sense in which the use of gestures would facilitate recall, as proposed by Biffle (2010) did have theoretical underpinnings. Theories of movement emerged during the eighteenth century that revolved around the idea that moving a body part created a sensational impression in the nervous system. When the movement was repeated it supported the strength of the impression, which in turn developed an association between the movement and the impression until one elicited the other (Buckingham, 2006). Common in students who struggled in reading, mathematics, and writing is a lack of vestibular input (Jensen, 2005). Increased movement required more neural resources and increased attention, resulting in improved recall. Along with movement, competitive and emotionally stimulating activities activated amines in the brain. Increased levels of amines in the brain have been found to stimulate attention to task (Jensen, 2005).

Repetition supports skill acquisition as it created and strengthened neural connections in the brain (Devlin, 2010; Jensen, 2005). Rivera, Reiss, Eckert, and Menon (2005) illustrated this assertion in their study of brain activation changes with age. Given a mathematical calculation, children responded slower and required increased use of attentional resources and working memory compared to adult subjects, even though task difficulty did not differ among ages. This functional difference in the prefrontal cortex between younger and older subjects indicated that a functional specialization occurs over time, which supported the strengthening of neural systems. Repetition was central in the

WBT classroom as the quick use of gesturing allowed for more opportunities to review concepts (Biffle, 2010).

One of the key elements in the learning process was to address the emotional states of students (Jensen, 2005). Neuroscience provided evidence of a direct link between emotion and cognition (Immordino-Yang & Faeth, 2010; Lane, Nadel, Allen, & Kaszniak, 2000) and experiences in the classroom provided an excellent opportunity to influence the emotional state of students (Jensen, 2005). Cacioppo, Berntson, Sheridan, and McClintock (as cited in Jensen, 2005) found that environmental events can make a substantial impact on changes in the human brain. The same mental processes were involved in exposure to a stimulus that was or was not emotionally charged. However, when humans were exposed to events that stimulate an emotional response, working memory was activated. Present stimuli and stored representations came together in the working memory via sensory processing and the medial temporal lobe memory system. As a result, working memory input increased when students were exposed to emotional stimuli. This lent support to Biffle's (2010) assertion that providing a classroom that triggers emotional responses impacted the prefrontal cortex, the brain region associated with cognitive processes used in task performance (i.e. attention, working memory) (Ansari, 2010).

Investigation in to patients with damage to the ventromedial prefrontal cortex provided evidence that cognition and emotion must converge for individuals to benefit from the knowledge. Damage to this prefrontal area interrupts the experience of embarrassment, guilt, and compassion. Disruption to these socially regulating emotions resulted in poor decision making in all aspects of life, despite intact factual knowledge

and logical reasoning skills (Immordino-Yang & Faeth, 2010). Humans benefited then from an interplay between factual knowledge and emotions (Sousa, 2006) (i.e. emotional thought) as it provided for the meaning of the knowledge, which was required for real world application (Immordino-Yang & Damasio, 2007; Immordino-Yang & Faeth, 2010). Development of emotional learning in the classroom was facilitated via a trusting and respectful classroom climate in which students felt secure. Linking emotions to academic tasks were essential to building this social climate. Once this is established, educators must work to manage the emotional connectivity to the academic content as too much or too little would hinder learning (Immordino-Yang & Faeth, 2010, Sousa, 2006).

Investigation in to the functioning of the prefrontal cortex, or the cognitive brain, and the sequence of data processing lent support for teacher efforts in managing the emotional climate in the classroom. The prefrontal cortex is a resource for cognitive processing networks (Williams, 2010) and has a limited number of processes that it can attend to at one time (Dehaene, 2010). For example, performing a mathematical calculation involves considerable attention and cognitive resources. While the prefrontal cortex is attending to the calculation, it cannot attend to other calculations requiring attention and effort (Dehaene, 2010). When one cognitive processing network was being used, the cognitive load in another area would be reduced. When students were using their resources for the processing of emotional stimuli, they would be unavailable to process other important input in the classroom (Williams, 2010). Information from classroom curriculum was processed into working memory only after physical and emotional input was processed (Sousa, 2006).

Attention to task was challenging because a student's brain was most concerned with evading the experience of embarrassment and failure (Jensen, 2005). The reticular activating system (RAS), located in the lower brain stem, filtered all sensory input before it was sent to the higher brain. This sensory register worked closely with the thalamus, which gained information from past experience to determine if the sensory input was related to survival (Sousa, 2006). The RAS was most responsive to the perception of threat or fear as this sensory input was critical to survival. As information from the emotional experiences of fear, sadness, and anger were attended to and maintained in the reactive brain, the RAS prevented other information from moving to the cognitive brain, or the prefrontal cortex, for processing. Therefore, decreasing the perception of embarrassment or punishment becomes an important part of the learning process in the classroom (Willis, 2010).

The WBT classroom reportedly decreased fear (Biffle, 2010) through its positively charged environment, which in turn improved attention to task and student engagement, a key element in the learning process (Jensen, 2005). The RAS was also more sensitive to information that evoked curiosity and pleasure (Willis, 2010). As a result, using humor (Immordino-Yang & Faeth, 2010; Sousa, 2006) and novelty in the classroom supported the activation of the RAS and the movement of the material into the prefrontal cortex (Sousa, 2006; Willis, 2010). Strategies teachers used in the WBT classroom that were recommended from RAS research (Willis, 2010) included: (a) voice modulating, (b) presenting novelty, (c) reducing the fear of participation, (d) using positive, structured peer interactions.

Saleh (2011) examined the impact of the Brain Based Teaching approach as indicated by the principles developed by Caine and Caine (1991, 2003). This approach resembled Biffle's (2010) conception of Whole Brain Teaching in that fear in the learning process was decreased, learning was an active process, and students were a part of many different educational experiences that elicited emotion as part of the learning process. Results of the qualitative study found that students exposed to brain based teaching improved in their scientific understanding of physics compared to students not exposed.

Research on the developmental changes in auditory sensory memory indicated that memory for the pitch of tones increased from the ages of six or seven to adulthood. While the neural basis for this is uncertain, the results suggested that speech stimuli in the classroom may impact the retention of oral instruction (Keller & Cowan, 1994). Using descriptive analysis of the linguistic behavior of 12 elementary and secondary school teachers and group interviews with their students, Karaduz (2012) found that original and emotional phrases made a positive impact on the classroom climate. Verbalizations frequently repeated during attempts to gain student attention led to negative emotional experiences for students. This lent support for instructor use of various tones of voice and novelty in the WBT classroom.

Sousa (2006) asserted that making sense and meaning out of information is needed in order for it to move from working memory into long-term storage. Cowan (2012) indicated that the successful transfer of information from working to long-term storage required the student to think about the information. When new learning data was interesting and personally relevant to the student, the child was more motivated to attend

to it, thus supporting its transfer into long-term storage. Motivation in the WBT classroom was addressed through the scoreboard technique (Biffle, 2010). While this approach did not necessarily help the student make sense of the information, it may have provided a sense of desire to attend to it. Using the Operation Span (OSPAN) task to measure working memory and variations of the Stroop task to measure task reaction time, Kane and Engle (2003) found that people with low working memory capacity experienced more Stroop interference than participants with high working memory capacity, supporting the notion that working memory capacity is a predictor of attention. Given this link between attention and working memory and the nature of working memory capacity, limited to approximately three chunks when verbal rehearsal is suppressed (Chen & Cowan, 2009), it becomes even more essential to apply meaning to the curricular information from the classroom.

Active learning must be balanced with passive learning (i.e. listening, watching) and time to reflect. Students must have processing time, with no new information being presented, in order to allow synapses to form. Without this time, new information would be forgotten. Direct instruction allowed for passive learning in the classroom and supported the quicker acquisition of strategies that are rule-based, as seen in science, when time is a competing factor in the classroom (Jensen, 2005). Monitoring the quantity of input is fundamental in the learning process (Jensen, 2005). Direct instruction that was used in the WBT classroom as teachers were instructed not to speak more than 30 seconds to one minute before cueing a class ritual that led to students turning to their partners to teach each other what they just learned (i.e. Teach - Okay).

Error correction was critical to the learning process (Jensen, 2005). Formative assessment with corrective feedback, without drawing attention to any individual student, supported memory and executive functioning (Willis, 2010). In addition, oral language could not be the only means for assessing student knowledge as the language system was not fully developed in elementary school-age students (Williams, 2010). This was particularly important for boys as their linguistic processing skills developed slower than that of girls (Burman, Bitan, & Booth, 2008). Elementary aged students depended on auditory and visuospatial processing for accurate language performance, whereas girls depended on language networks that transcended the sensory modalities relied so heavily on in boys (Burman, Bitan, & Booth, 2008). Therefore, providing opportunity for elementary students to demonstrate their learning through non-verbal means becomes important in the elementary setting. Teachers in the WBT classroom were able to assess students during 'Teach - Okay' as students turned to their partners to essentially teach, through gestures, what they just learned. Teachers could assess individual students, without pointing them out, by examining their non-verbal gestures or by listening to their verbalizations as they performed the gestures.

Bandura (1997) asserted that self-efficacy was influenced by an individuals' mood. Providing opportunities in the environment that demanded attention away from the self reduced tension (Pennebaker & Lightner, 1980) and improved efficacy beliefs (Cioffi, 1991). Studies on mood dependent memory indicated that negative moods elicited memories of failure while positive moods elicited memories of success (Bower, 1981) and a persons' mood, even if it was induced (as seen in the WBT classroom), would elicit congruent self-efficacy beliefs (Forgas, Bower, and Moylan, 1990; Salovey

and Birnbaum, 1989). This lent support for efforts in the WBT classroom to increase student attention, emotional connectivity to tasks, and create a positive emotional climate through voice modulating activities and novelty in the classroom, in addition to efforts to decrease fear of participation, facilitate positive peer interactions, and provide positive corrective feedback.

Self-Concept Modification

Interventions to improve self-concept have been designed based on one of two approaches. The first was a self-enhancement orientation that targeted the self-concept directly through the use of praise and performance feedback. The second was a skill development orientation in which constructs related to self-concept, such as academic achievement were targeted, affecting the self-concept indirectly (Craven, Marsh, & Debus, 1991). WBT can be conceptualized as a skill development approach as brain research points to direct influences of the techniques on academic achievement, indirectly leading to improved self-concept.

Elbaum and Vaughn (2001) conducted a meta-analysis of 64 self-concept intervention studies from 1975 to 1997. Each intervention used a self-enhancement or skill development approach to self-concept enhancement and targeted students with learning disabilities at the elementary, middle, and high school levels. Results indicated middle and high school students benefited the most from a self-enhancement approach while the self-concept of elementary students were only impacted from a skill development approach (ES = 0.17). This meta-analysis suggested that student self-concept could be impacted after one semester of intervention as the 64 interventions lasted, on average, less than 12 weeks in length.

Relationship between self-concept and achievement. Historically, it has been assumed that the relationship between self-concept and academic achievement was positive (Wylie, 1979). However, the strength of the relation and the causal predominance between the two constructs were questionable. West et al. (1980) and Hansford and Hattie (1982) found similar correlation coefficients between constructs in their review of the literature. However, due to the poor state of self-concept research (i.e., lack of consensus on definition of self-concept, structure, and theoretical basis) prior to 1980 (Shavelson et al., 1976), results must be considered with serious caution. Marsh (1993) provided compelling evidence as to the relationship between self-concept and achievement as work was built from the more established Shavelson (1976) and Marsh/Shavelson (1985) models. Using 11 studies of primary school students using the Self Discription Questionnaire I, Marsh (1993) found substantial correlations between English achievement and English self-concept (Md r = 0.39) and Math achievement and Math self-concept (Md *r* = 0.33). Nonacademic domains of self-concept in correlation with achievement scores were nonsignificant. The significant correlation between achievement and domain specific self-concept was further supported by research of secondary school students using the Self Discription Questionnaire II as correlational values from 0.45 to 0.70 (mean *r* = 0.57) were found (Marsh, 1992).

The direction of causality between academic self-concept and achievement has important implications in education as empirical support for the direction of causation may justify increased teacher effort into enhancing one construct over the other (Marsh & Martin, 2011). Review of the literature revealed conflicting findings on the casual predominance between self-concept and academic achievement. Some researchers

(Chapman, Cullen, Boersma, & Mauire, 1981; Shavelson & Bolus, 1982) argued for a casual predominance of self-concept over academic achievement, while other researchers (Calsyn & Kenny, 1977; West et al., 1980) argued for the casual predominance of academic achievement over self-concept. Researchers (Byrne, 1986; Pottebaum, Keith, & Ehly, 1986; Rubin, Dorle, & Sandidge, 1977; Scheirer & Kraut, 1979; Watkins & Astilla, 1987) have also argued that there is no evidence linking a causal relationship between self-concept and achievement. In a review of 23 studies, Byrne (1996) found 11 studies demonstrating the casual predominance of self-concept over academic achievement, another 11 studies demonstrating the casual predominance of academic achievement over self-concept, and one study with inconclusive results.

Byrne (1996) verified that many studies that have claimed a causal relationship between self-concept and academic achievement were actually cross-sectional studies. This is problematic as a longitudinal design is required in order to satisfy the condition of temporal precedence in the determination of cause. While studies using a cross-lagged panel correlation design provided for this requirement, Bryne asserted that results of the causal predominance between self-concept and academic achievement were still inconsistent. Rogosa (1980) argued that cross-lagged correlation (CLC) cannot be used to determine causal effects and failed to find any justification for its use. Rather than using CLC, Bryne argued for the use of the more sound approach of structural equation modeling (SEM) to analyze longitudinal panel data. For the purposes of this study, research examining the causal relationship between variables that does not use SEM must be considered with caution.

Reciprocal Effect Model. Concerned that the self-enhancement and skill development orientations were too simplistic (Marsh, 1990), Marsh and Craven (2006) developed the reciprocal effect model (REM). REM served as a sort of conciliation to the self-enhancement and skill-development models as it proposed that academic self-concept is both a cause and consequence of academic achievement.

In a four-wave panel study, Marsh (1990) examined the causal ordering of academic self-concept and academic achievement using Youth in Transition data (N = 1,456; Bachman & O'Malley, 1975). Academic ability, academic self-concept, and grades were assessed from subjects during tenth, eleventh, and twelfth grades and approximately one year after high school graduation. The paths from self-concept to grades in the following school year were statistically significant. These results supported the self-enhancement model as academic self-concept was causally predominant over grades. Student grades each year were directly linked to prior grades and assessment from the eleventh grade indicated a statistically significant path from grades to self-concept during the same school year. This significant path from grades to self-concept may in fact be an effect of previous grades on subsequent self-concept once the effects of prior self-concept are controlled for. In this regard, Marsh concluded that this supported the theory that academic achievement and academic self-concept have a reciprocal effect relationship. Bryne (1996) identified this study as providing the most accurate design for determining the causal relation between self-concept and academic achievement. In addition, Marsh was able to identify the importance of using school-based measures of achievement (e.g. school grades) as opposed to standardized achievement measures, as doing so may support stronger paths from self-concept to achievement.

In a three-wave study spanning three years, Marsh and Yeung (1999) examined the causal relationship between academic achievement and domain specific academic self-concept in the areas of english, mathematics, and science. Significant to the study of self-concept, this research represented the second causal relations study to examine multiple academic domains and the first to examine these constructs for more than a year. Student (N = 603) achievement was represented by student grades and teacher performance ratings and the Academic Self Description Questionnaire (ASDQ) was administered to measure self-concept in the three aforementioned subject domains. SEM models were evaluated and results revealed that each path, 63 total, from achievement to subsequent self-concept was statistically significant and 54 of the paths from self-concept to subsequent achievement were statistically significant. In addition to supporting the skill development model, this study provided considerable support for REM.

Valentine, DuBois, and Cooper (2004) conducted a meta-analysis of the self-enhancement, skill development, and reciprocal effect models from 60 studies and found the most support for REM. Valentine concluded that results supported the reciprocal relationship between affective, cognitive, and environmental variables as seen in social cognitive theory. Empirical support for the application of REM to children as young as the second grade has been found, however, additional research on the developmental aspects of REM is still needed.

Using SEM, McInerney, Cheng, Ching Mok, and Hap Lam (2012) examined the academic self-concept, assessed using the Academic Self-Description Questionnaire (Marsh, 1992), and achievement relationship among 8,354 students from 16 secondary schools in Hong Kong. Results provided support for REM and the domain specific

nature of the academic achievement/self-concept relationship as english achievement positively effected english self-concept and mathematics achievement positively affected student self-concept in mathematics. Ju, Zhang, and Katsiyannis (2012) also found support for REM in their study of 2,950 first through ninth grade students. Although general, rather than domain specific, self-concept was examined, researchers used SEM to confirm a reciprocal relationship between academic achievement and self-concept among elementary aged students. If whole-brain teaching actually improved student academic self-concept then we would have expected an increase in academic achievement as well. Likewise, if whole-brain teaching acted directly on acadmic achievement then there should have also been an improvement in acdemic self-concept.

Haney and Durlak (1998) conducted a meta-analytic review of the outcomes of 120 interventions, published prior to 1992, designed to enhance the self-concept and self-esteem of students 18 years of age or younger. Fifty-five percent of the interventions were conducted in the school setting and 84% were presented in a group setting. Forty-nine of the interventions examined focused only on self-concept/self-esteem enhancement while 71 of the interventions focused on other outcomes, such as academic skill development, in addition to self-concept/self-esteem enhancement. Results supported a self-enhancement approach and interventions with a theoretical and empirical basis were more successful. The type of intervention (i.e. treatment versus prevention) used emerged as the most significant predictor of self-concept/self-esteem. Treatment studies that targeted children with mental health problems were more likely to improve in their self-concept/self-esteem (*M* ES = 0.47) than children without mental health problems (0.09). However, it would be expected that significant improvement in the self-

concept/self-esteem of students without mental health problems would not be significant as they already have average self-concept/self-esteem. Derived from a unidimensional theoretical approach, self-concept interventions in the school setting have historically used a top-down model in which global self-concept was targeted. However, self-concept theory based on a multidimensional perspective supported a bottom-up model as domain specific aspects of self-concept were targeted (Craven, Marsh, & Burnett, 2004; Marsh & Hattie, 1996).

Summary

Efforts to enhance self-concept in the school setting was essential as important outcomes of intervention have been identified. Research on self-concept prior to the 1980s present with theoretical and methodological problems. Shavelson et al. (1976) improved these shortcomings and developed a multidimensional, hierarchical conjectural structure of self-concept (Marsh & Hattie, 1996). This model was revised by Marsh and Shavelson (1985) as it divided the academic facets of self-concept further. Examination of the seven self-concept facets in the Self Description Questionnaire provided empirical support for the multifaceted, hierarchical structure of self-concept (Marsh & Shavelson, 1988). Using these self-concept theories and a construct validity approach to research is essential for self-concept enhancement research (Craven, Marsh, & Burnett, 2004).

Whole brain teaching, as proposed by Biffle (2010), utilized seven brain based teaching techniques to improve student academic achievement and self-concept. Current self-concept enhancement research supported efforts among educators to use interventions that target academic self-concept and achievement. Research revealed a reciprocal relationship, as seen in the reciprocal effect model, between achievement and

self-concept in that improved academic achievement leads to improved academic self-concept and vice versa. While the literature failed to reveal any solid empirical evidence to support Biffle's claims of improved achievement and self-beliefs as a result of WBT, implications of brain research do suggest that use of the techniques may improve student achievement and subsequently impact self-concept by means of (a) improved recall, (b) improved attention, (c) opportunities for repetition, (d) improved emotional state and reduced fear in students, (e) increased emotional connectivity to the academic content, (f) improved motivation, (g) opportunities for both active and passive learning experiences, and (h) positive feedback. Therefore, WBT can be conceptualized as a skill development approach in which academic achievement is targeted directly and self-concept is indirectly impacted via improved achievement.

Scientific inquiry into the growing practice of WBT was essentially absent from current educational and psychological research. This study filled this gap in the literature by examining the difference in the mean academic self-concept scores among students exposed to three levels of the WBT factor. Chapter 3 explores the research methods used in this study and ethical considerations as it relates to the protection of participant rights.

Chapter 3: Research Method

Introduction

Chapter 3 explores the research methods used in this study including a description of the research design, setting and sample, participant recruitment, instrumentation and materials, and data collection and analysis. This chapter closes with information on ethical considerations that have been made and the measures taken for the protection of participants' rights.

Purpose of the Study

The purpose of this quantitative study was to examine the relationship between different levels of exposure to Whole Brain Teaching techniques and the mean difference in self-concept, as measured by the general-school, mathematics, and reading subscores on the Self Description Questionnaire I ([SDQI], Marsh, 1992), between treatment conditions after one semester of school. This study contributed to the educational field an objective analysis of student experience in the WBT classroom, which, in turn could prompt further research into this growing practice and assess WBT as a predictor variable of positive self-concept.

Research Design and Approach

The Coalition for Evidence-Based Policy (2003), a project sponsored by The Council for Excellence in Government, points to comparison-group studies as a possible approach to identifying educational practices that are evidence based. Therefore, a one-way multivariate analysis of variance was used to determine if there was a significant mean difference in the general-school, mathematics, and reading self-concept scores (i.e. dependent variables) among the three levels of the factor (i.e. WBT techniques): use of

no techniques, one to four techniques, and five or more techniques. In order to achieve the desired statistical power of .80, a power analysis, using G*Power, was conducted at the .05 level of significance. A three-group design with an estimated medium effect size required a minimum of 38 participants in each group to achieve desired power, for a minimum total of 114 participants (Faul, Erdfelder, Lang, & Buchner, 2007). Three additional participants were added for a total of 117 participants with complete data.

Setting and Sample

In order to ensure valid responding while keeping with analysis in the early elementary setting, I drew three samples from the second and third grade population. Samples of participants were recruited from public schools in two school districts in a rural Midwestern setting. I used convenience sampling as this approach did not require a huge team, years of work, or substantial amounts of money that was beyond the scope of this dissertation study. However, it still provided the needed data to answer the question under investigation. I selected participants equitably using a convenience sampling strategy. In order to be eligible for the study a letter of cooperation had to be received from a participating school district. All second and third grade teachers within participating school districts that taught in the second or third grade, general education setting that returned teacher screening forms were eligible for the study. All students in these classrooms that returned parent consent forms and provided assent were also eligible for participation.

Participant Recruitment

The whole brain teaching website provided an online networking forum for teachers around the country to communicate about WBT and their experiences (Biffle,

2014). Using a web based resource allowed this researcher access to teachers with working knowledge of WBT techniques. I used this website to ask teachers what school districts in a Midwest state were using WBT.

The following question was posted to the Missouri forum: What public school districts are using whole brain teaching in their schools? Districts that I identified on the website within seven days of the posted question and within boundaries of the Midwestern counties being examined were contacted within one week in order to obtain a Letter of Cooperation from the superintendent or assistant superintendent of schools. I made contact via email and/or mail. Phone contact was used if initial contacts failed to elicit a response.

Within three business days of obtaining a Letter of Cooperation, second and third grade teachers within that district received a teacher screening, via email or in their teacher's mailbox, to complete in order to identify initial eligibility for the study. A three day timeline was set for completion of the screening. Teachers who met initial eligibility for the study received, via email or teacher mailbox, the Data Collection Coordination Request and Teacher Consent form within three business days of screening completion. A one week timeline was set for completion of the Data Collection Coordination Request and Teacher Consent form. Once I obtained the Teacher Consent form and Data Collection Coordination Request with permissions to participate, the teacher sent home the Parent Informed Consent form and a copy of the Child Assent form to parents/guardians of students in their classroom. A one week deadline for the returned informed consent was set and a date was set to administer the questionnaire with the participating students. In order to ensure confidentiality, a locked dropbox was provided

in the school office for teacher screenings, Data Collection Coordination Request forms, Teacher Consent forms, and Parent Consent forms to be returned. On the day of data collection, assent was obtained from students in the classroom and then the Self Description Questionnaire I was administered to students with consent and assent. At this time, the Teacher Implementation Checklist was completed by the teacher and all students in the participating teacher's classroom received a new pencil. Data collection took place one time per classroom during the months March and May of 2015. The questionnaire took approximately 5 to 10 minutes to complete and the Teacher Implementation Checklist took about 1 to 2 minutes to complete. All parents/guardians of participants, superintendents/assistant superintendents and principals of schools, and teacher participants received information on the overall findings of the study in the form of a one to two page summary. Summaries were delivered within two weeks of study completion via mail or hand delivered to school district staff. Teachers were asked to distribute parent/guardian copies via student backpacks.

Instrumentation and Materials

I used a teacher screening to determine initial eligibility for the study. The screening asked teachers to identify the grade they teach and whether or not they teach in the general education classroom setting. I asked the teachers if they had been formally trained by Chris Biffle or one of his WBT associates. . While formal training was not required, this screening information helped determine which classrooms, if any, were using WBT. I used a teacher implementation checklist to measure the quasi-independent variable. The Checklist had the seven WBT techniques listed including Class-Yes, Classroom Rules, Teach/Okay, The Scoreboard, Mirror, Hands and Eyes, and Switch.

Teachers checked next to the techniques that they used in their classroom in order to identify three levels of the factor including classrooms in which one to four and five or more techniques were used and classrooms that did not use any WBT techniques.

I used the Self-Description Questionnaire I (SDQI; Marsh, 1992) to measure the dependent variables. I obtained legal copies of the instrument and manual and I obtained permission to use the instrument was from the developer, Herbert Marsh, of the SDQI (1992). The permission letter is included in the appendix. Eight areas of self-concept were in the SDQI including general-self, general-school, mathematics, reading, parent relations, peer relations, physical appearance, and physical abilities. Four of the scales were nonacademic in nature, three were academic, and one was a general scale (Marsh, 1992). For the purposes of this study, I only scored the academic areas of the SDQI as the rest of the scales were not relevant to the goals of this study, and research suggested domain specific scores more accurately reflect self-concept than one general self-concept score.

The academic subscales of the SDQI are a self-report measure that uses a Likert scale to measure responses to 30 declarative sentences (e.g., "I look forward to reading."). Students picked one of five possible responses: False, Mostly False, Sometimes False/Sometimes True, Mostly True, and True. Training for the administration of the questionnaire was not required. I administered the SDQI in the group setting in a classroom at the student's school. Administration time was approximately five to ten minutes. The SDQI has positively and negatively worded items in all of the scales to address the problem of positive response biases and the SDQI contains checks for random and biased responding. However, these scales can only be

used when the SDQI is administered in its entirety. Norms can be obtained for grade level and sex and are based on the SDQI results of 3,562 second through sixth grade students from New South Wales, Australia (Marsh, 1992). In addition, 662 second through fifth graders were administered the SDQ (Marsh & Shavelson, 1988). The general-school factor was largely correlated with academic factors while nonacademic factors were largely correlated with other nonacademic factors. This finding was consistent across all grade levels and correlations were highest in the second grade. Empirical research consistently supported a well differentiated self-concept by the age of eight (Van Den Bergh & De Rycke, 2003). Based on SDQ research, Marsh, Craven, and Debus (1991) provided the most convincing evidence that domain specific self-concept was found in young children as early as the age of five. While empirical evidence does indicate that older second graders are better able to differentiate among the multiple domains of academic self-concept compared to younger second graders when assessed individually, for consistency purposes, I administered the SDQ-I as a group. I read each question, per manual instructions, aloud to students twice, as they were asked to follow along with the group.

It was a condition of the use of more than 100 copies of the Self Description Questionnaire I that a computer readable data set be made available to the SELF Research Centre at the University of Western Sydney, Australia for inclusion in subsequent Self Description Questionnaire norms and related analyses. I did not release identifying information to the SELF Research Centre. Responses to the SDQI items, grade level, gender, age (in years and months), the country of administration, a general description of the setting (i.e. public schools in the Midwest), and a brief written

summary of the coding of the data and the circumstances of the data collection was provided to the SELF Research Centre. The information provided to the SELF Research Centre was stored on a disk and mailed first class directly from this researcher's home office to the SELF Research Centre.

Data Collection and Analysis

In order to ensure results were consistent with normative data, the following administration procedures, as recommended by Marsh (1992) were followed:

Please address the passive voice throughout these bullet points, as modeled on the first.

- I informed students that their responses would remain confidential.
- I handed each student one SDQ-I Questionnaire along with a pencil with an eraser.
- I told students to keep the Questionnaire closed until instructed to open it.
- I supported students in completing identifying and background information.
- I instructed students to listen and follow along while instructions on the front page were read. Questions were answered after the first sample item was read and were not allowed after administration of the Questionnaire began. A brief pause after Example 3 was provided so students could mark their response.
- I read the paragraph after Example 3 aloud and then read the following statement:

> We will be going quite fast, and you will have to mark your answer immediately. Then listen to the next sentence. If you fall behind, leave out the sentences you have not done. Listen to the sentence I am reading and answer that one. I will allow you time at the end to go back to any sentences that you have left out.

- When I was ready for students to start the Questionnaire, the following statement was read aloud:

  > Turn over the page and begin. Once you have started, PLEASE DO NOT TALK.

- I stopped any vocalizations in the room.
- I read each sentence and the sentence number in a clear, strong voice at a rapid and steady pace two times without any pause. A brief pause was provided between items.
- After reading all items, the administrator read the following statement aloud:

  > Now I will give you a minute or two to go back to any sentences which you left out. Be sure you have *one*, and only one, answer for each sentence. Please do this now. When you have completed all the sentences, put your paper face up on your desk and wait quietly for the rest to finish. If there are any questions about completing the sentences, hold up your hand, and I will come to you.

- After administration of the Questionnaire, I answered any questions by approaching the student individually. I paraphrased items as long as the meaning of the sentence was not changed. If a student had multiple problems with items that could not be quickly fixed, the problem was indicated on the front of the Questionnaire and I thanked the student.

If the fire alarm sounded during administration of the questionnaire or another emergency required evacuation of the classroom and break from the questionnaire, the questionnaires were to remain on the student's desk until students could return after the drill to complete the questionnaire. If a student became ill once the questionnaire was started, it was to be marked incomplete and invalid. Students only had one opportunity to participate in the study. If they were absent on the data collection day, they did not participate in the study. If there was a conflict of interest, a breach in confidentiality, or any other adverse event during the research process, I would have reported the conflict to the committee chair and, if necessary, to Walden's IRB to explore solutions and re-assessment of risks and benefits.

I immediately placed completed questionnaires in a large privacy envelope and then into a locked suitcase. Questionnaires were then immediately transported to a locked filing cabinet in my home to remain for five years after the date of my graduation from Walden University. After five years, I will retrieve the raw data to be shredded.

I calculated individual scale raw scores for the academic domains and identified item numbers for each scale. I converted student responses for each item to the following numbers: False = 1, Mostly False = 2, Sometimes False/Sometimes True = 3, Mostly True = 4, and True = 5. The sum of scores represented the individual scale raw scores (Marsh, 1992).

Exact cut off scores for interpretive purposes were not provided. However, self-concept scores that fall between the 25^{th} and 75^{th} percentiles are generally indicative of average self-perceptions. Scores below the 25^{th} percentile suggested problematic self-perception in that area. It is common for different domains of self-concept to reflect

variation in self-perceptions however, observation of scores that are consistently high or low across domains suggested inappropriate responding. While high scores suggest a positive self-concept, these scores are interpreted with caution as slight differences in participant responses can lead to considerable differences in percentile ranks. Raw score comparisons could be made between the academic scales as the language on these items correspond to each other (Marsh, 1992).

In order to explore the research hypothesis and determine if student exposure to WBT techniques affected student academic self-concept, by determining if the mean difference among factors was significantly different, I analyzed data using Version 18.0 of SPSS for Windows. I defined the variables and entered data into SPSS. I used the General Linear Model procedure to conduct a one-way multivariate analysis of variance test to assess whether means on the dependent variables were significantly different among the three groups. Follow-up univariate ANOVAs were conducted for significant MANOVAs and post-hoc multiple comparisons were conducted for each significant ANOVA in the three WBT-level analysis. Three pairwise comparisons identified the significance of the difference in means among the three levels of the factor.

Ethical Considerations and Protection of Participant Rights

The risks and benefits of participation in this study were carefully considered as the safety and well-being of participants was of primary concern. Walden University's Institutional Review Board approved this study (approval number: 02-11-15-0133440). All student participants were given an opportunity to participate in the study if their teacher met inclusion criteria. This included participants that were minors, mentally disabled, emotionally disabled, pregnant women, less than fluent in English, experiencing

crisis, economically disadvantaged, and elderly. Research should involve people from groups who are likely to benefit from subsequent applications of the research and was anticipated that these groups, though vulnerable, would benefit from the knowledge gained through the research. No groups were unfairly burdened with the risk of research and failure to include these groups could have resulted in gaps in scientific knowledge. These vulnerable groups were not denied the benefits of participation in this research as there were no scientific or ethical reasons not to include them. Minors were protected from being coerced into participating as the incentive, a new pencil, was minimal and was not inappropriately attractive. In addition, all students in a participating teacher's classroom, regardless of assent received the incentive. This study involved a paper pencil task that did not pose any physical or psychological threat beyond what would be typically expected of an adult or minor on a regular basis in the classroom setting. Participants were not recruited from the school that this researcher serves in as counselor in order to separate her role as researcher and school counselor. While potential teacher and student participants may have belonged to the same school district that this researcher was employed, participants would not have had interactions on a regular basis with this researcher and this researcher would not have been in a position of authority in other schools within the district. This protected subordinates, students, and/or co-workers from experiencing pressure or coercion to participate.

Informed consent was obtained and participants and their parents/guardians were assured that identifying information remained confidential and would not appear in any report based on the study. While recruitment, the informed consent and assent process, and data collection cannot be totally anonymous to this researcher, these processes were

conducted in a way that made it impossible to deductively examine demographics or trace responses back to determine the identity of participants. With the exception of participant grade level, gender and age (in years and months), student participant identifying information was not written on the questionnaire. Parental Consent forms asked for their child's date of birth in order for the student's age in years and months to be calculated. Each questionnaire was assigned a code number which was used to link direct identifiers that only this researcher had access to. A link between study code numbers and direct identifiers were retained after the data collection was complete in order to identify those participants who indicated they wanted their data withdrawn. Participating teachers had the potential of identifying which students in their classroom were or were not participating in the study as this researcher required the teacher to be present in the classroom during administration of the questionnaire for the purpose of supervision. Present teachers however were not allowed to observe individual student responses. Only data that was absolutely necessary to answer the research question for this study was collected. Therefore, protected health information, including ethnic/racial identification, was not collected.

Students that struggle in transition to unfamiliar people or situations may have experienced increased anxiety. This risk was explored with teachers so accommodations for students that needed additional preparation for the change in routine were provided. Students that experienced anxiety or feelings of frustration during testing situations may have been exposed to these feelings during the questionnaire as the question format and nature of the assessment may have elicited such feelings. In the event of this occurring, the student would have been recommended to the school counselor to address the issue.

The appraisal and career advancement of teachers as a result of participating in this study was considered. Teachers may be praised by administrators for participating in research and using results to guide their practice, which in turn may positively impact teacher appraisals or career advancement. Study results indicating a correlation between low self-concept scores and use of whole brain teaching may lead administrators to question use of the techniques. However, the appraisal and/or career advancement of teachers that use the techniques were not likely to be negatively impacted.

Participant's right to service was considered, however, while one sample may have experienced beneficial effects, participants in the no-WBT group may have benefited from another teaching intervention. In addition, the teaching strategies and interventions that participants experienced during the study would have been occurring naturally whether or not the research was completed.

The Parental and Teacher Consent forms were written at a seventh or eighth grade reading level. Parents received a copy of the child assent form, which was written at a second grade reading level. While student participants were minors and required parent/guardian consent for participation, students were involved in the informed consent process as the child's assent was requested. Prior to student assent, students were given time to ask questions regarding the study. The assent form was read aloud to students immediately prior to administration of the questionnaire. The child's signature and cooperation was requested. Once obtained, students started the questionnaire. Students that did not provide assent were given a crossword puzzle to do at their desk while other students completed the questionnaire. Instructional time was not interrupted as data collection was only taken during non-instructional, morning homeroom time. All

students, regardless of assent, received a pencil once all of the questionnaires were collected. In addition to informed consent, participants and their parents/guardians were given an opportunity to ask questions before and during participation in the study. I provided information on the Institutional Review Board (IRB), along with the IRBs contact information. I communicated in writing that participants could discontinue their participation at any time during the study without penalty. Additional information that I provided to participants and their parents/guardians included: (a) the risks and benefits of participation, (b) the extent that their identifying information was to remain confidential, (c) the nature of the study, (d) research procedures and sample questions, (e) description of participant expectations, and (f) an explanation that there was no cost or reimbursement for participation.

This research benefited participants and their parents/guardians in that the results helped educators further their understanding of the relationship between Whole Brain Teaching techniques and self-concept. This research provided objective information to help teachers make more informed, evidence-based decisions regarding their practice, thereby allowing students an opportunity to receive an educational experience that works to enhance their self-concept that is supported by scientific findings, rather than subjective assumptions. This study was the first empirical research conducted on Whole Brain Teaching. This study tested the theory that more WBT will lead to better self-concept scores in elementary students. Evidence that WBT improves student self-concept may prompt further scientific inquiry into the growing practice of WBT and serve to help substantiate or identify unsubstantiated claims made by WBT advocates.

Summary

I used a one-way multivariate analysis of variance to determine if there was a significant mean difference among levels of the WBT factor. Three samples requiring a total of 117 participants was drawn from the second and third grade population from public schools in Missouri. A teacher implementation checklist and the Self-Description Questionnaire I (Marsh, 1992) was used to measure the quasi-independent and dependent variables and Version 18.0 of SPSS for Windows was used to analyze data. Factors impacting validity, the protection of participant rights, and ethical research was considered and addressed. Chapter 4 provides results of the MANOVA performed on the three dependent variables in order to determine if there is a significant difference in the mean academic self-concept scores among students exposed to the three levels of the WBT factor.

Chapter 4: Results

The purpose of this quantitative quasi-experimental study was to examine the relationship between different levels of student exposure to whole brain teaching (WBT) techniques and the mean difference in academic self-concept scores among second and third grade students. Self-concept theory as posited by Shavelson et al. (1976) and the Marsh/Shavelson revision (1985), the skill development approach to self-concept enhancement (Craven, Marsh, & Debus, 1991), and the reciprocal effect model ([REM], Marsh & Craven, 2006) was used as a theoretical basis. A one-way MANOVA was performed on three dependent variables including reading, mathematics, and general school self-concept. WBT, the independent variable, was made up of three levels, students exposed to no WBT techniques, students exposed to one to four techniques, and students exposed to five or more techniques. This chapter was organized around the following research question and hypotheses:

1) Do the mean academic self-concept scores differ among students exposed to three levels of the WBT factor: those who are not exposed to WBT techniques, those who are exposed to one to four techniques, and those who are exposed to five or more techniques?

   H_0: The effect of student exposure to WBT techniques, as assessed by the teacher implementation checklist, has no effect on academic self-concept, as assessed by the Self Description Questionnaire I (Marsh, 1992), of second and third grade students.

   H_1: Student exposure to WBT techniques, as assessed by the teacher implementation checklist, does affect second and third grade student academic

self-concept, as assessed by the Self Description Questionnaire I (Marsh, 1992), in that the mean difference among factors are significantly different.

In this chapter I present the data collection time frame, recruitment, response rates, descriptive statistics, and analyses and results for the research questions and hypotheses.

Data Collection Timeframe, Recruitment, and Response Rates

Thirty school districts within five rural and suburban counties in a Midwestern state were contacted during the months of February and April 2015 in order to obtain a Letter of Cooperation. I received cooperation from two of the school districts contacted. I drew three samples from the general education, second and third grade populations in four elementary schools in a rural Midwestern setting.

The two school districts that volunteered to participate in the study shared similar demographics in terms of race and socioeconomic status as represented by the free and reduced lunch program, which was based on family income. Slight differences in both race and socioeconomic status exist between participating school districts and surrounding Midwestern counties as the Caucasian population in participating school districts were elevated and the free and reduced lunch program was increased in non-participating surrounding districts (Department of Elementary and Secondary Education, 2014).

Ninety-five percent of the student population in both participating school districts was Caucasian and less than five percent was Asian, African American, Hispanic, Indian, Multi-race, and Pacific Islanders. Other school districts in the same Midwestern state represented slightly more diversity in race as 73.3% of students were Caucasian, 16.4 %

were African American, and 5.3% were Hispanic. Five percent of the rest of the population was Asian, Indian, Multi-race, and Pacific Islanders. Students participating in the free and reduced lunch program due to low socioeconomic status represented 34.8% in one participating school district and the other represented 45.7%. This is slightly less than other school districts in the same Midwestern state with 50.3% of students representing the free and reduced lunch program (Department of Elementary and Secondary Education, 2014).

I sent teacher screenings to all second and third grade teachers in participating public schools on March 9, 2015 and May 6, 2015. Any second or third grade teachers in the general education classroom setting from participating schools were eligible for the study, regardless of their experience or training in WBT. Thirty-one screenings were distributed and 24 were returned, for a response rate of 77.4%. All of the teachers (n=24) who returned the screening were eligible for the study and provided their consent to participate. Eighteen of the 24 teachers who returned the screenings and subsequently participated in the study practiced WBT to some extent in their classrooms and came from the same school district. Seventeen of those 18 teachers practiced in a kindergarten through third grade school and one teacher that practiced WBT worked in a kindergarten through sixth grade school. The other six teachers participating in the study did not practice WBT in their classrooms, came from the same school district, and practiced in kindergarten through sixth grade schools (Department of Elementary and Secondary Education, 2014).

Teacher experience in the field of education and the levels of education taught was generally consistent between the two participating school districts and surrounding

Midwestern counties. In one participating school district, teachers had an average of 12.6 years of overall teaching experience. This is similar to the other participating school district with an average of 12.8 years of overall teaching experience among educators. Surrounding counties in the same Midwestern location had an average of 12.3 years of experience in education. Sixty percent of teachers in one participating school district had a master's degree or above. The other participating school district had 55% of teachers with a master's degree or above. This is similar to surrounding Midwest counties with 58.9% of teachers with a master's degree or above (Department of Elementary and Secondary Education, 2014).

Teachers received the parent 9nformed consent form to send home to parents/guardians of students in their classrooms within three days of receipt of their signed teacher consent forms to participate in the study. I distributed 579 consent forms and 241 were returned, for a response rate of 41.6%. I received four parent consent forms after the deadline. These students were not able to participate in the study as data collection already began. Therefore, 237 students were given the opportunity to participate in the study based on parental consent. Data collection took place during morning homeroom, which is a non-instructional time, during the months of March and May 2015.

I used convenience sampling which does pose drawbacks to this study in that sampling bias can occur, limiting the ability to generalize and make inferences about the entire population. Caucasian students represented 95% of the population in both of the participating Midwestern school districts. In addition, 34.8% and 45.7% of these students participated in the free and reduced lunch program, suggesting lower socioeconomic

status. The majority of this sample represents students without cognitive disabilities, with intelligence in the broad average range. All of these factors impact the generalizability of the data to people from other ethnic, cultural, and socioeconomic backgrounds. Therefore, it is important to generalize the findings with caution. However, as the first empirical study in WBT, use of a convenience sample provided for preliminary data to help demonstrate a need for additional inquiry in to the research question at hand.

Descriptive Statistics

Thirty three students (i.e., 13.9% of the students given the opportunity to participate in the study) were absent during data collection or did not provide assent to participate. Two hundred and four students provided assent and completed the SDQ-I. As later discussed, a total of 13 students were univariate outliers, due to invalid responding, age, and scores three standard deviations below the mean, and removed from the analysis. Therefore, 191 student questionnaires were included in the analysis (n= 191). A minimum required sample of 38 participants in each group was achieved, ensuring the statistical power of .80 was met in order to detect a statistically significant difference. The sample consisted of 54 students (28.3%) not exposed to any WBT techniques, 83 students (45.5%) exposed to one to four WBT techniques, and 54 students (28.3%) exposed to five or more WBT techniques. One hundred and nine students (57.1%) were second graders and 82 students (42.9%) were third graders. One hundred and seven students (56%) were female and 84 students (44%) were male. The average age of student participants was 8 years, 6 months (M = 102.2, SD = 10.87). Student demographic data by each level of the factor is found in Table 1.

Table 1
Student demographics by WBT group

	0 WBT	*1-4 WBT*	*5+ WBT*
Total students	54	83	54
2nd grade	27	63	19
3rd grade	27	20	35
Total % female	74	47	52
2nd grade	70	49	53
3rd grade	78	40	51
Mean age (in months)	104.94	101.02	105.13
2nd grade	99.56	98.08	96.98
3rd grade	104.94	101.02	105.13

A series of independent samples *t*-tests were run to compare academic self-concept scores across demographic variables. No significant differences in math self-concept, $t(189) = 0.72$, $p > .05$, reading self-concept, $t(189) = -0.11$, $p > .05$, or general-school self-concept, $t(189) = 1.29$, $p > .05$, were seen between male and female students. No significant differences were seen between second and third graders on math self-concept, $t(189) = 1.69$, $p > .05$, and reading self-concept, $t(189) = -0.22$, $p > .05$. However, second graders ($M = 32.78$, $SD = 6.08$) scored significantly higher than third graders ($M = 30.51$, $SD = 6.08$) on general-school self-concept, $t(189) = 2.53$, $p = .01$.

As seen in Table 2, bivariate correlations were run to address possible correlations between self-concept scores and age. While math and reading self-concept scores were not significantly correlated with age, general-school was negatively correlated with age, $r(189) = -.15$, $p = .03$.

Table 2
Means and standard deviations for age and self-concept measures

	No WBT (*n* =54)		1-4 WBT (*n* = 83)		4+ WBT (*n* = 54)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Age (months)	104.94	7.13	101.02	6.66	105.13	7.22
Math Self-concept	30.28	7.67	32.47	7.26	30.87	8.39
Reading Self-concept	33.65	7.00	35.25	5.25	34.30	5.46
School Subjects Self-concept	30.20	5.98	32.70	6.18	32.04	6.28

Teacher screenings indicated that 12 teachers (50%) taught in the second grade and 12 teachers (50%) taught in the third grade. All teachers taught in the general education setting. Teachers that reported using whole brain teaching techniques in their classroom were asked if they have participated in at least one training by Chris Biffle or one of his associates. Fourteen of the 18 teachers (77.7%) that indicated they used whole brain teaching reported that they have been formally trained in use of the techniques. In regards to the students exposed to WBT, 101 students (52.9%) were exposed from a teacher that has received training in WBT and 36 students (18.8%) were exposed in a classroom with a teacher that has not been formally trained. Teacher demographic data by WBT group is found in Table 3. An independent sample t-test indicated no significant differences in math self-concept, $t(135) = 0.25$, $p > .05$, reading self-concept, $t(135) = 0.46$, $p > .05$, or general-school self-concept, $t(135) = 0.49$, $p > .05$, between teachers that were and were not formally trained in WBT techniques.

Table 3
Teacher demographics by WBT group

	0 WBT	*1-4 WBT*	*5+ WBT*
Total teachers	6	10	8
2nd grade	3	7	2
3rd grade	3	3	6
Total trained teachers	0	6	8
2nd grade	0	3	2
3rd grade	0	3	6

The Teacher Implementation Checklist was given to teachers that used WBT techniques (n = 18) in order to identify how many techniques they were using and how often. All 18 of these teachers indicated that they used WBT techniques to some extent on a daily basis. However, there was more variability in the frequency of technique use among the teachers that used five or more techniques. One teacher indicated they used one of the techniques occasionally, one teacher indicated they used one of the techniques very seldom and one of the techniques three out of the five school days, and two of the teachers indicated that some of the techniques are used only on a weekly basis. Teachers who did not indicate that they used all techniques daily were coded separately from those who used all techniques daily. An independent samples t-test indicated no significant differences in math self-concept, $t(135) = 0.99$, $p > .05$, reading self-concept, $t(135) = -0.60$, $p > .05$, or general-school self-concept, $t(135) = -0.26$, $p > .05$, between teachers that use WBT on a daily basis and those that use it on a varying basis.

I took measures to ensure the assumptions of MANOVA were not violated. I evaluated subscores for skewness and kurtosis, univariate and multivariate outliers,

multivariate normality, linear relationships, homogeneity of variance covariance matrices, and correlations.

The math, reading, and general-school subscores were evaluated for skewness and kurtosis. Math (-0.91) and general-school (-0.67) were evaluated to have little skewness. Math (0.08) and general-school (-0.17) were also evaluated to have little kurtosis. Reading had adequate skewness (-1.25) and kurtosis (0.95). Therefore, I had no concerns for skewness or kurtosis in this data set as the data does not show skewness or kurtosis statistics above the cut-off value of +/- 2.0 (George & Mallery, 2011).

I converted each of the three subscores to z-scores and checked for univariate outliers using +/- three standard deviations as a cut off. The highest z-score was 1.3 and the lowest was -3.16. I removed three students from the analysis because their scores were three standard deviations below the mean. Five students omitted four or more responses on their questionnaire, invalidating their scores. While the omitted responses on the questionnaires appeared random, it is important to note that all five of these students were second graders. Five students were identified as at or below the age of six, invalidating their scores. I removed a total of 13 students from the analysis as they were univariate outliers.

Mahalanobis' distance was used to look for multivariate outliers. The smallest probability of a problematic mahalanobis distance score was .003363, which is greater than .001. Therefore, this data set does not appear to have any multivariate outliers.

The Shapiro-Wilk test of normality was used to look for multivariate normality. Results indicated that there are no concerns with multivariate normality within general-school self-concept. In reading and math, however, results appear to be slightly

negatively skewed in all three conditions. Overall, I had no concerns with multivariate normality.

A three-dimensional scatterplot was used to evaluate linearity between the dependent variables. Dependent variables were shown to have linear relationships.

I used Box's M test of equality of covariance to test the null hypothesis of equal population covariance matrices. Results indicated the population was not equal, $F(12, 127559.36) = 4.01$, $p < .001$. Therefore, I conducted Levene's test for equality of variances. Results indicated unequal covariance across conditions in reading self-concept scores, $F(2, 188) = 2.99$, $p = .05$, but no concerns for the math and general-school self-concept scores. Therefore, if a difference is observed in the reading outcome between conditions, results must be considered with caution.

I examined correlations between the three subscores using Pearson *r*. The three self-concept measures were significantly correlated but below .9. This suggests that math, reading, and general-school self-concept are separate but related constructs. Table 4 presents correlations between the academic self-concept subscores and age.

Table 4
Correlations

	Mean	SD	1	2	3	4
1. Age (Months)	102.2	10.87				
2. Self-concept – Reading	34.53	5.86	-.01			
3. Self-concept – Math	31.40	7.73	-.10	.32**		
4. Self-concept – School Subject	31.81	6.21	-.15*	.47**	.69**	

Notes: *$p < .05$, **$p < .01$

Inferential Statistics

Results of the three group, one-way MANOVA indicated there was not a significant effect of WBT on the combined dependent variable of academic self-concept, $F(6, 372) = 1.21$, $p = .30$; Wilks' Lambda = .96; partial $\eta^2 = .02$. Univariate analyses indicated that significant differences across levels of the WBT factor were not observed for the general-school DV, $F(2,188) = 2.74$, $p = .07$, partial $\eta^2 = .03$. However, general-school self-concept did reveal lower *p*-values compared to the math and reading subscores. In order to identify any trends in the data, univariate follow-up analyses using Tukey's post hoc were administered. Results indicated that the mean values of self-concept were lower in the no-WBT group ($M = 30.20$, $SD = 5.98$) than the 1-4 group ($M = 32.70$, $SD = 6.18$), but not significantly so, $p = .06$; lower in the no-WBT group ($M = 30.20$, $SD = 5.98$) than the 5-7 group ($M = 32.04$, $SD = 6.28$), but not significantly so, $p = .27$; and lower in the 5-7 group ($M = 32.04$, $SD = 6.28$) than the 1-4 group ($M = 32.70$, $SD = 6.18$), but not significantly so, $p = .81$. Group means are presented in Figure 12.

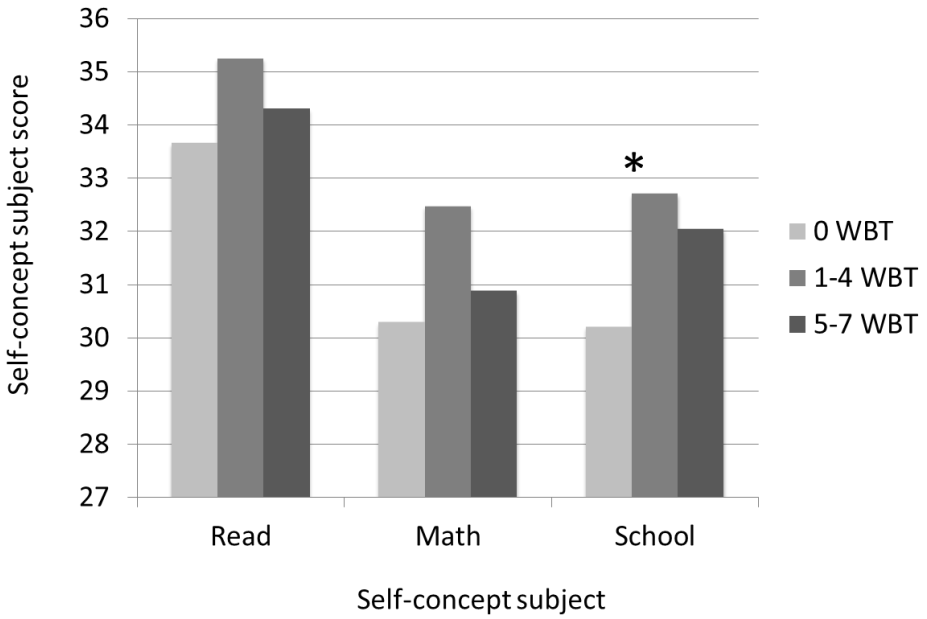

Figure 12. Mean self-concept scores across self-concept subtests and levels of WBT (3-group comparison). Slightly different means, but not significantly so, between subjects are shown with an asterisk, $p = .06$.

Due to the lack of empirical research on WBT, the three levels of the factor used for the comparative analysis in this study were arbitrarily created. The results of the three-group MANOVA and post hoc analysis prompted reconfiguration of the groups to determine if a two-group design, one group representing limited to no exposure to WBT (0-2 techniques) and one group representing exposure to three or more techniques, would reveal a significant difference between levels of the factor. Results of the two-group, one-way MANOVA indicated there is a significant effect of WBT on the combined dependent variable of academic self-concept, $F(3, 187) = 2.67$, $p = .05$; Wilks' Lambda = .959; partial $\eta^2 = .04$. Univariate analyses indicated that differences across levels of the WBT factor were observed only for the general-school DV, $F(1,189) = 5.76$, $p = .02$, partial $\eta^2 = .03$. Specifically, the mean values of self-concept were significantly lower in

the 0-2 WBT group (M = 30.32, SD = 5.91) than the 3+ WBT group (M = 32.57, SD = 6.25). There were no significant group mean differences in math and reading DV's. Group means are presented in figure 13.

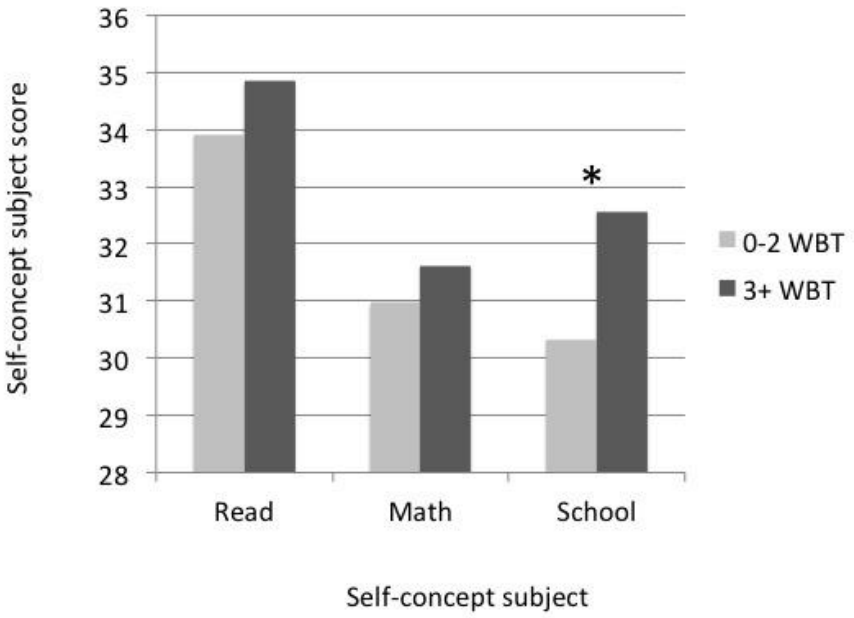

Figure 13. Mean self-concept scores across self-concept subtests and levels of WBT (2-group comparison). Significantly different means between subjects are shown with an asterisk, $p < .05$.

Summary

Results of the three-group, one-way MANOVA indicated that there was not sufficient evidence to illustrate a significant difference in the reading, math, and general-school self-concept scores among students exposed to no-WBT, one to four WBT techniques, and five or more WBT techniques. As a result of this finding, it is

appropriate to fail to reject the null hypothesis. Post hoc analysis was conducted in order to identify any trends in the data. Results indicated a slight difference across levels of the WBT factor for general-school self-concept, however, this difference was not significant. The arbitrary nature of the three-group design prompted reconfiguration of the groups. A two-group, one-way MANOVA was then conducted and the mean values of self-concept were significantly lower in the group with limited to no exposure to WBT compared to the group exposed to three or more techniques for the general school DV. Unfortunately, failure to find a difference (i.e., not rejecting the null hypothesis) is not really evidence of the existence of no difference as confounding factors, as discussed in Chapter 5, could have masked any relationships that actually exist. The next chapter explores the implications of this study for the educational community, addresses the limitations of this study, and provides recommendations for future research.

Chapter 5: Summary, Recommendations, Conclusion

The purpose of this study was to establish a relationship between whole brain teaching (WBT) techniques and academic self-concept and to assess WBT as a predictor variable of positive self-concept. Second and third grade students completed the academic subscales of the Self-Description Questionnaire-I, an instrument designed to assess the self-concept of children in the early elementary setting. Teachers completed a teacher implementation checklist in order to identify the amount of WBT techniques they were using in their classrooms.

This quantitative research sought to answer the following question: Do the mean academic self-concept scores differ among students exposed to three levels of the WBT factor: those who are not exposed to WBT techniques, those who are exposed to one to four techniques, and those who are exposed to five or more techniques? I collected data from two hundred and four students from 24 general education classrooms. Demographic data collected included student age, gender, and grade level, as well as teacher training experience in WBT, and the amount and frequency of WBT techniques used. I performed statistical procedures, including multivariate analysis of variance, to analyze demographic information and to establish whether the hypothesis was supported or rejected. This chapter discusses the findings, limitations, recommendations, and implications of this investigation.

Interpretation of the Findings

This research conceptualized academic self-concept as a construct made up of three interrelated self-concept constructs: Math self-concept, reading self-concept, and general-school self-concept. Results of the three-group, one-way MANOVA indicated

there was no evidence that WBT affects academic self-concept overall. However, results did reveal a slight difference across levels of the WBT factor for general-school self-concept when comparing no-WBT use and the use of one to four techniques. I found a significant difference in general-school self-concept between grade levels. I found no significant differences between self-concept scores and student gender, teacher training in WBT, or frequency of teacher use of the techniques.

The arbitrary nature of the three-group design and an attempt to find trends in the data, however, prompted reconfiguration of the groups and a two-group, one-way MANOVA was conducted. I found a significant difference for general-school self-concept and self-concept scores were significantly lower in the group exposed to limited to no WBT techniques. Results of the three- and two-group analyses suggested that WBT impacted the general-school self-concept of second and third grade students.

While results indicate that WBT may in fact work to enhance the general-school self-concept of elementary students, the difference in general-school self-concept was more likely the result of confounding factors (i.e. failure to examine longitudinal effects, failure to control for previous academic achievement, using group versus individually administered questionnaires for the second graders, and focusing on the general education setting versus at-risk populations) than exposure to WBT. Additionally, failing to find any overall significant differences from the three-group MANOVA weakens the assertion that WBT leads to any real improvements in any domains of academic self-concept. Educators advocating for and using WBT in the classroom as a means to improve student academic self-concept may need to consider use of additional, empirically supported techniques. A number of factors should be considered in the examination of these results,

including: (a) the relationship between WBT and self-concept intervention, (b) changes in gender role stereotyping, (c) developmental aspects of self-concept, and (d) teacher training and standardization of intervention procedures.

WBT as a self-concept intervention. Examining the theory behind self-concept enhancement was necessary in order to understand the link between WBT and academic self-concept. Three major approaches (i.e. skill development, self-enhancement, and reciprocal effect approach) to understanding this link emerged from the research.

The skill development orientation to self-concept enhancement indicates that with improved academic achievement comes improved academic self-concept (Craven, Marsh, & Debus, 1991). While the link between WBT and achievement was not directly examined in this study, it was assumed that WBT improves academic achievement, given the wealth of neuroscience research supporting this assertion (Buckingham, 2006; Jensen, 2005; Devlin, 2010; Rivera, Reiss, Eckert, & Menon, 2005; Immordino-Yang & Faeth, 2010; Lane, Nadel, Allen, & Kaszniak, 2000; Ansari, 2010; Immordino-Yang & Damasio, 2007; Sousa, 2006; Williams, 2010; Dahaene, 2010; Willis, 2010; Keller & Cowan, 1994; Karaduz, 2012; Cowan, 2012; Kane & Engle, 2003; Chen & Cowen, 2009). Assuming that WBT does in fact increase student academic achievement, examining WBT as a skill development approach to self-concept enhancement would suggest that it would be appropriate to expect a difference in self-concept scores between conditions. While the skill-development nature of the techniques may explain the difference found across levels of the WBT factor, it does not explain the lack of differences for use of WBT as an effective means to Math and Reading self-concept enhancement.

The self-enhancement orientation to self-concept intervention proposes that self-concept can improve as the direct result of praise and performance feedback (Craven, Marsh, & Debus, 1991). While I found evidence of the use of feedback in WBT, the wealth of neuroscience research provides the strongest evidence of support to conceptualize WBT as a skill-development approach to self-concept enhancement. In addition, it was unknown if the feedback that is provided in WBT is consistent with the less effective noncontingent praise or the more effective attributional feedback and contingent praise (O'Mara, Marsh, Craven, & Debus, 2006). As the present research did not collect or analyze data on the amount or presence of praise, future research examining these specific forms of feedback and frequency of use within WBT may provide evidence to conceptualize parts of WBT as a self-enhancement approach, providing another possible link between WBT and academic self-concept.

The reciprocal effect model ([REM], Marsh & Craven, 2006) proposes that academic self-concept is both a cause and consequence of academic achievement. Consistent with the REM, researchers claim the most lasting self-concept gains are the result of self-concept interventions that concurrently use a skill-development and self-enhancement approach (Marsh & Craven, 2006; O'Mara, Marsh, Craven, & Debus, 2006). While results from Elbaum and Vaughn's (2001) meta-analysis revealed that the self-concept of elementary students were only impacted from a skill-development approach to intervention, it is important to note that these findings only represent students with learning disabilities. While some students in the general education setting in this study may fall in to this population, the majority of students may not have experienced the same level of gains in academic self-concept compared to struggling students as they

may already be experiencing positive levels of academic-self-concept and average achievement. If academic achievement data had been available in the present research, it may have been the case that academic achievement was not enhanced in any conditions, which would be consistent with the idea of a reciprocal relationship between achievement and self-concept. However, the two-group MANOVA did reveal elevated general-school self-concept scores among students in the 3+ group compared to the limited exposure group. From the perspective of the REM, this suggests that exposure to at least three WBT techniques is necessary to provide the gains in academic achievement needed to make a significant impact on academic self-concept.

Gender role stereotyping. Academic self-concept scores were compared across demographic variables to explore possible predictors of positive self-concept. I found no significant differences between self-concept scores and student gender. This was not consistent with Marsh's (1989) finding that males exhibit higher math self-concept while scores reflect higher reading self-concepts in females. Marsh's (1989) results were more reflective of traditional stereotypes. This current investigation, however, may be an indication that changes in gender role stereotyping during the twenty-first century may be reducing gender stereotypic academic performance norms. While research does provide evidence that perceived incongruences between men and women have decreased in the past decade, role distributions in the work force continue to support traditional stereotypes (Eagly & Sczesny, 2009). Current research also supports the traditional stereotype that boys identify stronger in math (Cvencek, Meltzoff, & Greenwald, 2011) and girls identify stronger in reading (Plante, de la Sablonniere, Aronson, and Theoret, 2013). I assert this has important implications for the future of students as self-concept in

specific school subjects was significantly linked to student desire and subsequent choice to pursue specific courses of study (Marsh & Yeung, 1997b).

Developmental aspects of self-concept. While gender did not appear to be a factor in academic self-concept, data did indicate a relationship between student grade and age as it relates to general-school self-concept. Results revealed that second graders had significantly higher self-concept scores in the general-school sub-score compared to third graders. This decline in self-concept after second grade was consistent with correlational data that showed a significant negative correlation between age and general-school self-concept. This demonstrates that as age increases, general-school self-concept decreases. This is consistent with research on the developmental aspects of self-concept in that there is a consistent decline in self-concept during preadolescence (e.g. grades 2-6; Marsh, 1989).

Salient to self-concept theory and research is the contention that the multiple dimensions of self-concept are less distinct in children younger than eight years of age. While empirical research consistently supports a well differentiated self-concept by the age of eight, research has historically provided conflicting perspectives on when self-concept begins to differentiate (Van Den Bergh & De Rycke, 2003). Using confirmatory factor analyses, Marsh, Craven, and Debus (1991) provided the most convincing evidence that domain specific self-concept is found in young children (ages 5 to 8) and as age increases, self-concept differentiation consistently increased. It is important to note that while there was evidence that the process of differentiation begins early on, there still may be slight differences in the level of self-concept differentiation between a seven year old second grader and an eight year old second grader.

Teacher training and standardization of intervention procedures. Contrary to the assumption that increased training for intervention administrators would lead to increased intervention gains, a meta-analysis of 152 self-concept interventions revealed that the overall effectiveness of an intervention was not negatively affected when intervention administrators lacked training (O'Mara, Green, & Marsh, 2006). Consistent with this finding, the current study revealed that teacher training in WBT did not impact intervention outcomes. The standardization of the intervention may be more important than specific teacher training; a meta-analysis indicated higher effect sizes in self-concept interventions that use standardized intervention procedures (O'Mara, Green, & Marsh, 2006). The frequency of WBT use in the classroom did not impact academic self-concept scores between the three-group conditions. This suggested that while formal instruction in WBT may not necessarily lead to great gains in intervention success, standardized procedures as it relates to the frequency of WBT use may need to be explored in order to support more positive intervention outcomes.

Limitations and Recommendations

This investigation was restricted by several shortcomings that impacted the generalizability and validity of the results. To support future inquiry in to the relationship between self-concept and WBT, these limitations are presented and followed with recommendations.

Due to the cross-sectional design of this study, I did not examine the longitudinal effects of WBT on student self-concept. It could be the case that examining the same students, at different times, post intervention, may reveal different results. Therefore, I recommend the longitudinal effect of WBT on student self-concept be examined.

Previous academic achievement was not controlled for in this study so it was unknown if students started out similar in their level of academic achievement before being exposed to WBT. If a continuous variable addressing math, reading, and general-school academic achievement is found, I recommend that an ANCOVA be conducted to control for previous academic achievement. In addition, this study was built on my assumption that WBT directly improves academic achievement. Research testing my assumption is recommended in order to establish WBT as a predictor variable of increased academic achievement and to support further inquiry into WBT as a self-concept intervention.

While I explored exposure to two levels of the WBT factor in this study, it was not explored in great detail as doing so would have been beyond the scope of this investigation. Since this reconfiguration in groups did lead to a significant finding, I recommend researchers continue to explore how exposure to various levels of WBT impacts academic self-concept.

This study did not examine the nature or frequency of feedback in the WBT classroom or standardized procedures as it relates to the frequency of technique use. Further inquiry in to the use of feedback in WBT may reveal evidence of effective self-enhancement features in the techniques, providing another possible link between WBT and academic self-concept. In addition, standardizing the frequency of technique use may reveal more positive intervention outcomes.

Correlational data revealed that math, reading, and general-school self-concept are separate but related constructs. This data reinforced Shavelson et al. (1976) and Marsh and Shavelson's (1985) notion that the academic factors were largely correlated

with other academic factors. This lends support for use of the SDQ-I to assess student academic self-concept. However, I assert that the inability of this tool to measure the upper quartile of the distribution of scores should be addressed. Ninety-nine percent of the data from the three-group MANOVA was within three standard deviations (plus or minus) of the mean. However, there was a larger range of scores below the mean and a smaller range of scores above the mean despite most of the scores falling above the mean. Self-concept scores on the SDQ-I range from zero to 40 on each of the subscales. Forty students (20.9%) scored 40 in reading self-concept, 25 students (13%) scored 40 in math self-concept, and 18 students (9.4%) scored 40 in general-school self-concept. This data suggests a ceiling effect. Though we do not see variance in the scores of students who scored very high in self-concept, it could be the case that among students who made perfect scores there is significant variance in the actual level of self-concept. However, we cannot know as the highest score possible is 40 using the SDQ-I. This could be preventing the ability to see real differences in the data. Interestingly, the percentages of students who scored 40/40 on each subscale were higher in this sample (20.9%, 13%, and 9.4% respectively for reading, math, and general-school) than in the normative sample (6%, 6%, and 2% respectively for reading, math, and general-school; Marsh, 1992). This difference could be related to changes in the validity of the measure over time as the normative data was gathered in 1992. While the SDQ-I is among the most valid and reliable measures available for students in the elementary setting, I recommend exploring alternative self-concept measures, grounded in a multidimensional, hierarchal approach, for use in the early elementary setting.

O'Mara, Marsh, Craven, and Debus (2006) stressed the importance of using a multidimensional construct validity approach to evaluating self-concept interventions. This entails measuring both target and nontarget facets of self-concept when evaluating the impact of self-concept interventions. Target outcomes involved measuring specific facets of self-concept that were directly related to the goal of the intervention. In contrast, nontarget outcomes involved measuring specific facets of self-concept that were unrelated to the goals of the intervention. Nontarget scales in self-concept measures served as control scales to evaluate counter-interpretations of the intervention effects. The current investigation did not measure nontarget facets of self-concept, which in turn may have impacted the ability to observe important details in the data. I only administered the academic scales in the SDQ-I to students in the current study. While observation of scores that are consistently high or low across domains suggested inappropriate responding and prompts calculation of the control scores, since the SDQ-I was not administered in its entirety, checks for random and biased responding was not available. Administering all of the subscales in the SDQ-I may provide for measurement of nontarget facets in future research and allow for calculation of the control scores, possibly leading to more reliable data.

The current investigation examined students receiving their schooling in the general education classroom. While general education classrooms are typically inclusive settings supporting students at-risk for social, emotional, behavioral, and academic problems and students with disabilities, the majority of students are likely non-disabled with average intelligence. A meta-analysis of 200 self-concept interventions for children found that interventions targeting disadvantaged participants (e.g. students with learning

disabilities or behavior problems) were more effective than alternative interventions as the potential to improve self-concept is greater for this population (O'Mara, Marsh, Craven, & Debus, 2006).

Students in the WBT factors in the current sample may not have had the potential for gains as the overall level of academic self-concept may have already been at a high level. This exposes a limitation to the current investigation as student self-concept before the WBT intervention was not assessed. Therefore, I could not determine gains in self-concept as a result of WBT which, in turn, may limit our ability to see differences in the data from the three-group design. Future inquiry should include students (a) in upper elementary, middle, and high school settings, (b) with more diverse ethnic, cultural, and socioeconomic backgrounds, (c) in urban and suburban settings, and (d) disadvantaged due to disabilities or at-risk status.

Measuring the domain specific aspects of self-concept in young children, as seen in this study, is also limited to the maturational level of the student as the self-concept is not fully differentiated until the age of eight. Marsh, Craven, and Debus (1991) found that second grade students that received an individually administered SDQ-I were better able to differentiate among the multiple domains of self-concept compared to second grade students receiving the group administered measure. To facilitate standardized conditions among the grade levels, the current study used group administration procedures for data collection. In light of the current results, however, these data collection procedures may have limited the ability to find more substantial differences in the data as third graders may have had an advantage over the rest of the sample. This is further supported by the fact that all five of the assessments scored invalid due to a lack

of responses belonged to second grade students. Future research should accommodate for this difference in development by administering multifaceted self-concept scales one-one-one to students below the age of eight.

Implications

This research was the first empirical study examining the relationship between WBT and student self-concept. As previously discussed, this study is not without its limitations. However, important implications for researchers, educators, and students, as well as social change, can be drawn from these preliminary findings.

Conceptualizing WBT as a skill-development approach to self-concept enhancement indicates that academic achievement serves as a mediator between WBT and self-concept. In order to fully test this theory, researchers must measure academic achievement in relation to WBT. One of the major implications of this study is the understanding that any improvement WBT causes in academic achievement is the result of participant exposure to at least three of the WBT techniques. In addition to exploring the link between academic achievement and levels of exposure to WBT, I encourage researchers to identify other possible mediators involved in the relationship between WBT and self-concept. The skill-development approach and the reciprocal effect model can serve as productive frameworks to further explore the WBT, academic achievement, and academic self-concept relationship.

While the self-enhancement aspects of WBT were not measured in this study, I did find evidence of the use of feedback. I assert that the strength of any self-enhancement aspects of WBT may have been sufficient enough to lead to substantial gains in academic self-concept as a result of exposure to the techniques. This implies that

WBT may be effective as a self-enhancement approach to self-concept intervention. This implication should encourage efforts on behalf of researchers and educators to further explore the self-enhancement (i.e. feedback, praise) qualities of WBT as modifying the form of feedback or standardizing its use within WBT may lead to more desired outcomes. The self-enhancement approach to self-concept intervention can serve as an effective framework to further explore the link between the self-enhancement qualities of WBT and self-concept.

From a theoretical perspective, I encourage researchers to continue conducting research in this area using a multidimensional, construct validity approach, building on the work of Shavelson et al. (1976) and the Marsh/Shavelson revision (1985). This entails using measures of self-concept that can tap in to its domain-specific nature and using scales both related and unrelated (i.e. nontarget) to the aim of the intervention. Using nontarget scales in future assessment of the variables under investigation may reveal undiscovered links between WBT and other facets of self-concept (i.e. non-academic domains).

This study provided objective information to help teachers make more informed, evidence-based decisions regarding their practice of WBT. In addition, it demonstrated how essential it is for educators to be vigilant when adding strategies and techniques that claim positive outcomes to their teaching repertoire as a link between use of WBT and improved reading and math self-concept was not found. Educators using WBT may need to consider use of additional techniques that are supported with empirical evidence, such as use of attributional feedback and contingent praise (O'Mara, Marsh, Craven, & Debus, 2006). This becomes especially important given the negative correlation found between

general-school self-concept and age; efforts to boost academic self-concept using empirically supported techniques during the second and third grade may help to reduce this decline.

This study contributed to the efforts made by the educational community to enhance the self-concept of children. In terms of social change, I am optimistic that this study will prompt further scientific inquiry into the growing practice of WBT and encourage its advocates to make more empirically sound claims. This will allow students exposed to WBT in classrooms throughout the United States an opportunity to have an educational experience grounded in scientific findings, rather than subjective assumptions.

Conclusion

Biffle (2010) asserted that when the whole brain is stimulated during the learning process, as seen in WBT, improved self-beliefs and achievement will ensue. While results of the three-group MANOVA failed to support use of WBT techniques to improve the academic self-concept of second and third grade students in the public school, general education setting, the two-group MANOVA did provide more promising results as participants exposed to at least three WBT techniques did experience higher general-school self-concept scores than students exposed to a limited (i.e. 0-2 techniques) amount of WBT. Assessing a more diverse student population in terms of age, ethnic, cultural, and socioeconomic status, as well as, students at-risk for educational problems may reveal more convincing evidence for WBT as an effective self-concept intervention. Future inquiry in to the direct and indirect links between WBT and academic achievement, the self-enhancement aspects of the techniques, and levels of exposure to

the techniques, may also demonstrate more conclusive evidence for WBT as a predictor variable of positive academic self-concept.

References

Ansari, D. (2010). The computing brain. In D. A. Sousa (Ed.), *Mind, brain, & education: Neuroscience implications for the classroom* (pp. 3631-4053 of 4895). Bloomington, IN: Solution Tree Press.

Bachman, J. G., & O'Malley, P. M. (1975). Youth in transition, data file documentation (Vol 2). Ann Arbor, MI: Institute for Social Research.

Bandura, A. (1977). *Social learning theory.* Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Baumeister, R. F. (1990). Suicide as escape from self. *Psychological Review, 97*(1), 90-113.

Biffle, C. (2010). Whole brain teaching for challenging kids. Retrieved from http://www.wholebrainteaching.com/index.php?option=com_content&view=article&id=155&Itemid=201

Biffle, C. (2014). Research. Retrieved from http://www.wholebrainteaching.com/index.php?option=com_k2&view=item&id222:research&Itemid=166

Bower, G. H. (1981). Mood and memory. *American Psychologist, 36*(2), 129-148

Bracken, B. A. (1992). *Examiner's manual for the multidimensional self concept scale*. Austin, TX: Pro-Ed.

Bracken, B. A. & Lamprecht, M. S. (2003). Positive self-concept: An equal opportunity construct. *School Psychology Quarterly, 18*(2), 103-121.

Branden, N. (1994). Six pillars of self-esteem. New York: Bantam.

Buckingham, H. (2006). A pre-history of the problem of Broca's aphasia. *Aphasiology, 20*(8), 792-810.

Burman, D. D., Bitan, T., & Booth, J. R. (2008). Sex differences in neural processing of language among children. *Neuropsychologia, 46*(5), 1349-1362.

Byrne, B. M. (1986). Self-concept/academic achievement relations: An investigation of dimensionality, stability, and causality. *Canadian Journal of Behavioural Science, 18*(2), 173-186.

Byrne, B. M. (1996). Academic self-concept: Its structure, measurement, and relation to academic achievement. In B. A. Bracken (Ed.), *Handbook of self-concept: Developmental, social, and clinical considerations* (pp.287-316). New York, NY: John Wiley & Sons, Inc.

Byrne, B. M. (2002). Validating the measurement and structure of self-concept: Snapshots of past, present, and future research. *American Psychologist*, 897-909.

Calsyn, R. J., & Kenny, D. A. (1977). Self-concept of ability and perceived evaluation of others: Cause or effect of academic achievement? *Journal of Educational Psychology, 69*(2), 136-145.

Cioffi, D. (1991). Beyond attentional strategies: A cognitive-perceptual model of somatic interpretation. *Psychological Bulletin, 109*(1), 25-41.

Chapman, J. W., Cullen, J. L., Boersma, F. J., & Maguire, T. D. (1981). Affective variables and school achievement: A study of possible causal influences. *Canadian Journal of Behavioural Science, 13*(2), 181-192.

Chen, Z., & Cowan, N. (2009). Core verbal working memory capacity: The limit in words retained without covert capacity: the limit in words retained without covert articulation. *Quarterly Journal of Experimental Psychology, 62*, 1420-1429.

Coch, D. & Ansari, D. (2012). Constructing connection: The evolving field of mind, brain, & education. In S. D. Sala & M. Anderson (Eds.), *Neuroscience in Education: The good, the bad and the ugly* (pp. n.a.). Oxford, New York: Oxford University Press.

Coopersmith, S. A. (1976). The antecedents of self-esteem. San Francisco, CA: Freeman.

Cowan, N. (2012). In S. D. Sala & M. Anderson (Eds.), *Neuroscience in education: The good, the bad and the ugly* (pp. n.a.). Oxford, New York: Oxford University Press.

Craven, R., Marsh, H., & Burnett, P. C. (2004). Breaking the self-concept enhancement conundrum: Re-conceptualising the next generation of self-concept enhancement resesarch. In: NZARE/AARE Conference 2003: Educational Research, Risks, & Dilemmas, 29 November – 3 December 2003., Auckland, New Zealand.

Craven, R. G., Marsh, H. W., & Debus, R. L. (1991). Effects of internally focused feedback and attributional feedback on enhancement of academic self-concept. *Journal of Educational Psychology, 83*(1), 17-27.

Cvencek, D., Metzoff, A. N., & Greenwald, A. G. (2011). Math-gender stereotypes in elementary school children. *Child Development, 82*(3), 766-779.

De Boer, A., Bothma, T., & du Toit, P. (2011). Enhancing information literacy through the application of whole brain strategies. *Libri, 61*, 67-75.

Dehaene, S. (2010). The calculating brain. In D. A. Sousa (Ed.), *Mind, brain, & education: Neuroscience implications for the classroom* (pp. n.a.). Bloomington, IN: Solution Tree Press.

Devlin, K. (2010). The mathematical brain. In D. A. Sousa (Ed.), *Mind, brain, & education: Neuroscience implications for the classroom* (pp. n.a.). Bloomington, IN: Solution Tree Press.

Eagly, A. H. & Sczesny, S. (2009). Stereotypes about women, men, and leaders: Have times changed? In Barreto, M., Ryan, M. K., & Schmitt, M. T. (Eds.), *The glass ceiling in the 21st century: Understanding barriers to gender equality* (pp. 21-47). Washington: American Psychological Association.

Elbaum, B. & Vaughn, S. (2001). School-based interventions to enhance the self-concept of students with learning disabilities: A meta-analysis. *Elementary School Journal, 101*(3), 303-329.

Faul, F., Erdfelder, E., Lang, A., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191. Retrieved August 20, 2013 from http://www.psycho.uniduesseldorf.de/abteilungen/aap/gpower3/download-and-register/Dokumente/GPower3-BRM-Paper.pdf

Forgas, J. P., Bower, G. H., & Moylan, S. J. (1990). Praise or blame? Affective influences on attributions for achievement. *Journal of Personality and Social Psychology, 59*(4), 809-819.

Goswami, U. (2012). Principles of learning, implications for teaching? Cognitive neuroscience and the classroom. In S. D. Sala & M. Anderson (Eds.), *Neuroscience in education: The good, the bad and the ugly* (pp. n.a.). Oxford, New York: Oxford University Press.

Haney, P. & Durlak, J. A. (1998). Changing self-esteem in children and adolescents: A meta-analytic review. *Journal of Clinical Child Psychology, 27*(4), 423-433.

Hansford, B. D., & Hattie, J. A. (1982). The relationship between self and achievement/performance measures. *Review of Educational Research, 52*, 123-142.

Harter, S. (1996). Historical roots of contemporary issues involving self-concept. In B. A. Bracken (Ed.), *Handbook of self-concept: Developmental, social, and clinical considerations* (pp. 1-37). New York, NY: John Wiley & Sons, Inc.

Harter, S. (1999). *The construction of the self*. New York, NY: The Guilford Press.

Hattie, J. (2004). Models of self-concept that are neither top-down or bottom-up: The rope model of self-concept [R]. Retrieved February 23, 2013 from http://www.education.auckland.ac.nz/webdav/site/education/shared/hattie/docs/hattie-models-of-self-concept-(2004).pdf

Helmke, A. & Aken, M. A.G. v. (1995). The casual ordering of academic achievement and self-concept of ability during elementary school: A longitudinal study. *Journal of Educational Psychology, 87*(4), 624-637.

Immordino-Yang, M. H., & Damasio, A. R. (2007). We feel, therefore we learn: The relevance of affective and social neuroscience to education. *Mind, Brain, and Education, 1*(1), 3-10.

Immordino-Yang, M. H. & Faeth, M. (2010). The role of emotion and skilled intuition in learning. In D. A. Sousa (Ed.), *Mind, brain, & education: Neuroscience implications for the classroom* (pp. n.a.). Bloomington, IN: Solution Tree Press.

Jacobs, J. E., Bleeker, M. M., & Constantino, M. J. (2003). The self-system during childhood and adolescence: Development, influences, and implications. *Journal of Psychotherapy Integration, 13*(1), 33-65.

Jensen, E. (2005). Teaching with the brain in mind, 2nd Ed. Association for Supervision and Curriculum Development: Alexandria, VA.

Ju, S., Zhang. D., & Katsiyannis, A. (2012). The causal relationship between academic self-concept and academic achievement for students with disabilities: An analysis of SEELS data. *Journal of Disability Policy Studies, 24*(4). Retrieved September 1, 2013 from http://dps.sagepub.com/

Kane, M. J. & Engle, R. W. (2003). Working-memory capacity and the control of attention: The contributions of goal neglect, response competition, and task set to stroop interference. *Journal of Experimental Psychology: General, 132*(1), 47-70.

Karaduz, A. (2010). Linguistic acts teachers use in the classroom: Verbal stimuli. *Education, 130*(4), 696-704.

Keith, L. K. & Bracken, B. A. (1996). Self-concept instrumentation: A historical and evaluative review. In B.A. Bracken (Ed.), *Handbook of self-concept: Developmental, social, and clinical considerations* (pp. 91-170). New York, NY: Wiley.

Keller, T. A. & Cowan, N. (1994). Developmental increase in the duration of memory for tone pitch. *Developmental Psychology, 30*(6), 855-863.

Kobayashi, N. (2010). Brain science and education. New Horizons for Learning. Retrieved from http://education.jhu.edu/PD/newhorizons/Neurosciences/articles/Brain%20Science%20and%20Education/index.html

Lane, R. D., Nadel, L., Allen, J. J. B., & Kaszniak, A. W. (2000). The study of emotion from the perspective of cognitive neuroscience. In R. D. Lane & L. Nadel (Eds.), *Cognitive Neuroscience of Emotion* (pp. n.a.). New York, NY: Oxford University Press, Inc.

Ledoux, J. (2000). Cognitive-emotional interactions: Listen to the brain. In R. D. Lane & L. Nadel (Eds.), *Cognitive neuroscience of emotion* (pp. n.a.). Oxford, NY: Oxford University Press, Inc.

Marsh, H. W. (1989). Age and sex effects in multiple dimensions of self-concept: Preadolescence to early adulthood. *Journal of Educational Psychology, 81*(3), 417-430.

Marsh, H. W. (1990). Causal ordering of academic self-concept and academic achievement: A multiwave, longitudinal panel analysis. *Journal of Educational Psychology, 82*(4), 646-656.

Marsh, H. W. (1992a). Content specificity of relations between academic achievement and academic self-concept. *Journal of Educational Psychology, 84*, 35-42.

Marsh, H. W. (1992b). Self-Description Questionnaire I. SELF Research Centre, University of Western Sydney, Australia.

Marsh, H. W. (1993). Academic self-concept: Theory, measurement, and research. In J. Suls (Ed.), *Psychological perspectives on the self* (Vol. 4). Hillsdale, NJ: Erlbaum.

Marsh, H. W., Barnes, J., Cairns, L., & Tidman, M. (1984). Self-description questionnaire: Age and sex effects in the structure and level of self-concept for preadolescent children. *Journal of Educational Psychology, 76*(5), 940-956.

Marsh, H. W., Byrne, B. M., & Shavelson, R. J. (1988). A multifaceted academic self-concept: Its hierarchical structure and its relation to academic achievement. *Journal of Educational Psychology, 80*(3), 366-380.

Marsh, H. W. & Craven, R. G. (2006). Reciprocal effects of self-concept and performance from a multidimensional perspective: Beyond seductive pleasure and unidimensional perspectives. *Perspectives on Psychological Science, 1*(2), 133-163.

Marsh, H. W., Craven, R. G., & Debus, R. (1991). Self-concepts of young children 5 to 8 years of age: Measurement and multidimensional structure. *Journal of Educational Psychology*, *83*(3), 377-392.

Marsh, H. W. & Hattie, J. (1996). Theoretical perspectives on the structure of self-concept. In B. A. Bracken (Ed.), *Handbook of self-concept: Developmental, social, and clinical considerations* (pp. 38-90). New York, NY: Wiley.

Marsh, H. W. & Martin, A. J. (2011). Academic self-concept and academic achievement: Relations and causal ordering. *British Journal of Educational Psychology, 81*(1), 59-77.

Marsh, H. W., Parada, R. H., Yeung, A. S., & Healey, J. (2001). Aggressive school troublemakers and victims: A longitudinal model examining the pivotal role of self-concept. *Journal of Educational Psychology, 93*(2), 411-419.

Marsh, H. W., Richards, G.E., & Barnes, J. (1996). Multidimensional self-concepts: The effect of participation in an outward bound program. *Journal of Personality and Social Psychology, 50*(1), 195-204.

Marsh, H. W. & Shavelson, R. (1985). Self-Concept: Its multifaceted, hierarchical structure. *Educational Psychologist, 20*(3), 107-123.

Marsh, H. W. & Smith, L. D. (1982). Multitrait-multimethod analyses of two self-concept instruments. *Journal of Educational Psychology, 74*, 430-440.

Marsh, H. W. & Yeung, A. S. (1997a). Causal effects of academic self-concept on academic achievement: Structural equation models of longitudinal data. *Journal of Educational Psychology, 89*(1), 41-54.

Marsh, H. W. & Yeung, A.S. (1997b). Coursework selection: The effects of academic self-concept and achievement. *American Educational Research Journal, 34*(4), 691-720.

Marx, R. W., & Winne, P. H. (1978). Construct interpretations of three self-concept inventories. *American Educational Research Journal, 15*, 99-109.

McInerney, D. M., Cheng, W. R., Ching Mok, M. M., & Hap Lam, A. K. (2012). Academic self-concept and learning strategies: Direction of effect on student academic achievement. *Journal of Advanced Academics, 23*(3), 249-269.

Morris, R. J. (2006). Left brain, right brain, whole brain? An examination into the theory of brain lateralization, learning styles and the implications for education. PGCE Thesis, Cornwall College St Austell, http://singsurf.org/brain/rightbrain.html

No Child Left Behind Act of 2001, H.R. 1, 107th Cong. (2002). Retrieved from the US Department of Education.

O'Mara, A. J., Green, J., & Marsh, H. W. (2006). Administering self-concept interventions in schools: No training necessary? A meta-analysis. *International Education Journal, 7*(4), 524-533.

O'Mara, A. J., Marsh, H. W., Craven, R. G., & Debus, R. L. (2006). Do self-concept interventions make a difference? A synergistic blend of construct validation and meta-analysis. *Educational Psychology, 41*(3), 181-206.

Pajares, F. & Schunk, D. H. (2001). Self-beliefs and school success: Self-efficacy, self-concept, and school achievement. In R. Riding & S. Rayner (Eds.), *Perception* (pp. 239-266). London: Ablex Publishing.

Pennebaker, J. W., & Lightner, M. (1980). Competition of internal and external information in an exercise setting. *Journal of Personality and Social Psychology, 39*(1), 165-174.

Plante, I., de la Sablonniere, R., Aronson, J. M., & Theoret, M. (2013). Gender stereotype endorsement and achievement-related outcomes: The role of competence beliefs and task values. *Contemporary Educational Psychology, 38,* 225-235.

Posner, M. I. (2010). Neuroimaging tools and the evolution of educational neuroscience. In D. A. Sousa (Ed.), *Mind, brain, & education: Neuroscience implications for the classroom* (pp. 3631-4053 of 4895). Bloomington, IN: Solution Tree Press.

Pottebaum, K. A., Keith, T. Z., & Ehly, S. W. (1986). Is there a causal relation between self-concept and academic achievement? *Journal of Educational Research, 79*(3), 140-144.

Rivera, S. M., Reiss, A. L., Eckert, M. A., & Menon, V. (2005, November). Developmental changes in mental arithmetic: Evidence for increased functional specialization in the left inferior parietal cortex. *Cerebral Cortex, 15*(11), 1779-1790.

Rogosa, D. (1980). A critique of cross-lagged correlation. *Psychological Bulletin, 88*(2), 245-258.

Rubin, R. A., Dorle, J., & Sandidge, S. (1977). Self-esteem and school performance. *Psychology in the Schools, 14*(4), 503-507.

Saleh, S. (2011). The effectiveness of the brain based teaching approach in enhancing scientific understanding of Newtonian physics among form four students. *International Journal of Environmental & Science Education, 7*(1), 107-122.

Salovey, P., & Birnbaum, D. (1989). Influence of mood on health-relevant cognitions. *Journal of Personality and Social Psychology, 57*(3), 539-551.

Scheirer, M. A., & Kraut, R. E. (1979). Increasing educational achievement via self-concept change. *Review of Educational Research, 49*, 131-150.

Schunk, D. H. (1999). Social-self interaction and achievement behavior. *Educational Psychologist, 34*(4), 219-227.

Schunk, D. H., & Zimmerman, B. J. (1997). Social origins of self-regulatory competence. *Educational Psychologist, 32*, 195-208.

Shapka, J. D. & Keating, D. P. (2005). Structure and change in self-concept during adolescence. *Canadian Journal of Behavioural Science, 37*(2), 83-96.

Shavelson, R. J., & Bolus, R. (1982). Self-concept: The interplay of theory and methods. *Journal of Educational Psychology, 74*(1), 3-17.

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-concept: Validation of construct interpretations. *Review of Educational Research, 46*(3), 407-441.

Sousa, D. A. (2006). How the brain learns, 3rd ed. Thousand Oaks, CA: Corwin Press.

Sousa, D. A. (2010). How science met pedagogy. In D. A. Sousa (Ed.), *Mind, brain, & education: Neuroscience implications for the classroom* (pp. n.a.). Bloomington, IN: Solution Tree Press.

U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance (2003, December). Educational Practices Supported by Rigorous Evidence: A User Friendly Guide. Retrieved August 12, 2012 from http://www2.ed.gov/rschstat/research/pubs/rigorousevid/rigorousevid.pdf

Valentine, J. C., DuBois, D. L., & Cooper, H. (2004). The relation between self-beliefs and academic achievement: A meta-analytic review. *Educational Psychologist, 39*(2), 111-133.

Van Den Bergh, B. R. H. & De Rycke, L. (2003). Measuring the multidimensional self-concept and global self-worth of 6- to 8- year-olds. *The Journal of Genetic Psychology, 164*(2), 201-225.

Watkins, D., & Astilla, E. (1987). Causal dominance among self-concept, locus of control, and academic achievement. *The Journal of Psychology, 120*, 627-633.

West, C. K., Fish, J. A., & Stevens, R. J. (1980). General self-concept, self-concept of academic ability and school achievement: Implications for "causes" of self-concept. *The Australian Journal of Education, 24,* 194-213.

Williams, D. L. (2010). The speaking brain. In D. A. Sousa (Ed.), *Mind, brain, & education: Neuroscience implications for the classroom* (pp. n.a.). Bloomington, IN: Solution Tree Press.

Willis, J. (2010). The current impact of neuroscience on teaching and learning. In D.A. Sousa (Ed.), *Mind, brain, & education: Neuroscience implications for the classroom* (pp. n.a.). Bloomington, IN: Solution Tree Press.

Winne, P. H., Marx, R. W., & Taylor, T. D. (1977). A multitrait-multimethod study of three self-concept inventories. *Child Development, 48,* 893-901.

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81*(3), 329-339.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist, 25*(1), 3-17.

Appendix A: Data Collection Coordination Request

Data Collection Coordination Request

October 5, 2014

Dear Teacher,

I have obtained your school district's support to collect data for my research project entitled Effect of Whole Brain Teaching on Student Self-Concept.

I am requesting your cooperation in the data collection process. I propose to collect data one time during the month of January, February, or March of 2015. I will coordinate the exact time of data collection with you in order to minimize disruption to your instructional activities.

If you agree to be part of this research project, I ask that you send information home to parents of students in your classroom via student's backpacks about the study. Data collection will take place on one day during morning homeroom time. On this day, I ask that you stay in the classroom to supervise students during this time. While your presence is needed for supervision purposes, I ask that you do not view student responses on the questionnaire. The student questionnaire will take approximately 5 to 10 minutes to complete. I would also ask that you complete a Teacher Implementation Checklist which will take no more than one or two minutes to complete. The Teacher Implementation Checklist will help identify your use of and level of training in whole brain teaching. All students in your classroom, regardless of their participation in the study, will receive a new pencil on the day the questionnaire is presented. When the research study is complete, I will provide a one to two page written summary of the results. I ask that you send this summary home to parents/guardians via student backpacks.

If you prefer not to be involved in this study, that is not a problem at all.

If circumstances change, please contact me via phone at or email at

Thank you for your consideration. I would be pleased to share the results of this study with you if you are interested.

I am requesting that you reply to this email with "I agree" to document that I have cleared this data collection with you.

Sincerely,

Printed Name of Teacher _____

Date _____

Teacher's Written or Electronic* Signature _____

Researcher's Written or Electronic* Signature _____

Electronic signatures are regulated by the Uniform Electronic Transactions Act. Legally, an "electronic signature" can be the person's typed name, their email address, or any other identifying marker. An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically.

Please return this form to the locked drop box located in the school office by _____ (date).

Appendix B: Teacher Implementation Checklist

Teacher Implementation Checklist

Name: _____Grade: _____

1. Do you use any Whole Brain Teaching techniques, as proposed by Chris Biffle, in your classroom?

   ____ Yes (Complete questions 2 and 3)
   ____ No (Skip questions 2 and 3)

2. Please indicate with a checkmark which Whole Brain Teaching techniques you use in your classroom:

   ____ Class-Yes!
   ____ Classroom Rules
   ____ Teach/Okay
   ____ The Scoreboard
   ____ Mirror
   ____ Hands and Eyes
   ____ Switch

3. How often are the techniques you checked used?

   _____

Please return this form to the locked drop box located in the school office by _____ (date).

Appendix C: SDQ-I Academic Scales

Please circle the number which is the most correct statement about you.

	Statement	False	Mostly False	Sometimes false, sometimes true	Mostly True	True
01.	I am good at all **SCHOOL SUBJECTS**.....	1	2	3	4	5
02.	I get good marks in **READING**.....	1	2	3	4	5
03.	I hate **MATHEMATICS**.....	1	2	3	4	5
04.	I enjoy doing work in all **SCHOOL SUBJECTS**	1	2	3	4	5
05.	I like **READING**.....	1	2	3	4	5
06.	Work in **MATHEMATICS** is easy for me.....	1	2	3	4	5
07.	I get good marks in all **SCHOOL SUBJECTS**...	1	2	3	4	5
08.	I am good at **READING**.....	1	2	3	4	5
09.	I look forward to **MATHEMATICS**.....	1	2	3	4	5
10.	I hate all **SCHOOL SUBJECTS**.....	1	2	3	4	5
11.	I am interested in **READING**.....	1	2	3	4	5
12.	I get good marks in **MATHEMATICS**.....	1	2	3	4	5
13.	I learn things quickly in all **SCHOOL SUBJECTS**.....	1	2	3	4	5
14.	I am dumb at **READING**.....	1	2	3	4	5
15.	I am interested in **MATHEMATICS**.....	1	2	3	4	5
16.	I am interested in all **SCHOOL SUBJECTS**.....	1	2	3	4	5
17.	I enjoy doing work in **READING**.....	1	2	3	4	5
18.	I learn things quickly in **MATHEMATICS**.....	1	2	3	4	5
19.	I am dumb in all **SCHOOL SUBJECTS**.....	1	2	3	4	5
20.	Work in **READING** is easy for me.....	1	2	3	4	5
21.	I like **MATHEMATICS**.....	1	2	3	4	5
22.	I look forward to all **SCHOOL SUBJECTS**.....	1	2	3	4	5
23.	I look forward to **READING**.....	1	2	3	4	5
24.	I am good at **MATHEMATICS**.....	1	2	3	4	5
25.	Work in all **SCHOOL SUBJECTS** is easy for me.....	1	2	3	4	5
26.	I hate **READING**.....	1	2	3	4	5
27.	I enjoy doing work in **MATHEMATICS**.....	1	2	3	4	5
28.	I like all **SCHOOL SUBJECTS**.....	1	2	3	4	5
29.	I learn things quickly in **READING**.....	1	2	3	4	5
30.	I am dumb at **MATHEMATICS**.....	1	2	3	4	5