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Behavioral and Academic Effects of *Brainology*

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Behavioral and Academic Effects of *Brainology*

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DEDICATION

To my mother who would be amazed to see how far her daughter has come!

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Behavioral and Academic Effects of *Brainology*

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The purpose of this study was to investigate the effects of a computer program for students with emotional behavioral disorder (EBD) on behavior and academics. This concurrent, multiple baseline study investigated the use of *Brainology* with three upper elementary students diagnosed with EBD. Evaluations across behavior, academics, and behavioral academic indicators resulted in indications of possible effectiveness with one fourth grade student and limited to no effects with the other two students. There was a lack of multiple demonstration of intervention effect in this study across the baseline for behavior.

Overall, student effort appeared to increase using this intervention, which is an important finding given the problems with disengagement that students with EBD experience (Wagner et al., 2004. Despite the limited results of this study, *Brainology* appears to hold some promise for students with EBD and it is hoped that further research will explore this possibility further. The teachers and students indicated that the treatment

had strong to moderate validity on validity measures. Implications for *Brainology* and students with EBD are presented. Study limitations and directions for future research and practice are discussed.

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CHAPTER I: INTRODUCTION

Due to the innovation of technology, the growth of knowledge, and the increasing diversity in student populations within the past 50 years, the world of education has changed drastically. However, the need for structure and discipline in the classroom and school remain necessities that must be in place in order for teaching and learning to occur in our classrooms (Allen, 2010). In fact, as recently as 2010, based on the 42nd Annual Phi Delta Kappa/Gallup Poll, school discipline remained one of the public's top concerns (Bushaw & Lopez, 2010). Poor classroom behaviors are likely to affect teaching and learning for all students (Sutherland, Wehby & Yoder, 2002). In order for academic instruction to flourish in the school setting, a focus on student behavior is just as critical as quality academic instruction (Witt, VanDerHeyden, & Gilbertson, 2004). Yet, problem behaviors in the classroom continue to be a concern for teachers as research indicates that teachers and administrators spend 50% of their time responding to problem behavior instead of teaching (Gresham, Lane, MacMillan, & Bocian, 1999; U.S. Department of Education, 2000). As a field we must identify effective ways to proactively intervene with students who have problem behavior such as those students with or at risk for Emotional/Behavioral Disorders (EBD).

Challenges for Students with Emotional/Behavioral Disorders

By definition many students with EBD demonstrate behaviors that severely impact classroom performance (Individuals with Disabilities Education Act [IDEA], (IDEA 2004). According to the Individual with Disabilities Education Act (IDEA)

Public Law 94-142, students with disabilities including those with EBD must be taught in the least restrictive environment. Additionally, the reauthorization of IDEA (1997, 2001) stipulates that students with disabilities, including students with EBD, participate in state accountability testing alongside their peers without disabilities. This requirement for participation and adequate performance has increased the academic rigor with which schools are educating students. NCLB mandates that all states have challenging academic standards, implement assessments to measure each student's progress compared to those standards, and hold schools accountable for the test results in order to demonstrate school performance (McLaughlin & Rhim, 2007). This increased rigor has resulted in more students with disabilities being included in the general education classroom in order to access the general education curriculum using the most effective teaching practices (Vannest, Temple-Harvey, & Mason, 2009). This movement of students with disabilities into general education settings includes students with EBD (McLaughlin & Rhim, 2007). In addition to the demands placed on schools because of such accountability requirements, the addition of more students with EBD to the general education classroom has added another dimension of difficulty for the classroom teacher and their methods of classroom management (Kauffman & Wong, 1991).

In observational studies, it has been found that the pattern of behavior between teachers and students negatively impacts the instruction and classroom environment (Wehby, Symons, & Canale, 1998; Wills, Kamps, Abbott, Bannister & Kaufmann, 2010). Yet, the need to manage behavior and maintain order in the classroom has amplified due to the increased academic requirements that have come with No Child Left Behind

(NCLB, 2001) and IDEA (2004) as teachers have an even greater impetus to ensure that all students are mastering the academic curriculum (McLaughlin & Rhim, 2007). Not only are students with EBD to be included in such state accountability measures but the federal adequate yearly progress (AYP) standards are not adjusted for students with EBD (Vannest et al., 2009). The performances of these students are measured by the same standards, despite the facts that (a) the academic performance of many of these students is typically a year or more below grade level (Trout, Nordness, Pierce, & Epstein, 2003; Kauffman, Cullinan, & Epstein, 1987), (b) they struggle with more behavioral problems than their peers with other disabilities, (c) they have poor social skills, and (d) they receive fewer grades of A and B compared to other students in school (Bradley, Henderson, & Monfore, 2004). Students with EBD may also have learning difficulties comparable to the learning challenges experiences by youth with learning disabilities (Trout et al., 2004), which can compound the problems in the classroom including the demonstration of problem behavior. Students with EBD often demonstrate a lack of academic and behavioral skills and experience a host of negative school and life outcomes including suspension, expulsion, failure, retention, dropout, unemployment and incarceration (Wagner, Newman, & Cameto, 2004; Wagner, Newman & Shaver, 1989). Additionally, a lack of social skills has been documented over time (Epstein, Kinder, & Bursuck, 1989; Trout et al., 2004). With the likelihood of such deleterious outcomes, regardless of the cause, it is apparent that students with EBD need interventions that will help them to be successful in school and ultimately in life.

Need for Intervention

It is essential to implement strategies to improve student behavior before poor behavioral patterns are established (Ladd, Birch & Buhs, 1999; Lloyd, Hallahan, Kauffman, & Keller, 1998). The negative habits in behavioral, social, and academic areas are established and learned during the preschool and elementary school years (Webster-Stratton & Reid, 2003), and are very difficult, if not impossible, to unlearn or correct as the child progresses in school (Landrum, Tankersley, Kauffman, 2003; Webster-Stratton & Reid, 2003). Interventions are needed that will help the child to change negative behavioral cycles that begin in these formative years (Duncan, Forness, & Hartsough, 1995; Webster-Stratton & Reid, 2003). Yet, for many students such early intervention has not taken place or it has not been successful (West, Denton, & Reaney, 2000). This means that by the time a child reaches elementary school he or she may be still demonstrating behaviors that are associated with poor school outcomes (Webster-Stratton, Reid, & Stoolmiller, 2008). Thus, in addition to academic instruction and achievement in school, teachers and other school staff must provide instruction to help students behave appropriately in order to maximize instructional time and academic learning. This means that teachers and school staff proactively work to screen and identify students who may require additional behavioral interventions.

Research (Duncan et al., 1995) has shown that students with EBD are often misidentified early in their school careers, as many students with EBD are identified early on as students with LD only to be reclassified at fourth grader or later as a student with EBD. Unfortunately, the best time for intervention, particularly behavioral intervention,

is during the early childhood period (i.e., through age 8 or by third grade). After this period such behaviors become much more stable (Webster-Stratton & Reid, 2003). This does not mean that we should simply give up on older students with EBD or challenging behavior. Instead we must redouble our efforts in order to facilitate their behavioral growth and simultaneous academic achievement.

A challenging aspect of working with these students is the question of cause and effect with regard to students with EBD - which is the cause- academics or behavior and which is the effect – academics or behavior (Kauffman 2001; McMichael, 1979). Hinshaw (1992) reviewed the research literature to determine which came first, the behavior or the academic problems. Hinshaw's findings were inconclusive with regard to causality as little evidence was able to firmly support a unidirectional relationship.

Some behaviors are related to academic outcomes such as task persistence which is cited repeatedly as a problem for students with EBD (Gagnon & Maccini, 2001; Maccini & Gagnon, 2000). Various studies have demonstrated that the more difficult the task the greater the increase in negative behaviors (Center, Deitz, & Kaufman, 1982; Weeks & Gaylord-Ross, 1981; Witt et al., 2004). Two studies (DePaepe, Shores, Jack & Denny, 1996; Gilbertson, Duhon, Witt, &, Dufrene, 2008) found that students, who were more engaged and showed more task persistence, completed their work accurately and fluently, with more on-task behavior, when the work was easier and they were more successful. While this seems a rather obvious conclusion that students work better at easier tasks, the material and difficulty at school becomes increasingly more complex and requires more effort and problem solving as the students' progress through their K-12

school careers. This, interestingly, can often coincide with the behavior problems increasing proportionately due to escape and/or work avoidance (Dunlap, Kern, & Worcester, 2001). This problem has been addressed in research by changing the tasks, the reinforcers for the task and/or the environment of the task (Blair, Umbreit, & Bos, 1999; Dunlap et al., 1994; Kern, Choutka, & Sokol, 2002). These have all been successful strategies with regard to increasing task persistence, but all of these studies also employed interventions that included praise, rewards, and additional attention.

While teaching at an appropriate level is also part of student success (Witt et al., 2004), the student's own ability to persist with a task even when learning new skills is also necessary for academic success. Given the shift that occurs in third grade in from basic skills to content skills—for example, learning to read versus reading to learn (Gajria, Jitendra, Sood, & Sacks, 2007; Wanzek, Wexler, Vaughn, & Ciullo, 2010) and the academic difficulty and frequent escape-based behavior of students with EBD, it would seem that interventions to improve task persistence and facilitate academic and behavioral success would be critical at this educational juncture for this population.

Behavior Management Techniques

A number of behavior management techniques are used with students with EBD to improve their classroom performance including task persistence. Commonly used techniques in work with students with EBD tend to consist of reinforcement and consequence systems, token economies, and/or behavioral contracts as options available in the general education classroom. These strategies can be intensive and require added adult management and monitoring, but they can be effective in adapting the student's

behaviors while concurrently facilitating increases in their performance (Smith, Lochman, & Daunic, 2005).

While teachers and other school staff play critical roles in student performance, students must also begin to be responsible for their own behavior. In an article by Albrecht (2009), Frank Wilderson indicated, "To change behavior from maladaptive to adaptive requires a change of locus of control" (p. 6). Locus of control is defined as the extent to which individuals believe that they can control the events in their lives (Rotter, 1965; Rotter, 1966). People with internal loci of control believe that they have control of events in their lives. Individuals with external loci of control believe the opposite—that is, that they do not have control of the events that affect their lives. Students with EBD not only tend to demonstrate serious behavioral problems but they have also been found to have external loci of control such that they believe fate or chance are more responsible for their intellectual, social, and physical abilities particularly when compared to perceptions of students with LD and mild intellectual disabilities (Morgan, 1986). More recently, researchers (e.g., Judge, Erez, Bono, & Thoresen, 2002) argued that the theory of locus of control refers to the same ideas as the concept of self-efficacy. Self-efficacy is defined as the measure of a person's own ability to complete tasks and reach goals (Ormrod, 2006). Recent studies investigating the use of interventions that incorporate elements of self-efficacy have demonstrated significant promise with students with EBD, for example studies concerning Self-Regulated Strategy Development particularly in the area of writing (c.f., Graham, Harris, & Mason, 2005; Mason & Shriner, 2008). These writing intervention studies, which have incorporated components of self-efficacy, have

resulted in various improvements using strategies such as goal-setting, self-instruction, and self-reinforcement. Part of changing students' loci of control or levels of self-efficacy may include changing their thought processes so that they are able to engage in activities of goal-setting, self-instruction, and self-reinforcement in order to engage in tasks and attain goals.

Mindset Theory

Over the past 25 years Carol Dweck has conducted extensive research (Dweck and Legett, 1988, Dweck 1999, 2007, 2008) concerning how students think, what motivates them and what causes them to persist through tasks. The heart of this theory in psychology is defined as implicit theories of intelligence (Blackwell, Trzesniewski, & Dweck, 2007; Dweck and Legett, 1988; Dweck, 1999). They are not usually seen explicitly, but they underline how we learn and the resilience we have in learning. These implicit theories give us a "framework for making predictions and judging the meaning of events in one's world (Yeagar & Dweck, 2012, p.303). In 2006 Dweck published a book about this research called *Mindset*, within this book she explained a classification for how students think called *mindset*. *Mindset* is classified as either fixed or growth. A *fixed mindset* means that a person's potential is limited in that area and no further growth is possible. In this *mindset* challenges are impossible and threatening because they may show something that the individual is not capable of achieving or where success is not possible. A *growth mindset* means that you can grow and achieve in any area with education and hard work. This group sees challenges as an opportunity to grow and learn more (Dweck, 2008). See figure 1 for a schematic of fixed versus growth mindset.

One of the central concepts is that the difference between the two mindsets is the value put on effort. Students with fixed mindsets appear to think that if you have to apply effort to learn and it doesn't happen easily then that is not an area of strength. As a result, they mentally limit themselves in that area to what comes easily and with little to no effort. In contrast people with growth mindsets believe that the harder you work, the better you get. This growth mindset group realizes that the locus of control is within their control and whether they do well or not depends on their effort toward the goal.

With this as a theoretical foundation, Dweck has developed a program that she has been using with general education students to help develop more of a growth mindset than a fixed mindset. Dweck theorized that learning about one's brain will help students to learn about their internal locus of control such that students might be able to realize that they can manage their own behavior. As a result of her experimentation and results, Dweck developed a computer program, *Brainology,* in which students examine a representation of how the brain works. Dweck's theory is that using *Brainology* assists students in seeing their brains from a growth perspective so that they understand that they can teach themselves (i.e., their brains) to behave differently.

Fixed mindset	Growth mindset
- set amount I can learn	- no set amount I can learn
-much effort= no talent	-much effort = learning
-limited at birth	-unlimited at birth

Figure 1. Fixed vs. growth mindset.

She has had some success using this program in middle schools with the general education population (Dweck, 2007, 2008). To date, this theory and Dweck's work has only been studied with adolescent students without disabilities (Dweck, 2007, 2008; Yeager & Dweck, 2012); yet, it would seem likely that students with EBD could benefit from what this program teaches such that they see a visual picture of how they are in control of their learning and their choices—that is, they are not at the whim of their emotions or other people around them; they determine what they learn and can accomplish. Figure 1 provides a schematic of fixed versus growth mindset as represented in Dweck's mindset theory. Her theory and the *Brainology* program is designed to be

developmentally appropriate and appears to be acceptable to youth in general education programs at the middle school level.

An additional element to the *Brainology* program is a core concept of task persistence. Through using elements of the brain and how it learns. Students are presented with facts and information on how to help them learn. Specifically, they are taught that work is how your brain learns. If you work hard and practice skills, your brain builds new connections and learns the material. This is an important concept to internalize. As stated previously, task persistence, fluency and accuracy, diminishes as tasks become more difficult for students with EBD (Witt et al., 2004). If the internal dialogue in these students can be changed to realize that having to struggle through a problem to understand it is normal and helpful training your brain, then it should be a natural, socially valid progression for them to work harder and have greater task persistence.

Theoretical and Conceptual Framework

By teaching students about effort and to have greater persistence their overt behavior might be able to be changed as well. Crucial to this premise is that the intervention is developmentally appropriate. By teaching students a "how to think" framework for schoolwork or other situations and gives them a blueprint to come back to when they encounter academic or behavioral situations. This is in contrast to a "what to think" (Smith & Daunic, 2004, p.74) reference influenced by outside sources such as teachers (Daunic, Smith, Brank, & Penfield, 2006). In the early stages of development some youth might not be ready to learn "how to think", yet, if such learning can take

place in an interactive and visually stimulating way (Wasterfors, 2011), then perhaps this instruction and learning would be more developmentally appropriate, socially valid, and more effective. Dweck's program, *Brainology,* is computer-based, so not only it is supposed to teach youth "how to think" but is also visually stimulating and interactive through technology.

Over the last 20 years, various researchers have found computer-assisted instruction (CAI) to be an effective instructional addition for students with a variety of disabilities (Blood, Johnson, Ridenour, Simmons, & Crouch, 2011; Gillette & Depompei, 2008; Hecker, Burns, Elkind, Elkind, & Kartz, 2002). Yet, most of these CAI approaches have been used for self-instruction purposes such as helping students learn particular social skills and navigate specific job-related task or as an alternative to worksheets. Previous CAI has not attempted to change behavior through facilitating change in the way that students think; yet, CAI appears to have positive effects on students' ability to remain on-task and focused on academic tasks (Haydon, Hawkins, Denune, Kimener, McCoy, & Basham, 2012), perhaps because CAI offers a visual stimulating way of learning new material. By using CAI, the material can be presented vicariously through characters in a computer setting giving students an opportunity to develop a new metacognitive (thinking about their thinking) strategies (Smith & ERIC, 2002). Thus, Dweck's, *Brainology* may meet students at their developmental level to help them learn "how to think" by learning more about the ways in which their brain works.

Learning "how to think" helps students generalize their learning beyond the current situation, which is one of the primary problems with which students with EBD

struggle. With this *Brainology* program perhaps students with EBD would learn "how to think", think more about their own behavior, possibly demonstrate improved school behavior, and consequently access more academic instruction, but research concerning its effects is needed. See figure 2 for a schematic of the "what to think" and "how to think" approaches.

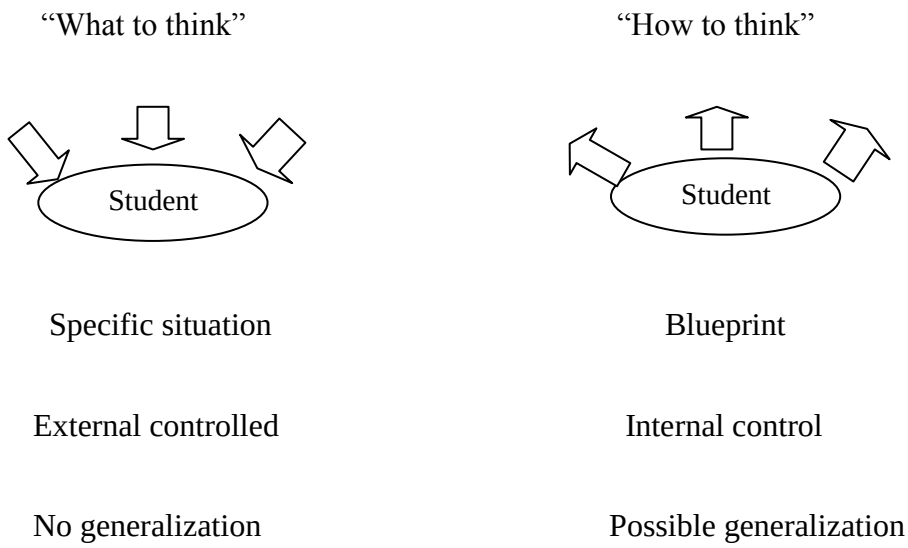

Figure 2. Thinking Approaches

One way to measure or quantify task persistence or effort for a student is to analyze the time on-task as a behavioral measure. Effort combined with time spent on-task is found throughout educational research (Johns, Crowley, & Guetzloe, 2008; Winn, Menlove, Zsiray, 1997). Time on-task is also referred to as academic time on-task (McDougall & Brady, 1995), time on-task (Locke & Fuchs, 1995), on- task behavior (Lee, Sugai & Horner, 1999; Sutherland, Wehby, & Copeland, 2000), academic

engagement (Callicott & Park, 2003), or student attention to task (Regan, Mastropieri, & Scruggs, 2005). Regardless of the name the goal is to measure the amount of time that the student spends on a task. Time on-task is correlated with higher levels of achievement (Johns et al., 2008). Given the behavioral difficulty of students with EBD and their academic performance challenges, as well as the correlation between time on-task (task persistence), behavior, and achievement, it seems that improving time on-task in this population is a very important endeavor.

Purpose and Research Questions

The purpose of this study was to investigate the use of the computer-based *Brainology* program on the behavioral and academic performance of students with EBD. This study was guided by the following three research questions.

1) What is the effect of *Brainology* on the behavioral performance of upper elementary school-aged students with EBD?
2) What is the effect of *Brainology* on the academic performance of upper elementary school-aged students with EBD?
3) To what degree do students and their teachers consider the *Brainology* program to be socially valid?

CHAPTER II: REVIEW OF THE LITERATURE

In the following sections, a review of the literature is presented. This literature review will: (a) provide a rationale for why time on-task (task persistence) is an important variable for study, (b) review the independent variables used to change time on-task for students with EBD, that have used time on-task as a dependent variable, (c) review the extent to which these studies also investigate the effects on academic performance, and (d) briefly review the literature pertaining to computer assisted instruction.

Synthesis of Literature: Time on-task for Students with EBD

A synthesis of the literature was conducted to examine the use of time on-task as a dependent variable for students with EBD. Studies were identified through a variety of search methods. First, an electronic search was conducted using Academic Search Complete, PsycINFO and ERIC with the following descriptors in different combinations: time on-task, emotional disturbance, behavior disorder, and task persistence to identify studies published between 1990-2013. Reference lists for similar syntheses and meta-analyses (Joseph & Eveleigh, 2011) were analyzed for articles that would fit the criteria of this synthesis. Studies were selected for inclusion if they met the following criteria:

(1) Participants were between the ages of 8 and 12

(2) Participants had a disability classification of ED (EBD, or SED) or data were disaggregated for students with ED.

(3) The intervention occurred in a school setting including alternative, private, residential and/or juvenile justice schools.

(4) Included time on-task as a dependent variable.

(5) Published in a peer-reviewed journal between 1990 and 2013.

6) Published in English to ensure understanding by the researcher.

7) Study was conducted in the United States school system since the academic rigor and inclusion aspects of NCLB is a propelling force in education for this population.

After reviewing over 300 references, 25 articles potentially fit the criteria. A more thorough review of these articles resulted in the removal of seven articles. The final pool of articles concerning time on-task as a dependent variable included a total of 17.

All studies were coded using a modified form of a coding sheet developed by Edmonds et al. (2009). The code sheet was used to organize the following essential information: (a) publication, (b) author, (c) date of publication, (d) description of participants and setting, (e) ED/BD diagnosis, (f) experimental design, (g) time on-task and definition, (h) other measures, (i) independent variable, (j) duration, (k) social validity, (l) interobserver agreement, (m) dependent measures, (n) treatment integrity, and (o) results. This coding sheet was completed as the studies were coded and double-coded to ensure that the correct information was collected. The following sections provide information pertaining to study design, participants, duration, independent variables employed, and dependent variables with a particular focus on independent and dependent variables.

All of the studies used single subject designs which were evaluated with visual analysis and percentage of non-overlapping data (PND). This procedure involves identifying the data points in intervention and/or post-intervention that are above the highest data point in the baseline condition. Calculation of PND requires counting the

total number of data points measured during the intervention or post-intervention phase that exceed the highest or lowest data point in the baseline phase (depending on the intended study outcome) and then dividing by the total number of data points in the intervention or post-intervention phase (Scruggs & Mastropieri, 1998). PND can be interpreted as follows: greater than 90% of PND means that the treatment can be considered a very effective treatment, 70% to 90% PND means that the treatment can be considered as mildly effective, 50% to 70% PND suggests very questionable treatment effects, and PND below 50% can be considered ineffective treatment (Scruggs & Mastropieri, 1998). PND was calculated for all measures that included a graph of the results or that provided data specific enough to calculate the PND.

Participants

There were a total of 63 participants across the 17 studies. More detailed information concerning the characteristics of the studies can be found in Table 1. Most of the participants were males with only four studies having female participants (Lee et al., 1999; Skinner, Hurst, Teeple, & Meadows, 2002; Sutherland, Alder, & Gunter, 2003; Sutherland et al., 2000). There were seven females and fifty-six males ranging from 5 to 14 years old. This total includes three boys below the target age of eight years old (Beck, Burns, & Lau 2009; McDougall & Brady, 1995) who were part of the studies and one study (Callicott, & Park, 2003) that listed the males from 10 to14 years old without disaggregating specific ages. Nine studies listed exact ages for their participants while eight studies listed a general age range that fit between the ages of 8 and 12.

Of the seventeen studies, eleven studies did not contain information about race while seven studies did include such information. Of those seven studies, there were fourteen Caucasians, twenty-two African Americans and one Hispanic. That was for a total of 37 of the students, which is 59% of the total participants which is 32 of the 56 males (57%) and five out of seven females (71%).

Only five studies included intelligence quotients for the participants. These scores ranged from 67-114 with only four studies giving exact IQ scores. For example, Locke and Fuchs (1995) reported that their participants had IQ scores of 75, 81, and 85. Blood, Johnson, Ridenour, Simmons, and Crouch (2011) only had one student with an 82 IQ. Alter (2012) listed scores of 67, 81, 88, and 68 for their participants. Miller, Gunter, Venn, Hummel, & Wiley (2003) indicated that their participants had IQ scores of 95, 105, and 114. One study listed a range of IQ scores for the participants of 78-92 (Nelson, Johnson, & Marchand-Martella, 1996).

Table 1

Study Characteristics

Author/Year	N	Race	Setting	Design	Duration
Alter (2012)	N=4 4-m 3-11 and 1-10	3-AA 1-Caucasians	alternative day school Midwestern city	Multiple baseline, intervention with self-management	16-18 sessions
Beck, Burns, & Lau (2009)	N=2 2-m 1-6 year old 1- 9 year old	1-Caucasians-1-AA	elementary school, general education or hallway for teaching	single subject multi element with alternating design	12 sessions

Table 1, cont.

Author/Year	N	Race	Setting	Design	Duration
Blood, Johnson, Ridenour, Simmons, & Crouch, (2011)	N=1 1-m 10 year old 5th grade	NS	special ed. class-math-public elementary, northern Illinois	single subject A-B-BC	16 sessions
Callicott, & Park (2003)	N=4 4-m between 10-14	NS	alternative day school-, Missouri , separate classroom	ABAB design	31-40 sessions
DePaepe, Shores, Jack, & Denny (1996)	N=2 2- m 12 year old , 9-year old	NS	self-contained primary class, extra school room-elementary and middle	ABAB design	23 sessions
Gulchak (2008)	N=1 8 year old m European-American	NS	public elementary, large city southwest79 % European and 29% free lunch, self-contained	single subject ABAB	19 sessions
Lee, Sugai, & Horner (1999)	N=2 2-m 9 year old 3rd grade	NS	special education class self-contained	ABA within subject reversal then CACACA or CACA	35 sessions 3-5 per week

Table 1, cont.

Author/Year	N	Race	Setting	Design	Duration
Levendoski, & Cartledge (2000)	N=4 4-m 9.10-11.6 10.5, 9.1, 11.6, 10.3	3-Caucasians 1-AA	self-contained class	ABABC	46 days, 9 weeks
Locke & Fuchs (1995)	N=3 3- m 11 year old- 5th grade	NS	urban-middle school-self-contained class	ABAB design	20 days
McDougall & Brady (1995)	N=3 3-m 5- years old 8 years old 7 years old	NS	summer school-adaptive behavior unit	multiple baseline across subjects-baseline/intervention	26 sessions
Miller, Gunter, Venn, Hummel, & Wiley (2003)	N= 3 3-m 9 -12 years old 2-5th grade 1-4th grade	NS	special day school- 1 was in 1/2 days in another school	study 1-witdrawal of treatment-ABACDCD study 2-multiple baseline	49 sessions
Nelson, Johnson, & Marchand-Martella (1996)	N=4 4-m 8-9 years-3rd grade-	AA-1 Caucasians-3	Washington state-self-contained-experimental class with 8 to 12 students without disabilities	alternating treatment design	18 sessions 6 of each instructional conditions

Table 1, cont..

Author/Year	N	Race	Setting	Design	Duration
Paramore, & Higbee (2005)	N=3 3-m- 9, 10, 11	NS	special education's office, and general education class math and reading	Baseline, alternating treatment with contingent preferences	32-34 sessions
Regan, Mastropieri, & Scruggs (2005)	N=5 1-f 4-m between 11-12 4-11 yr. m 1-12 yr. f	2- AA - males 1 Hispanic- Female 2- Caucasians- males	self-contained room, elementary school, diverse suburban county eastern US- PDS prof. dev. School.	multiple baseline across participants,	40 sessions
Skinner, Hurst, Teeple, & Meadows (2002)	N=4 9-11- 3 -f and 1-m	NS	self-contained school- Southeastern US-summer program	alternating treatment design	14 sessions
Sutherland, Alder, & Gunter (2003)	N=9 1-f, 8-m ages 8-12	1 girl-AA 7 boys- AA 1 boy Caucasians	self-contained- urban school southeastern US	ABAB design	daily 32 sessions

Table 1, cont.

Author/Year	N	Race	Setting	Design	Duration
Sutherland, Wehby, & Copeland (2000)	N=9 2- f 7- m from 10-11 years old	2 females-AA 4 boys - AA 3-Caucasians	middle school, large southeastern city -self-contained	ABAB design	3 times a week, 25 sessions

Note. Setting refers to type of school setting. N refers to number in the intervention; m refers to males, f refers to females. AA is African American. Duration refers to length of intervention. NS refers to not stated in the article.

Setting

Most of the studies (n = 11) occurred in the public school self-contained settings. Three studies took place in a special and/or alternative school (Alter, 2012; Callicott, & Park, 2003; Miller et al., 2003), two occurred in a general education setting (Beck et al., 2009; Paramore, & Higbee, 2005), and one in a special education class (Blood et al., 2011). Only three studies indicated economic status for their participants (Beck et al., 2009; Nelson et al., 1996; Sutherland et al., 2003).

Experimental Design

All 17 studies were single subject studies. There were three main types of design used with time on-task measures. There were four studies that used a baseline followed by an intervention (Alter, 2012; Blood et al., 2011; McDougall & Brady, 1995; Regan et al., 2005). Some researchers extended the interventions and added components to the intervention such as in the study by McDougall and Brady (1995) which contained additions of self-management training and visuals which they titled B_1, B_2, and B_3. There were nine studies that used some form of ABAB design with some adding additional

components that resulted in C and D phases (Lee, Sugai, & Horner, 1999; Miller et al., 2003). Four studies used an alternating treatment design (Beck et al., 2009; Nelson et al., 1996; Paramore, & Higbee, 2005; Skinner et al., 2002). See Table 1 for further details.

Overview of Qualifying Studies

The studies that used on-task measures as a dependent variable can be analyzed in terms of the independent variables that were employed. Six of the seventeen articles focused on behavioral interventions. The remaining eleven articles focused primarily on academic interventions. Three of the articles concerning behavioral intervention focused on changing the teacher's behavior (Sutherland et al., 2000; Sutherland et al., 2003) or classroom instruction (Nelson et al., 1996). Two focused on variations of self-monitoring (Blood et al., 2011; Gulchak, 2008) and the final article investigated preferred reinforcers (Paramore, & Higbee, 2005). Six articles concerned math activities (Alter, 2012; Callicott & Park, 2003; DePaepe, Shores, & Jack, 1996; Lee et al., 1999, Levendoski & Cartledge, 2000; Skinner et al., 2002) and examined the effects of the independent variable on time on-task. Two other articles researched reading (Beck & Burns, 2009; Locke & Fuchs, 1995) and writing (McDougall & Brady, 2001; Regan et al., 2005) interventions. Another article contained two studies with one having a math intervention and the second have a writing intervention (Miller et al., 2003). The following sections include more detailed information pertaining to the articles that were included in this review of the literature concerning on-task behavior (task persistence) as an outcome variable. See Table 2 for more information.

Table 2

Independent Variables and Other Measures

Author/Year	Independent variable	Academic Dependent Variable	Other Behavioral Measures	Dependent measures
Alter (2012)	laminated card with problem solving steps, token point card and praise- with reinforcers	1 percentage of problems correct daily, 2- problems on pretest -posttest measure	added self-management for Eric - did his own points after 15th session	time on-task and 2 academic
Beck, Burns, & Lau (2009)	Pre-taught words before reading time for 20 minutes using incremental rehearsal randomized baseline and treatment	none	none	
Blood, Johnson, Ridenour, Simmons, & Crouch (2011)	effects of (1) video modeling and (2) video modeling and self -monitoring- used two same age peers to demonstrate behavior with narration keep eyes on board, answer questions, open book, 4 minute length on IPOD touch before math lesson 5 minutes- use 2 min loop to monitor behavior during BC phase	none	measured with partial interval 15 sec. disruptive behavior occurrence-talking w/o permission, blurting, singing, profanity, teasing peers	1-time on-task 2-occurrence of disruptive behavior

Table 2, cont.

Author/Year	Independent variable	Academic Dependent Variable	Other Behavioral Measures	Dependent measures
Callicott, & Park (2003)	scripted lesson, reinforcers, Baseline-10 minutes, B1 gave him statement about his work , B2-intervention paired with speech for reinforcer increase of 15% b3-delaying reinforcement an hour, matched assignments to instructional level with increased difficulty	# of correct digits	self-directed speech (SDS) (audiotape) correspondance matched statement with performance exceeding baseline by at least 15%	1-correct and incorrect responses, 2-verbalization of SDS, 3-correspondance with SDS, 4-academic engagement,5- teacher behavior for script following= 100%
DePaepe, Shores, Jack, & Denny (1996)	easy- difficult sheets-praise every 3 min,	correct digits for problems	percentage of time in disruptive behavior-interrupt learning or is dangerous	1-disruptive behavior and 2- on-task behavior and 3-correct digit/errors

Table 2, cont.

Author/Year	Independent variable	Academic Dependent Variable	Other Behavioral Measures	Dependent measures
Gulchak (2008)	computer- chimed at 10 minute intervals for one hour during reading agreed with observer student had to agree with behavior definition report-graph using hand-held computer time and indicate on-task or not- during reading time	none	none	time on-task
Lee, Sugai, & Horner (1999)	10 minutes switch difficult and easy task after teach where the students were 85% successful with teacher with first set, 2nd set instructions same as before children assess answers upon completion with component skill instruction or not	percentage of correct math problems	percentage of intervals with problem behaviors- aggression, disruptive behavior,	1- intervals with problem behavior 2- off-task behavior 3- percent of correct math problems
Levendoski, & Cartledge (2000)	self-monitoring cards with beep every 10 minutes, "At this exact second am I doing my work?" yes or no Worksheets at students level with more problems than student usually finished by 20%	percentage of math problems completed correctly	none	time on-task 2- academic productivity

Table 2, cont.

Author/Year	Independent variable	Academic Dependent Variable	Other Behavioral Measures	Dependent measures
Locke & Fuchs (1995)	Peer Mediated Instruction - trained to identify and correct word recognition errors as they occurred. They were taught a script for missed words and praise for correct words taught how to be positive and encourage friends 4 day training. .Dyads for reading based on reading level and assigned book of appropriate difficulty timed the activity, monitored reading/retelling procedure. Groups given points for following procedures and later earned reinforcers.	none	social interaction (SI) positive interaction smile, pat, verbal rotating boys with / if a positive interaction on form	1-on-task, 2- social interaction

Table 2, cont.

Author/Year	Independent variable	Academic Dependent Variable	Other Behavioral Measures	Dependent measures
McDougall & Brady (1995)	8- min. study period during spelling class baseline- audio cued self-monitoring- "Am I using the hand method to study?" with form and cassette player- pencil, verbal, tape- initial acquisition task- Bobby more behavioral instruction session 16-18 and Picture of pencil on desk and verbal cues. Then specific verbal reminder on tape for Bobby session 24	spelling orally for teacher- percentage of words spelled orally correctly- generalization probes every fourth session written spelling 8 of 26 sessions-	none	1-time on-task 2- spelling acquisition
Miller, Gunter, Venn, Hummel, & Wiley (2003)	2 studies in one article-1 nonfunctional writing, then functional writing, then nonfunctional with model next functional with a model 2- Long math assignment packet of five sheets, short math assignments but half the problems 1/2 sheet they could trade for another whether finished or not and then short with models	Study 1-correct academic responses for writing- capitalized beginning, proper noun, punctuation ending, subject - verb-Study 2- correct digit in each column	none	2 studies- time on-task 2- academic measure- math and writing

Table 2, cont.

Author/Year	Independent variable	Academic Dependent Variable	Other Behavioral Measures	Dependent measures
Nelson, Johnson, & Marchand-Martella (1996)	Participants exposed to 3 different conditions - direct instruction (scripted), Cooperative (group work), Independent (individualized folders) in randomized order each session lasting 30 minutes	none	disruptive behavior- physical aggression, verbal aggression, playing with objects, non-academic tasks, off topic verbalization	1-on-task 2- disruptive behavior
Paramore, & Higbee (2005)	Using information from a brief MSWO preference assessment- edible stimuli high, medium, low offered before each session in a semi-random order earned stimuli based on three consecutive observations of on-task behavior	none	none	On-task

Table 2. cont.

Author/Year	Independent variable	Academic Dependent Variable	Other Behavioral Measures	Dependent measures
Regan, Mastropieri, & Scruggs (2005)	dialogue journal (guidelines) - focus on social and behavioral difficulty list of expectation and examples both phases they were told "You should be focusing on your journal." wrote and turned it in when students started new topics- teacher engaged but redirected to targeted behaviors	Length - number of words. Quality- Likert scale of 1 lowest to 8 for highest	none	1-attention while writing,2-length, 3-quality 4- student survey
Skinner, Hurst, Teeple, & Meadows (2002)	review skills, constructed 4 controlled assignment- 2 controlled and 2 experimental- same problems but really easy ones interspersed	comparing controlled versus experimental assignments- total problems worked	none	On-task
Sutherland, Alder, & Gunter (2003)	increased OTR during intervention- researcher met with teacher, set goals graph data- taught to graph his rate of OTR rate daily- feedback after each lesson- withdrawal no feedback, did get teachers graph- resumed feedback and graphs from baseline data	correct response- math	disruptive behavior- student call out, out of seat tapping pencil	1- Opportunities to respond (OTR) 2- praise 3- correct responses 4- disruptive behavior 5- on-task behavior

Table 2, cont.

Author/Year	Independent variable	Academic Dependent Variable	Other Behavioral Measures	Dependent measures
Sutherland, Wehby, & Copeland (2000)	Coaching the teacher with verbal feedback on BSPS after each lesson, the teacher set goals for each lesson set goal for lessons and provided feedback after each lesson.	none	none	1-non behavior specific praise 2-behavior specific praise 3 – on-task

Independent Variables with a Behavioral Focus

Blood, Johnson, Ridenour, Simmons, & Crouch (2011) used a single subject A-B-BC design. There was only one student, a 5th grade male with EBD who attended a public elementary school. This study took place in the special education class. The study focused on improving on-task behavior and disruptive behavior utilizing video-modeling for the first intervention and the second intervention was combining video modeling and self-monitoring. The video modeling used two peer aged modeling with instruction. He watched it right before math class every day and then in the second part he used a self-monitoring sheet using a timer on the IPod. There were a total of 16 sessions. The PND was 100% for on-task behavior and 100% for disruptive behavior.

Gulchak (2008) used a single subject ABAB withdrawal design. There was one 8-year old Caucasian student with an EBD in a public elementary school setting. The behavior intervention took place in a self-contained class during reading time using a self-monitoring program on a hand held computer device. Using computer generated tones from the handheld computer the student indicated whether he was on-task or not at

that moment. This was the only measure in this study. The article suggested an overall mean increase in on-task behavior; however, examination of the graph and calculation of PND revealed PND of 0% for on-task behavior.

Paramore & Higbee (2005) used an alternating treatment with contingent preferences. There were three male students ranging from age from 9 to 11 years of age with EBD. The students were given a brief multiple-stimulus-without-replacement (MSWO) for high, medium and low edible preferences in a special education office. Then these preferences were examined using an alternating treatment design with an on-task behavior as a dependent measure. The high preference item chosen by the boys during the MSWO produced the greatest time on-task data for all three students. The PND for the highest preference item was 100% for all three students. It was also 100% for the medium preference for two of the students. The other student yielded a PND of 88% for medium preference. For low preference, two of the students still yielded a preference of PND 89% and 88%.

Nelson, Johnson, & Marchand-Martella (1996) used an alternating treatment design by manipulating classroom instruction. There were four male students ranging in age from 8 to 9 in 3rd grade with EBD. The study took place in a self-contained experimental class with these students and eight to twelve students without disabilities. The intervention used three different instructional settings where on-task behavior was a dependent measure. There were 18 sessions evaluated using six 30- minute sessions of direct instruction (DI), cooperative learning (CL), and independent learning (IL). The

highest average for on-task behavior was in the DI condition (M = 92.5%), CL was the second highest (M = 80.4%), and the lowest average was IL (M= 79.3%).

The next two studies studied on-task behavior and other measures by changing teacher behavior. Both studies had the same lead researcher. Both studies (Sutherland, Wehby, & Copeland, 2000; Sutherland, Alder, & Gunter, 2003) used an ABAB designs in a self-contained class in a large school in a southeastern city. Both studies included nine students with EBD. Sutherland et al. (2000) included two African American females and seven males, four African Americans and three Caucasians, who ranged in age from 8 to 12 years old across 25 sessions while Sutherland et al. (2003) included one African American female and eight males, seven African Americans and one Caucasian across 32 daily sessions.

Both studies used teacher coaching in an attempt to change the student's on-task behavior. Sutherland et al. (2000) coached the teachers in the value of behavior specific praise. The teacher set a behavior specific praise goal for each lesson, and met with researcher after the lesson for feedback. One of the three dependent variables included in this study was on-task behavior which evidenced a PND 83%. Sutherland et al. (2003) coached the teachers in Opportunities to Respond (OTR), asked the teacher to set a goal for the coming lesson, took OTR data during the lesson then provided the OTR information, graphed the data and gave feedback after the lesson. On-task behavior was one of the five dependent variables included in this study where PND was found to be 76%.

Independent Variables with an Academic Focus

Math. There were six studies that combined a math intervention with an on-task measure. Alter (2012) used a multiple baseline intervention across participants design with a self-management component. There were four males with EBD, three 11 year olds and one 10 year old. There were three African Americans and one Caucasians. The study took place in an alternative day school in a Midwestern city. Time on-task was one of the three dependent variables. The intervention included using a laminated card with problem solving steps, a token point card, and praise- with points given for each step used correctly then the points were exchanged for reinforcers at the end of each lesson. The four students had PNDs of 100%, 78%, 60% and 100% for percentage of problems correct and PNDs of 0% (two students), 56%, and 40% for on-task behavior two students had a PND of 0%, one had 56% and the last had a PND of 40%.

Callicott & Park (2003) used an ABAB withdrawal design with four students with EBD with a range of ages from 10 to 14 years. The study occurred in an alternative day school in Missouri in a separate classroom over 31 to 40 sessions. The intervention used math worksheets matched to each student's instructional level. There were three phases to the intervention- B1 was requesting the student to make a statement aloud about his fast and accurate performance on the worksheet (SDS) using a script, B2 paired the SDS with reinforcement when the statement corresponded with an improvement of 15% academically, and then B3 attempted to establish maintenance by delaying reinforcement by an hour. There were four measures for this study-correct math responses (PND for students 0%, 6%, 38% and 27%), student's verbalizations of SDS (improvement for all

students and effective for all but one), correspondence with SDS (students corresponded in 14/15, 13/17, 15/16 and 3/16 sessions), academic engagement (all four had a PND of 0%), and teacher behavior for script following (100% for 20% of sessions).

DePaepe, Shores, Jack, and Denny (1996) used an ABAB design to alternate easy and difficult worksheets that were designed specifically for the two male students with EBD who were 9 and 12 years old. The study took place in a self-contained primary class in an extra school room for 23 sessions. During each academic session praise was given on a fixed interval schedule every 3 minutes. On-task and disruptive behavior were measured during easy and difficult activities. For on-task behavior PND was 25% and 36% and disruptive behavior had PND of 55%, and 9%. A third measure was correct digits in the math problems one student averaged 0.3 for the easy and 0.5 for the difficult and the other student averaged .23 for easy and .45 for the difficult problems.

Lee, Sugai, & Horner (1999) used an ABA within subject reversal then CACA for 35 sessions with 3 to 5 sessions per week. The study was completed with two male students diagnosed with EBD. Both were 9 years old and in the third grade. The intervention took place in a special education self-contained class. Students' abilities were determined and worksheets were created for the two students. The tasks presented were difficult, easy, difficult, then addition instruction, worksheets, subtraction instruction, worksheets, and discrimination training. The measures compared difficult to easy for on-task (PND 87% and 63%), answers correct (PND 100% and 100%), and problem behaviors (PND 62% and 0%).

Levendoski & Cartledge (2000) used an ABABC design with 4 male students with EBD. Three of them were Caucasian and one was African American, and they ranged in age from 9 to 11 years old. The intervention was completed in a self-contained class for 46 days. Worksheets were designed for the student's instructional level and self-monitoring cards with their names and the statement, "At this exact second am I doing my work?" with a no and yes for responses were developed. During intervention, self-monitoring cards were distributed and a timer signaled the end of every 10-minute period, which served as a reminder for teachers to mark behavior on the appropriate card. The final phase was a fading procedure fading out the supports. Two dependent variables served as measures of effect, time on-task (PND 100% for all students) and academic productivity (PND 15%, 70%, 0%, and 58%).

Skinner, Hurst, Teeple, & Meadows (2002) used an alternating treatment design for 14 sessions to study the effects of controlled worksheets on students' behavior. Four students, three females and one male with EBD between the ages of 9 and 11, were included in the study. The study took place in a self-contained school in a summer program. Researchers created four sets of controlled worksheets. Two were controlled with basic problems and two were experimental with very simple problems interspersed with the same problems from the controlled sheets. The only measure was on-task behavior for this study comparing the two conditions. PNDs for the four students were 86%, 29%, 80% and 14%. See Table 1 and 2 for more information.

Writing. McDougall & Brady (1995) used a multiple baseline across subject design with baseline and intervention. The study was completed with three male students with EBD. Their ages were 5, 7, and 8 years old. The study was completed in a summer school program in an adaptive behavior unit setting. The intervention required use of a self-monitoring form during spelling. Word lists were designed to make sure the student was in an initial acquisition stage with the words that they were learning. The self-monitoring program used an audio-cued program with cassette players and headphones. In addition to the self-monitoring component, two additional intervention components were implemented to improve the intervention. For example, one student's on-task scores were not as high as the other two students therefore the researcher conducted a specific training of verbal instructions, modeling, and practice to modify this behavior and a visual aid was placed on the desk. There were two measures used for this study: academic time on-task and spelling acquisition. The results for spelling acquisition were PND of 0% for one student and 6% for the other two students. For on-task behavior the PND was 31%, 64% and 0%.

Regan, Mastropieri, and Scruggs (2005) conducted their study with five participants with EBD. The one 12 year old female student was Hispanic. Four 11 year old males (two African Americans and two Caucasians) were the remaining students. The study took place over 40 sessions in an elementary school self-contained classroom. The design was a multiple baseline design across participants. The intervention for writing consisted of use of a dialogue journal. The journal was used as a dialogue between the student and teacher about targeted behaviors. If the student went off topic, the teacher

engaged but returned to the targeted behavior dialogue. Three measures were used in this study: time on-task (PND 81%, 10%, 100%, 14% and 0%), length of writing (PND 0%, 0%, 14%, 35% and 100%), and quality of writing (PND 0%, 0%, 0%, 35%, and 44%).

Reading. There were only two studies that used time on-task as a dependent variable to evaluate reading interventions since 1990 until the present. Beck, Burns, and Lau (2009) used a single subject multi-element alternating design. The study was implemented with one 6 year old Caucasian boy with a BD diagnosis and one 9 year old African American boy with a BD diagnosis. The intervention was applied two to three times per week with one session per day for 12 to 14 sessions. The intervention included pre-teaching words or letter sounds using incremental rehearsal prior to the lesson. For both boys, this teaching took place in the hallway for 15-20 minutes prior to the whole class reading lesson. Time on-task was measured in the regular classroom. For time on-task PND for the 6 year old was 88% while the PND for the 9 year old was 100%. There was no reading measure only time on-task.

The other reading study (Locke & Fuchs, 1995) utilized an ABAB withdrawal design with three male students in the 5th grade who were 11 years old with SED. The study took place in an urban middle school in a self-contained class over 20 days.

The students were taught for four days how to use Peer Mediated Instruction and how to be positive and encouraging friends. A chart was also designed for motivation where each paired reading dyad received points based on following correct procedures. The students were paired in dyads according to reading level and given reading material at the appropriate level for their dyad. The two measures were on-task behavior and

positive comments. The PND for on-task behavior was 90%, 78% and 74% while the PND for positive comments was 13%, 88% and 64%.

Combination. Miller, Gunter, Venn, Hummel, & Wiley (2003) put two studies in one article with a math and writing focus. Each study used an academic and an on-task dependent measure. Both studies included the same three students who were males with EBD between the ages of 9 and 12 years old, two fifth graders and one fourth grader. The study was conducted in a self-contained special day school.

The math study used a multiple baseline across students for up to 48 sessions. The researchers compared on-task behavior and rates of correct responses between long and shortened math assignments and then finally with shortened assignments with models from baseline to intervention phases. The PND for the three students on correct responses per minute were 13%, 12%, and 32%. For on-task behaviors the students' PNDs were 35%, 18%, and 32%.

The writing study also utilized the same three students as the math study and examined a writing intervention with a with an ABACDCD design. The independent variable worked on facilitating student's nonfunctional writing (writing to prompts) and functional (writing to a soldier) writing. Then nonfunctional writing with model was compared to the functional writing with a model. The intervention consisted of the students writing to random prompts for nonfunctional writing and writing to a soldier overseas for the functional writing. The intervention then was modified to give a model for both the nonfunctional and functional writing prompts to see if there was a difference

in the outcomes. One dependent variable was the frequency of correct responses (capitalization, punctuation, and subject and verb agreement) in writing per minute comparing nonfunctional in both conditions to functional writing in both conditions. The results were PND 0%, 5%, and 7%. The other measure used was time on-task comparing nonfunctional in both conditions to functional writing in both conditions. The result for all three students was PND 0%. Refer to Table 3 for further information.

Table 3

Results of the studies

Type of intervention	Author/ Year	Time on-Task Results	Other Results
Behavior-Individual	Blood, Johnson, Ridenour, Simmons, & Crouch (2011)	PND of 100%	disruptive behavior PND 100%
Behavior - Individual	Gulchak (2008)	PND 0%	none
Behavior - Individual	Paramore, & Higbee (2005)	High all 3-PND 100% Medium 100%, 100%, 88%, Low 89% and 89%	none
Behavior – Instruction	Nelson, Johnson, & Marchand-Martella (1996)	DI M=92.5% CL M=80.4% and IL M=79.3%	Disruptive behavior- DI-M=8.7%, CL- M=20.4%, and IL M= 21.6%.
Behavior - Teacher	Sutherland, Alder, & Gunter (2003)	PND 76%	OTR data (PND 76%), praise data (no graph), correct responses (PND 0%), disruptive behavior (PND 0%),

Table 3, cont.

Type of intervention	Author/ Year	Time on-Task Results	Other Results
Behavior - Teacher	Sutherland, Wehby, & Copeland (2000)	PND 83%	Non-specific behavior praise- PND 0%, behavior speak praise PND- 0%,
Academic-Math	Alter (2012)	two students had a PND of 0%, one had 56% and the last had a PND of 40%.	PNDs of 100%, 78%, 60% and 100% for percentage of problems correct. The pretest –posttest measure, two students + 50% and the other + 10%. - 20%.
Academic-Math	DePaepe, Shores, Jack, & Denny (1996)	PND 25% and 36%	Disruptive behavior PND 55%, and 9% correct digits in the math problems averaged .3 for the easy and .5 for the difficult- the other student averaged .23 for easy and .45 for the difficult problems.
Academic – Math	Callicott, & Park (2003)	all four had a PND of 0%	Correct math responses (PND 0%, 6%, 38% and 27%), student's verbalizations of SDS (improvement for all students and effective for all but one), correspondence with SDS(students corresponded in 14/15, 13/17, 15/16 and 3/16 sessions)
Academic – Math	Lee, Sugai, & Horner (1999)	PND 87% and 63%	Correct answers (PND 100% and 100%), and problem behaviors (PND 62% and 0%).
Academic – Math	Levendoski, & Cartledge (2000)	PND of 100% for all 4 students	Academic productivity (PND 15%, 70%, 0%, and 58%)

Table 3, cont.

Type of intervention	Author/ Year	Time on-Task Results	Other Results
Academic – Math	Skinner, Hurst, Teeple, Meadows (2002)	the PNDs were 86%, 29%, 80% and 14%	none
Academic - Math and Writing	Miller, Gunter, Venn, Hummel, & Wiley (2003)	Math- PND 35%, 18% and 32%. Writing- PND 0% for all three	Math- correct responses per minute PND-13%, 12% and 32% Writing- responses per minute PND 0%, 5% and 7%
Academic - Reading	Beck, Burns, & Lau (2009)	9 year old- PND 100%	none
Academic - Reading	Locke & Fuchs (1995)	PND 90%, 78% and 74%	Positive comments were PND 13%, 88% and 64%.
Academic - Writing	McDougall & Brady (1995)	PND was 64%	Academic tasks was PND of 0%
Academic - Writing	Regan, Mastropieri, & Scruggs (2005)	PND 81%, 10%, 100%, 14% and 0%	Length of writing (PND 0%, 0%, 14%, 35% and 100%) and quality of writing (PND 0%, 0%, 0%, 35%, and 44%).

Summary

These seventeen studies widely varied in the independent variables employed but all utilized on-task behavior as a primary dependent measure. Four studies used it as their only measure two with behavioral interventions (Gulchak, 2008; Paramore & Higbee, 2005) and two with academic interventions (Beck & Burns, 2009; Skinner et al., 2002). See Table 3 for further details.

Overall, the interventions found to be effective for increasing student time on-task (task persistence) included using iPods for self-monitoring (Blood et al., 2011) or changing teacher behavior either through OTR (Sutherland et al., 2003) or behavior specific praise (Sutherland et al., 2000). Paramore and Higbee showed that using a preferred reinforcer for students is highly effective for on-task behavior too. Interventions that show an effect for math are easier tasks (Lee et al., 1999), self-monitoring cards with instructionally appropriate worksheets (Levendoski & Cartledge, 2000), and experimental worksheets with very easy problems interspersed among grade level problems (Skinner et al., 2002). Both strategies used in the reading interventions were shown to be effective; these included pre-teaching (Beck & Burns, 2009) and peer-mediated instruction (Locke & Fuchs, 1995) for on-task behavior.

Impact of Time On-Task Increases on Academic Achievement

Of the eleven academic studies, eight of them had an academic measure in addition to the time on-task measure. Skinner et al. (2002), Beck and Burns (2009), and Locke and Fuchs (1995) did not have an academic measure. In the remaining eight with an academic measure only two had PNDs over 60% and they were both math interventions, Alter (2012) used a laminated study sheet and token point card. The students in the Lee et al. (1999) study alternated difficult and easy sheets. Overall, there is limited evidence in these articles that on-task behavior leads to greater academic achievement as academic results demonstrated significant variability across subject areas. However, it was promising that researchers are considering the effect of behavioral

interventions on academic performance and the effect of academic interventions on behavior such as time on-task (task persistence).

Computer Assisted Instruction for Students with EBD

As stated earlier, Dr. Carol Dweck, a psychologist, has developed a theory of learning (Dweck, 1999; Dweck & Leggett, 1988; Blackwell et al., 2007) that assigns attitudes toward learning to either a fixed mindset or a growth mindset. Dweck's mindset theory has been applied to a computer instruction program called *Brainology.* Dweck's theory is that through teaching students about their brain combined with study skills these students become motivated, engaged, and subsequently achieve.

Prior to using this computer-based intervention with this population, a cursory search on the journal databases – Academic Search Complete, PsycINFO and ERIC – was completed to answer the question of -What interventions have been completed with students in the 8 to 12 age range using the computer for part of or all of the instruction in a given area? This search from 2006 to present yielded nineteen results for computer assisted instruction. The majority of these studies addressed students with disability classifications other than EBD (e.g., Bottge, Rueda, Serlin, Ya-Hui & Jung, 2007; Hammond, Whately Ayres & Gast, 2010; Kim et al., 2006). One study was found which addressed students with EBD (Blood et al., 2011) in which the researchers used an iPod to increase self-monitoring behaviors. This study is referenced in the time on-task section of this chapter and revealed that it resulted in a PND of 100% for on-task behavior. This dissertation study is expected to add to the extant literature by examining the effect of

Brainology, a computer-based instructional program, on the academic and behavioral performance of students with EBD.

CHAPTER III: METHOD

Overview

Students with EBD experience some of the most pejorative outcomes of any disability group—suspension, expulsion, failure, retention, school dropout, unemployment and incarceration (Wagner et al., 2004). Interventions to facilitate the academic and behavioral growth of students with EBD are sorely needed. School-based intervention research concerning these domains for this population typically concerns various behavioral management practices as well as academic instructional procedures to some extent as was examined on a small scale through the previous chapter and examination of studies that have utilized on-task as a measure for both academic and behavioral studies. This dissertation study examined the effect of a computer-based program called *Brainology on* the behavioral and academic skills of students with EBD in order to add to the extant literature concerning interventions for students with EBD. This study was guided by the following three research questions.

1) What was the effect of *Brainology* on the behavioral performance of upper elementary school-aged students with EBD?
2) What was the effect of *Brainology* on the academic performance of upper elementary school-aged students with EBD?
3) To what degree do students and their teachers consider the *Brainology* program to be socially valid?

Design

A single-subject, concurrent multiple baseline design across students was used in order to examine the effects of *Brainology* on the on-task behavior, academic performance, and academic task persistence of participating students. Single-subject designs rely on the individual to serve as their own control. When researchers use single subject designs they compare each participant's baseline data to data in other phases, within the same participant, such as in the intervention phase. By making these comparisons between baseline and other phases the researcher attempts to understand changes that occur as a function of the intervention that has been implemented (Horner et al., 2005). Repeated measurements of baseline data allowed for the establishment of a trend before implementation of an intervention. More information concerning data collection, dependent variables, and data analysis will be presented later in this chapter.

A concurrent, multiple baseline design was appropriate for this dissertation study as the participants were learning new skills, which would make it impossible for participants to return to baseline levels of performance (Kennedy, 2005, Chapter 14). When such learning cannot be reversed a concurrent, multiple baseline design is viewed as an appropriate procedure for examining experimental effect (Gay & Airasian, 2000). When determining the presence of a functional relationship in a multiple baseline design the following characteristics must exist: (1) a stable baseline, (2) a change in dependent variable only upon introduction of the independent variable, (3) stability in other baseline phases upon introduction of the independent variable to other participants, and (4)

replication of experimental effects when the independent variable is introduced to additional study participants.

Setting

The study took place in a large urban district in the southwestern United States. The district serves over 66,000 students. The general socioeconomics of the area was low to middle class. One public elementary school campus served as the study site. The enrollment at this school was almost 850 students ranging from K-5th grades. The school was culturally and linguistically diverse with a population close to 60% Hispanic, 28% Caucasian, 8% African American and 2% Asian. The intervention was implemented in a separate empty classroom using a school laptop. Observational data were collected during the students' math periods, which took place in the general education classrooms. The general education classrooms contained approximately 20 - 23 students with one classroom teacher. The classrooms were set up with each student sitting at their own desks. Some students were in groups of two while other desks were by themselves. Two students participating in this study always sat in an area by themselves at the back or side of the classroom. The third student sat with one other student for part of the study and by himself for the rest of the observations. For this study, observational data were collected during the students' mathematics periods. During these periods activities included instruction, guided practice, and/or independent practice. These activities required students to be actively listening, copying problems, orally respond to questions as called on, work in groups, and/or sit at their desk, and to work independently on a given task for 15 minutes or more.

Participants

Students. The students were selected from the population of elementary school students with an EBD classification. Students' EBD classifications were based on school district guidelines for identification and were recorded as such in their Individualized Education Programs (IEPs). In order to qualify for special education service and receive the EBD classification, the student's behavioral problems must impact academic performance. The students who participated in this study were all included in the general education elementary school classroom for the majority of their school days; however, each spent one to two periods per day in the special education resource room for social skills instruction and/or academic reinforcement. All students received traditional social skills lessons provided on a weekly basis as part of their curriculum. A total of four students were reviewed to participate in this study. One student's baseline data were indicated 100% on-task behavior for two observations. Since there was no room for improvement in the on-task measure the researcher decided not to include this student in the current study.

The three students selected all had average intelligence. Bobby and Kelly spent 80% of their day in general education while Daisy spent an average of 50% to 70% of her day in general education. As noted in Table 6, Bobby and Kelly also have diagnoses of Specific Learning Disability (SLD). Bobby qualified for special education under two disability categories, SLD and EBD in the last year. Kelly qualified under SLD and EBD two years ago. Daisy has been qualified as EBD for one and one-half years. Bobby's academic performance is affected in all areas of reading and written expression while

Kelly's academic performance is impacted in reading and math computation. Daisy's academic performance is only impacted by her behavior. She is on grade level in all subjects and above grade level in reading. School records for all three students indicate that off-task behaviors interfere with learning. See table 4 for a summary of participants' characteristics.

Table 4

Student Participants' Characteristics

Pseudonym	Sex	Age	Ethnicity	Eligibility	Free Lunch
Bobby	Male	10	White	SLD, ED	no
Kelly	Female	10	African American	SLD, ED	no
Daisy	Female	9	White	SLD, ED	no

Note. SLD refers to the federal disability category of Specific Learning Disability and ED refers to the disability category of Emotional Disturbance.

Teacher participants. The students' general education classroom teachers were participants in this study for the purposes of social validity. They also filled out the before and after rating scales for behaviors. Each student was in a different classroom. Bobby's fourth grade teacher has been teaching for 12 years and has extensive experience with special education students especially students with behavioral difficulties both diagnosed and undiagnosed. Kelly's teacher has been teaching 15 years. She is not as experienced with special education students. Daisy's third grade teacher has been teaching about 15 years and also has extensive experiences with students with disabilities. All three teachers were very cooperative and easy to work with during the

study. They all exhibit great class management skills and have effective teaching strategies in place.

The author of this dissertation also participated in the study as the special education resource room teacher who implemented the computer-based program with each student participant. She has been teaching for 16 years and has extensive experience in working in the classroom with students with special needs. She has worked primarily with upper elementary grades during those 16 years of experience.

Procedures

Baseline phase

After students returned their consent and assent forms, baseline data were gathered concerning each participant's behavior and academics. The students' math classes served as the data collection sites. All three teachers utilized a gradual release teaching method with whole group instruction, modeled instruction, guided practice (completing problems together), and then independent practice. The observations of behavior typically took place during whole group instruction and modeled instruction portion of the day's math lesson. Baseline data was recorded for Bobby every two to three days initially to establish his baseline. Intervention began when a baseline trend was established for the first student. This meant that the trend demonstrated that either the on-task behavior or academic task completion were becoming worse or that they were not improving to meet expectations across three or more observation sessions. After a baseline was established, the intervention began for Bobby. The other two participants continued to be observed in the baseline phase and their behavior continued to be

recorded once a week throughout the study. After all four lessons were completed and Kelly began the intervention during week 5. This pattern continued with Daisy commencing intervention when Kelly had completed lesson 4 which was during week 8.

Intervention Phase

Each student began the intervention phase by completing a brief introduction to the components of *Brainology* and lesson 1 of *Brainology.* The subsequent lessons were completed at a rate of one per week. *Brainology*, a computer program was used as the intervention. This program was developed by Dr. Carol Dweck based on her Growth Mindset Theory (Dweck, 2006). The program has been used successfully with general education students in a middle school setting (Blackwell et al., 2007; Mueller & Dweck, 1998) and could be a useful intervention tool for students with EBD at the appropriate developmental level.

The lessons were implemented in the special education classroom and/or a separate classroom depending on availability. The program was online and easily accessed through an internet connection. The first lesson consisted of a 10-minute introduction to the program and proceeded to lesson one on brain basics. One day per week the researcher showed the student how to sign on and observed the student working through lesson one and then subsequent lessons during this block of time. Students were permitted to move through the lessons at their own pace. For some students this meant that they stayed on pages that interested them such that some activities were completed repeatedly. Embedded within the program were journal activities. The students were asked to comment on sections that they had just finished watching. Since Bobby and

Kelly's SLDs affected their ability to read the questions given by *Brainology*, the questions were read for them. The researcher also acted as a scribe for them due to their disabilities that affected their written language output. When the researcher acted as a scribe the students would dictate the response that they wanted to enter. The researcher would type the student's precise words and then read them back to the students for verification. Daisy did not need this assistance because her reading and writing level were appropriate for the requirements of *Brainology* and her instructional level was higher than that of the other two students. The information in *Brainology* was primarily presented in a cartoon format.

The program consisted of four lessons presented on the computer as a "Brain Master" challenge. The students mastered each level to attain the next level. The set amount of time used by the student each lesson was from 30 to 45 minutes per lesson. Each lesson was completed in one session. All lessons were able to be completed in one sitting for each of the intervention sessions. One lesson was completed for each student each week. The student had access to return to any lesson and review during the week as he or she had time or wanted to since it was available in the classroom that they attended daily. Provided that the students had an internet connection at home, they could also access program at home as well. The lessons addressed both how the brain learns and how emotions influenced the brain.

Through these lessons the students learned a variety of information concerning the way the brain processes information and how various strategies might help them

make more appropriate choices. See Table 5 for a summary of the *Brainology* unit features.

Table 5.

Brainology Lessons

Introduction	Unit 1: Brain Basics	Unit 2: Brain Behavior	Unit 3: Brain Building	Unit 4: Brain Boosters
What is the curriculum and its purpose	"Brain Basics" which includes the basics of brain structure and function	How the brain functions	How learning changes the brain- the key to the growth mindset	Memory- how it works?
How to use *Brainology*	How to maintain readiness to learn	How learning and emotions influence the brain	Intelligences can be developed through mental exercise	Study strategies to capitalize on the way the brain works, learns and remembers
	How attention and concentration are supported	Strategies for managing their negative emotions and enhancing the positive ones	What sorts of activities promote learning	How to apply *Brainology* study skills to the schoolwork

(http://www.brainology.us/program/structure.aspx)

Using a computer program allowed standardization of presentation and implementation for the intervention phase of the multiple baseline design. The intervention required four weeks to implement with each student.

Post-intervention phase

After each student completed the program, post intervention data were collected. These data were collected using direct observations of students in math class throughout the remaining weeks as the other students began and completed the intervention. This dependent variable and the data collection methods are described in detail in the measures section. During the post-intervention phase no additional teaching or use of the *Brainology* program took place.

Fidelity of implementation

Fidelity of implementation was measured continuously during the intervention. The intervention was monitored by feedback within the *Brainology* system. The researcher kept a treatment protocol of when the intervention began and qualitative notes about the student during each session. This data and the data from the *Brainology* program were compared for fidelity of treatment information. Please see Appendix D for a sample Fidelity of Implementation (Treatment Protocol) form.

Measures

There were a total of seven measures used in this study. Three measures were used in order to evaluate question one about behavioral changes. Two to evaluate academics and an additional two were used to evaluate behaviors associated with learning, effort, and task persistence.

Time on-task. Time on-task data were collected using a computer program that was able to record on and off task behaviors in real time. The computer program provides instant data. The computer program enables the observer to measure the duration of the behavior by pressing a letter on the keyboard. For these observations, "f" was pressed when the student was off task and "o" was pressed when the student was on-task. The behaviors were continuously noted as on or off task for 10-minute sessions or a total of 600 seconds. The computer program was able to divide and calculate the number of seconds on-task compared with the number of seconds off task. The computer provided the percentage of on-task behaviors using another program called an instant analyzer. On-task was defined as (a) eyes on the teacher, task materials, or other speaker in the class, and (b) the student completed work as instructed by the teacher during the interval being recorded. The student did not receive credit for the interval if the student was asked to leave because of problem behavior. Extra movement such as fidgeting or moving around was not counted as long as the attention remained focused on the teacher or the task.

Emotional and Behavioral Problem Survey-2 (EBPS-2). The Emotional and Behavioral Problem Survey-2 was used to evaluate a child's problem behaviors and competencies with home and school versions. According to the EBPS-2 manual, scale standardization was based on a nationally representative sample (Hawthorne, 2012). The EBPS-2 allows for the collection of varying perspectives concerning a child's behavior from parents, and teachers. This instrument can also be used to measure a change in behavior over time or following a treatment which was the purpose in this study. The EBPS-2 was provided to parents and teachers for completion. The school version

included 58 Likert-scale items and took approximately 15 minutes to complete using a paper and pencil format. The subtests for both the home version and school vision include a theoretical interpretation of learning problems, interpersonal relations, inappropriate behavior, unhappiness /depression and physical symptoms/fears. The measure also has a secondary set of empirical interpretations using the same data with the following five subscales: social aggression /conduct disorder, social/emotional withdrawal/depression, learning /comprehension, avoidance/unresponsiveness and aggressive/self-destructive. Internal consistency of the EBPS-2 school version exceeded .74 for each subscale. The test-retest reliability correlation coefficient was .85 for the total score. The survey was used to provide a pre-test baseline behavioral measure from the special education teacher, the general education teacher, and the parent. The same measure was also administered at post-test to detect any differences in student performance from these perspectives.

Academic grades. This study occurred over the course of 16 weeks of school. The first grading period had just ended as the study began and the second grading period ended week 7 of this study with the third grading cycle ending as this study ended. Even though behavioral observations were conducted in math class, academic grade information was collected for all academic areas as the academic benefits may have been apparent in other subjects.

STAAR released test. The STAAR is the newly developed state test for Texas developed for 3rd-12th grades. STAAR is used yearly as a comparison for all of the

schools in Texas. According to the Texas Education Agency, "External validity evidence was collected to inform standard setting and support interpretations of the performance standards. Scores on each assessment were linked to performance on other assessments in the same content area" (http://www.tea.state.tx.us/student.assessment/staar/). The state has released a brief sample of test questions for each grade. This study used the version for 3rd grade as an academic evaluation for the fourth graders and for the third grader an equivalent end of 2nd grade level test of 14 items was used. The STAAR released test and equivalent measure were used as a distal academic measure. All three students took the test prior to intervention and then 17 weeks later after post-intervention data was completed.

Task completion. A chart was kept for each student on which the researcher recorded the number of assignments the students in the class were asked to complete and the number completed by the participant during behavioral observations. This was a measure to compare the number of tasks completed by all of the students in the class compared to the participant (Witt et al., 2004). These data were collected during the observation sessions that took place during math. This data was compiled for each observation and recorded for all students during all three phases of the study.

Effort evaluation. As students completed the STAAR released questions or 2nd grade diagnostic test, the researcher rated their effort level on each math problem and recorded that on a chart. Each problem was evaluated by the amount of effort the student expended using a Likert scale of 0 to 4. A score of 0 representing that they did not answer. A 1 was that they scanned and guessed. A 2 was given if they tried a strategy

and/or read through all answer choices. A 3 was given if they showed some work and then matched the answer. A score of 4 conveyed that they made every effort to thoroughly work the problem and checked their answer. These efforts were further evaluated based on the time that the students took to actively work through the problem. Actively working on the problem included showing work on paper and/or self- talk as they worked through the individual problems. This evaluation was an attempt to quantify an aspect of the students' learning that indicated either a growth or fixed mindset. According to Dweck's theory, a growth mindset is indicated if a student expends effort because that equates to learning (Dweck, 2007, 2008). See Appendix E for the effort evaluation form used by the researcher.

Social validity. The students and teachers completed a brief questionnaire about the intervention. Teachers completed the Intervention Rating Profile (IRP-15; Martens, Witt, Elliot, & Darveaux, 1985), which was distributed at the end of the study for completion. The IRP instrument contains 15 statements that help to measure an intervention's acceptability to the teachers. A 6-point Likert type scale is used to measure each statement which results in a total score that ranges from 15 to 90. The IRP-15 included items such as: (a) this would be an acceptable intervention for the child's problem behavior, (b) this intervention should prove effective in changing the child's problem behavior, (c) I would be willing to use this intervention in the classroom setting, and (d) this intervention would *not* result in negative effects for the child. The higher the score the greater the teachers liked the intervention and found it acceptable.

The students were also be given a written Likert–scale created by the researcher asking about the intervention. The student social validity measure contained five items rated on a 3 point Likert scale. A total of 15 points was possible on the student social validity measure with a possible range of 5 to 15. A higher score equated to greater acceptability of the intervention by students. See Appendix F for a sample of the researcher-developed social validity interview measure.

Post-lesson audio recording. To provide weekly feedback and ongoing feedback from the participants, the students were recorded answering two questions after each intervention lesson: (1) What did you think of the lesson from *Brainology*? (2) What did you learn today? The purpose of these questions was to try to evaluate how and what the students were processing as they proceeded through the lessons such as to ascertain the impact of the curriculum on the children and to get ongoing feedback from each student's perspective. An audio recording was completed after each lesson for each student. These recordings and the journals added qualitative information from the students about the intervention.

Fidelity of scoring. The study involved data collection in the classroom. In an effort to prevent problems of expectancy- changes in data based on knowledge of intervention implementation- the teachers were not notified when the *Brainology* curriculum began. They were notified that a study was being conducted, but they were not given details about measures or timeline in order to control for rater effects to the degree possible.

As stated previously, a treatment protocol was used to monitor the individual intervention lessons. There were 12 intervention lessons in total- four for each student. The protocol monitored who, when (date and time), where, was lesson completed, assistance provided, and qualitative comments about the session. See Appendix D for further information about the treatment protocol sheet. In addition, the program *Brainology* maintains a log of when students log in and their journal content. This log was used as a secondary source of data for fidelity of implementation. The treatment procedure and date log agreed 100%. This means that the treatment protocol that was filled out with each intervention and the date log for the *Brainology* indicated the same dates for each lesson and that one lesson with all its components was completed during each time period. The treatment protocol included more specific time of day data and assistance provided during each lesson as well as any qualitative observations pertinent to the students. For instance if a student was agitated or not as engaged or sleepy, then that was notated on the procedure document.

Interrater agreement (IOA). As a measure of interrater agreement (IOA) two trained individuals scored the students' behaviors by observing and recording the duration of students' on-task behavior. The IOA was recorded during baseline, intervention, and post-intervention. The total percent agreement was calculated and ranged from 89% to 100% with an average of 95% across all students. IOA was calculated by dividing the smaller on-task duration by the larger on-task duration. IOA was completed for 22% of Bobby's sessions, 27% of Kelly's sessions, and 23% of

Daisy's sessions. The range for Bobby's IOA was 89% to 95%. While the range for Kelly was 95% to 100%, and the range for IOA for Daisy was 93% to 100%.

Data Analysis

The primary method of data analysis for this concurrent multiple baseline design was visual analysis of the graphed data. In a concurrent multiple baseline design all participants are observed from week one. Data points were recorded for all three participants at each stage of the intervention to show the changes on a consistent basis across time (i.e., weekly in this study). Visual analysis consisted of examining changes in level and trend for each student between baseline, intervention, and post-intervention conditions. Changes in trend and level were examined in order to determine whether the intervention was effective for time on-task in the classroom. The percent of non-overlapping data points (PND) was also calculated by identifying the number of data points (i.e., on-task behavior data points) in intervention and/or post-intervention phases that were above the highest data point in the baseline condition. The calculation involved counting the total number of data points measured during the intervention or post-intervention phase that exceed the highest data point in the baseline phase and then dividing by the total number of data points in the intervention or post-intervention phase (Scruggs & Mastropieri, 1998). PND was interpreted as follows: greater than 90% of PND meant that the treatment was considered a very effective treatment, 70% to 90% PND meant that the treatment was considered as mildly effective, 50% to 70% PND suggests very questionable treatment effects, and PND below 50% was considered ineffective treatment (Scruggs & Mastropieri, 1998).

Pre and posttest scores on the EBPS-2, academic grades, 3rd grade STAAR released test and 2nd grade diagnostic measure, task completion, effort evaluations, and social validity were also descriptively analyzed. The EBPS-2 pre-intervention and post-intervention scores were subtracted from each other and the difference was divided by the number of items in the subscale to give a numerical average increase or decrease in behavior across areas.

CHAPTER IV: RESULTS

The purpose of this study was to examine the effects of the computer-based program, *Brainology,* on the behavioral and academic performance of students in upper elementary grades. Another central question of this study was to what degree teachers and students found this intervention to be socially valid. These effects were measured by direct observation, EBPS-2, academic grades, the third grade STAAR released test or second grade diagnostic test, task completion measure, an effort evaluation measure, and a social validity measure. A concurrent, multiple baseline design was utilized. Three upper elementary students with a diagnosis of EBD from three general education classes participated in this study which took place over 15 weeks. The observations occurred in the general education classroom during math instruction and independent practice. Following baseline, the intervention began with the first participant individually in a separate classroom for four consecutive weeks. Each intervention session lasted from 20 minutes to 40 minutes. This data was analyzed using PND data points and visual analysis data.

Input was also solicited from the teachers and parents on rating scales (i.e., the EBPS-2) at the beginning of the 15 weeks during baseline and following the conclusion of post intervention observations for each student. The academic and effort evaluations were given pre- and post- intervention. Grades were also recorded as a proximal measure across subject areas. Social validity was evaluated from student and teacher perspectives.

The results are presented here for the three questions that guided this study: (1) what is the effect of *Brainology* on the behavioral performance of upper elementary school-aged students with EBD? (2) What is the effect of *Brainology* on the academic performance of upper elementary school-aged students with EBD? (3) To what degree do students and their teachers consider the *Brainology* program to be socially valid? The findings for each of these questions are presented in the following sections for each student. Findings related to social validity are presented prior to the end of this chapter.

Results for Bobby

Behavioral. Bobby began in the intervention phase after four baseline points. Based on the design requirements, observations were completed each week for all three participants. Bobby's baseline data ranged from 56% to 70% for on-task behavior. Bobby's on-task behavior decreased during the intervention and post-intervention phase. Bobby's data were somewhat variable with a largely decreasing trend during treatment. During treatment he spent 36%, 59%, 36% and 44% of his time on-task. The post-intervention data ranged from 49% to 70%. The PND was below 50% which is considered ineffective treatment (Scruggs & Mastropieri, 1998). Based on the visual analysis and calculated PND, Bobby did not demonstrate improvement, although when PND averages between baseline, intervention, and post-intervention were examined a slight improvement in on-task behavior at post-intervention was observed, but never attained the levels observed at baseline. See Table 6 for the results. Some possible reasons for this will be discussed in more detail in the following sections.

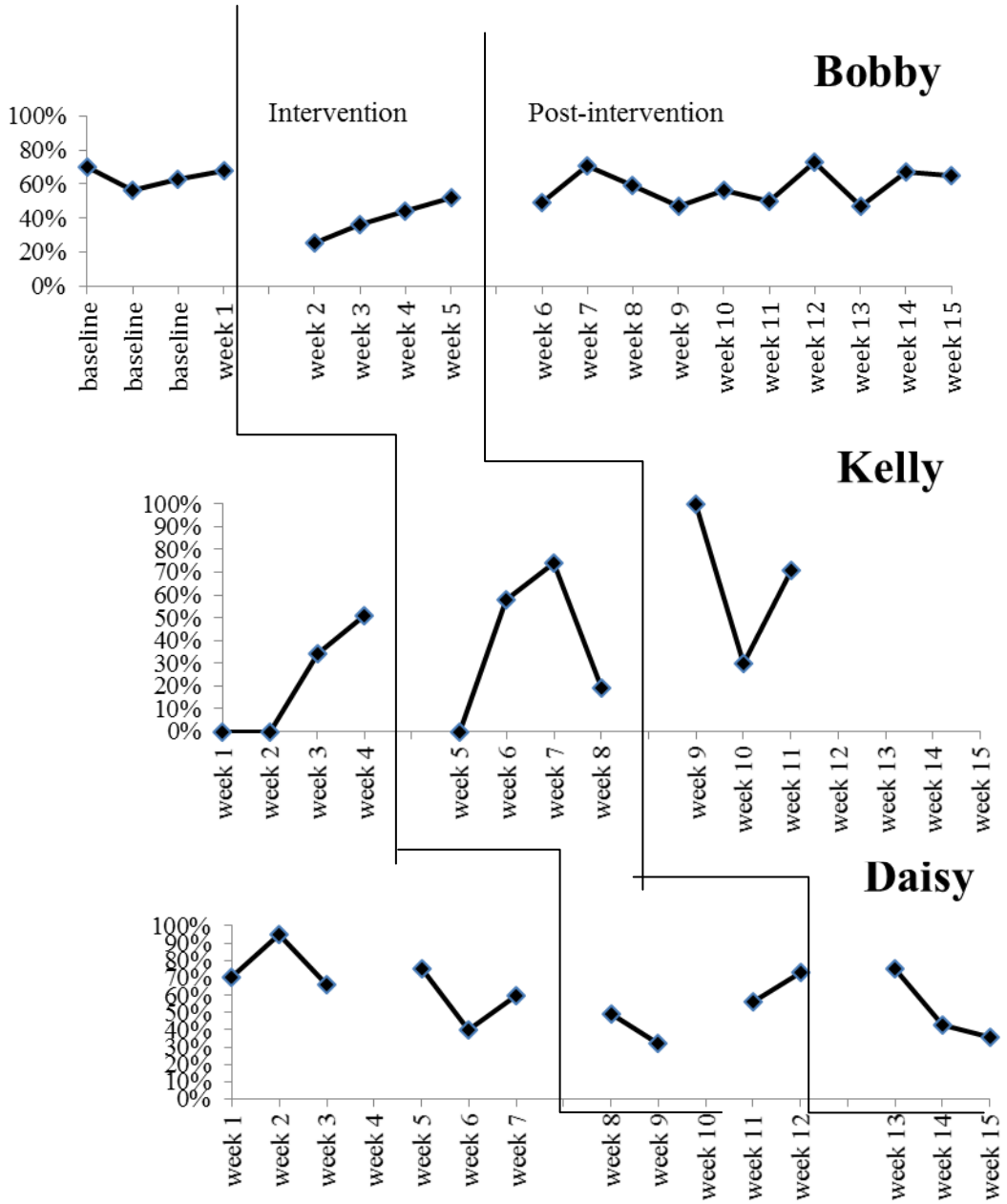

Figure 3. On-task behavior across participants.

On the EBPS-2, Bobby's teacher rated Bobby higher in all areas from pre-intervention to post-intervention indicating more behavior problems across all 10 subscales as shown on Table 10. The average increase ranged from .42 prior to the intervention to 2.81 after the intervention. The four areas with an average increase of over two points per item were interpersonal relations (2.7), inappropriate behavior (2.4), unhappiness /depression (2.6) on the theoretical scales with the empirical scales only showing a 2-point increase in the area of social aggression/conduct disorder (3.3). There was no improvement behaviorally for Bobby during this intervention as indicated on the teacher rating scale.

Scores from the parent-rated measure indicated only very slight improvements (learning comprehension 0.8, physical symptoms/fears 0.6, learning problems 0.4, and avoidance/ unresponsiveness 0.4) or slight declines (interpersonal relations -0.3, inappropriate behaviors -0.3, social aggression/conduct disorder -0.3, social emotional withdrawal/depression -0.2, and unhappiness/depression -0.1) with one subscale rating exactly the same (aggressive/self-destructive). The range of improvement was from 0.8 to 0 .4 with declines falling in the same range from -0.3 to -0.1. These results are summarized in Tables 7 and 8.

Academics. Bobby's grade decreased in reading in the 2nd trimester and improved by 2 points for the 3rd trimester. Language arts decreased across all three semesters and mathematics decreased from 90% to 80% and then increased five percentage points to 85%. Science decreased in the second semester and then increased. Social Studies increased through all three semesters starting at 81% and ending at 86%. See Table 9 for

specific grade information. On the STAAR distal measure, Bobby showed a decrease in knowledge. See Table 10 for a summary.

Behavioral academic indicators. Figure 4 compares Bobby's task completion with what was expected for his class. Out of the 13 problems on the STAAR test Bobby's effort on the post-intervention assessment exceeded the pre-intervention assessment on 11 out of 13 problems. Four problems had the same effort while the remaining seven items showed an increase of one or two points for an overall increase in effort of seven points as shown on Table 11 and 12. He scored a 29 in effort out of a possible 52 on the pre-assessment which was a percentage of 55%. Then on the post-assessment he improved by 7 and scored 36 out of 52 which was 69% effort and was an overall improvement in effort of 14%.

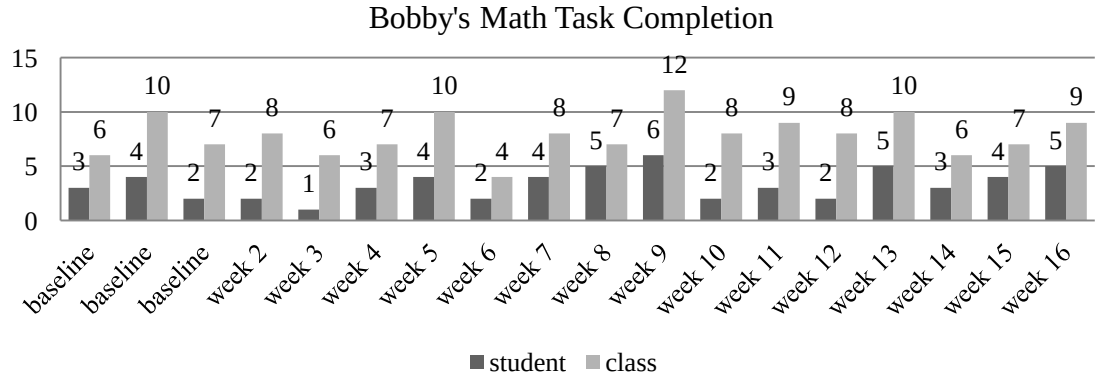

Figure 4. Bobby's task completion.

Post-lesson audio recording feedback. After the first lesson, in response question 1: what did you think of the lesson from *Brainology?* Bobby stated, "that it probably was kind of hard and sort of easy" and in response to question 2 (i.e., What did

you learn today?) “That using the brain is easy”. He would often repeat snippets of information from the lesson such as, he “learned about brain cells”, or that he learned “that running around can help your brain” or “how to keep your thoughts and memorize”. Bobby’s responses were usually given in one sentence or a short phrase. Bobby’s journal entries in *Brainology* were also one sentence even with the researcher serving as a scribe.

Results for Kelly

Behavioral. Kelly began the intervention after 4 baseline points. The baseline data ranged from 0% to 51% of on-task behavior. During treatment, data for on-task behavior was 0%, 58%, 74% and then 19%. The PND during intervention was 50%. There was a steady increase except for the last data point during treatment. Following the intervention, the three data points were 100%, 30% and 71%, which was evidence of a decreasing trend. The participant moved to another school after that point which curtailed further observations. The PND for post-intervention with only one overlapping data point was 67%, which is categorized as questionable treatment effects. When averages for on-task behavior in each phase were calculated, a slight improvement was observed from baseline (28%) to treatment (38%) and finally to post-intervention (67%).

The visual analysis of her data showed an improving trend during baseline. Then Kelly started the intervention back at zero but showed an upward trend during intervention. The results visually in post intervention were demonstrating a mix of increasing and decreasing trends.

Kelly’s teacher indicated improvements in behavior on eight of the ten EBPS-2 subscales. The only two subscales that evidenced an increase of negative behaviors were

academic learning problems (+0.7) and learning/comprehension disorders (+1.7). Her decreasing behavior ranged from decreasing by 2.8 points on the social aggression/conduct disorder subscale, interpersonal relations -1.8, social emotional withdrawal /depression -1.5, physical symptoms/fears – 1.0, unhappiness /depression -0.9 and - 0.4 on three subscales (avoidance/ unresponsiveness, inappropriate behaviors, aggressive/self-destructive).

Her parent also indicated improvements. There were no increases of negative behaviors indicated on any subscales. The decreases in negative behavior across the subscales ranged from -0.4 to -2.7. She decreased over two points across four subscales. Three were in the theoretical subscales- interpersonal relations (-2.4), inappropriate behavior (-2.6) unhappiness/depression (- 2.1) - and one was in the empirical subscales- social aggression/conduct disorder (-2.7). The other subscales with scores were social emotional withdrawal/depression (-1.2), aggressive/self- destructive (-1.1), avoidance/ unresponsiveness (–1.0), learning/comprehension disorders (- 0.7), and at -0.4 learning problems and physical symptoms/fears. Kelly's scores are summarized in Tables 7 and 8.

Academics. Kelly grades showed a variety of results. Her reading decreased from 75% to a 55%. Her Language Arts grades started at 75% then decreased to 73% and then increased to 77%. Her mathematics grade did not change across the three grading periods and remained at 70%. Science decreased from 79% to 71%. Social Studies started at 80% then went to 73% and then returned to 79%. See Tables 9 and 10 for a summary of these results.

Behavioral academic indicators. Figure 5 represents the tasks that Kelly completed compared to the tasks that were expected of her class**.** Kelly demonstrated an overall improvement of 12 points in overall effort per problem when comparing her pre-test with her post-test results from her effort evaluation on the STAAR assessment. She also had two problems on which she scored lower by one point on the post-test, four items that were the same value and the remaining seven items were all higher for her effort rating. Two of the seven items demonstrated an effort improvement of three points on the four point scale. These results are summarized in Table 11 and 12. She scored a 29 in effort out of a possible 52 on the pre-assessment, which was a percentage of 55%. Then on the post-assessment she improved by 12 points and scored 41 out of 52 which was 79% total effort score and an improvement of 24%.

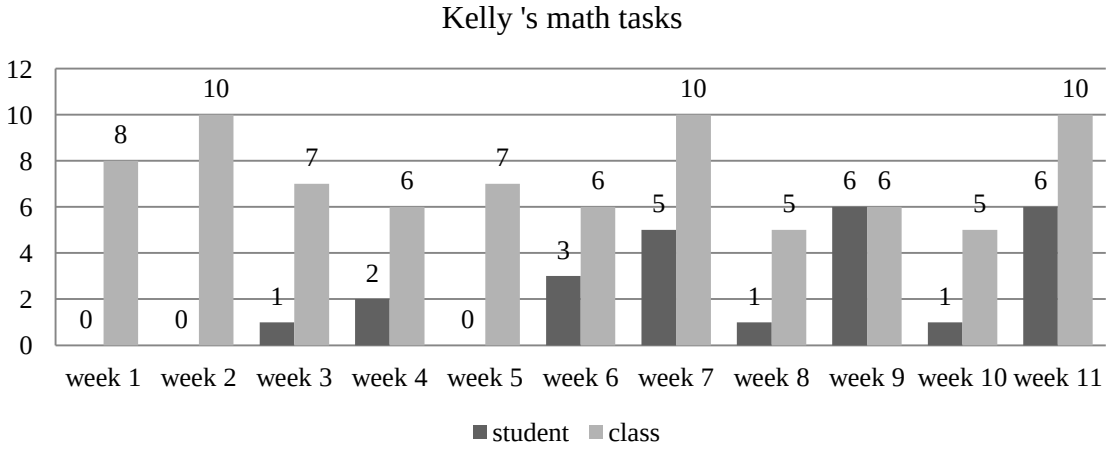

Figure 5. Kelly's task completion.

Post-lesson audio recording. In response to question 1 Kelly said that she thought, "it was cool". In response to question 2 she said, "that you should always study and stay focused in class so that you can learn. Your brain needs to study". Her responses were usually two to three sentences of details from the lesson. Within the *Brainology* program, Kelly's responses were more extensive. Responses were typically about two sentences repeating information with references to how she could apply the content to her own life.

Results for Daisy

Behavioral. Daisy was the youngest student who participated in the study and the only third grader. Because of the concurrent design, Daisy had six baseline data points before treatment ranging from 95% to 40%, which represented a decreasing trend in time on-task during the baseline phase.

Daisy missed one week of data because she was not in the class during week 4 of the study. This will be discussed further in Chapter 5. After completing two consecutive intervention sessions Daisy was hospitalized for eight days. When Daisy returned from her hospital stay, the final two sessions were completed. Daisy's percentages of on-task behavior during the intervention phase were 49%, 32%, 56% and 73%, which demonstrated an increasing trend in her on-task behavior. Her PND during intervention was 0%. Data during post-intervention reflected a decreasing trend. Her post-intervention data were 75%, 43%, and 36%. Daisy's PND for post-intervention was also 0%. When

her sessions were averaged by phase her data also showed that the baseline levels of on-task behavior were higher than intervention and post-intervention averages.

Her baseline showed mixed results increasing every other point and missing week 4. Her intervention showed a slight increasing trend of three points for week two through four of the intervention. Then there was a decreasing visual trend during post intervention indicating that she was increasingly off-task with each observation.

Results from the EBPS-2 completed by Daisy's teacher suggested improvement across the subscales except for two categories. The two categories in which the teacher did not indicate improvement were learning problems which decreased by 0.7 and learning /comprehension by 1.3. Areas of improvement demonstrated changes from 0.1 to 3.0. She had three subscales that exhibited improvement of more than 2 points. These subscales included: unhappiness/depression (2.3), physical symptoms/fears (2.1), and social/emotional withdrawal/depression (3.0). The other subscales scored at aggressive/self-destructive (-1.9), interpersonal relations (-1.8), social aggression/conduct disorder (- 1.0), inappropriate behavior (-0.2), and avoidance/ unresponsiveness (-.1).

Daisy's parent's responses on the EBPS-2 were somewhat varied. Parent ratings evidenced slight improvements in five areas, ranging with improvements in behavior from +0.4 (unhappiness/depression) to +0.7 points (aggressive/self- destructive). Decreases in behavior were also indicated on areas with decreases ranging from - 0.1 (social emotional withdrawal/depression) to -0.4 (physical symptoms/fears) while one subscale remained unchanged (social aggression/conduct disorder. See Tables 7 and 8 for summaries of these findings.

Academics. Daisy's grades were maintained across all three semesters with changes of up to six percentage points. The greatest change was in science (6% change) and the least was in mathematics (1% change). See Table 9 for specific grade information. Daisy was the only student to appear to have had a growth of knowledge from 64% to 100% as shown on Table 10.

Behavioral academic indicators. Figure 6 represents Daisy's task completion compared to that which was expected of students in her class during observations. Daisy's effort level remained somewhat the same between baseline and intervention on all items on the diagnostic test. Her overall score reflected a nine-point improvement with six items being rated the same effort and improvement being shown on the remaining seven items. All of the increases in effort were represented by one-point increases with the last question being improved by two points. These results are indicated on Table 11 and 12. She scored a 42 in effort out of a possible 56 on the pre-assessment which was a percentage of 75%. Then on the post-assessment she improved by 9 points and scored 51 out of 56 which was 91% total effort score but an improvement of 16%.

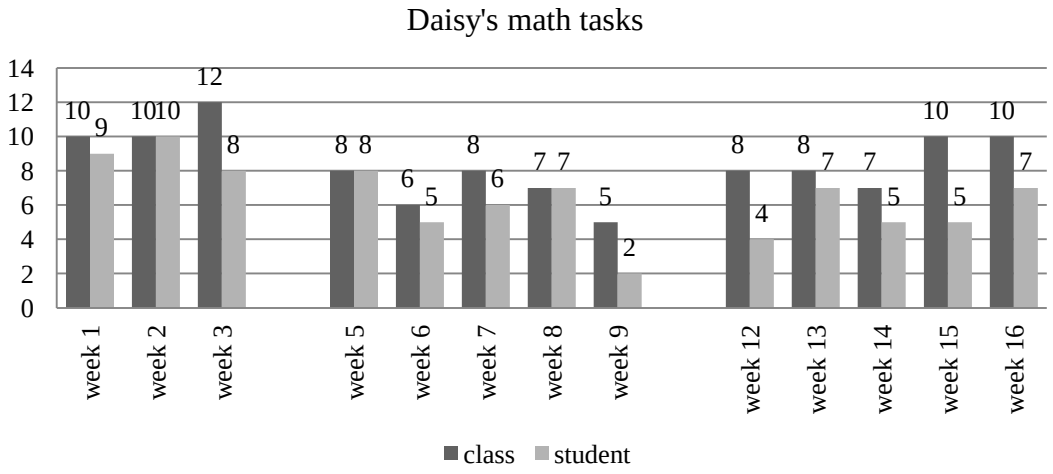

Figure 6. Daisy's task completion.

Post-lesson audio recording. Daisy reported that she enjoyed the lessons. She stated that the first lesson was "good". For question 2 after the first lesson she said that she learned "the part of the brain, how your brain works and that Dr. C has an enormous brain and it is yellow." Her responses were usually enthusiastic and noted what level she was completing. She also tended to focus on extraneous details from the computer presentation like the rats used in one section to present information (she doesn't like them) and other details such as, "Dr. C's [one of the characters] fingers are too long. Sometimes she would also include details from that day's lesson in her journal entries; Daisy's responses were enthusiastic with lots of exclamations points. While the other two student's journals were always on topic, Daisy's journals were often off-topic. Out of 12 journal entries, eight were on topic. The other entries concerned her interests, or extraneous details from the computer program such as about rats or Dr. C's head.

Table 6

Results from on-task behavior observations

Pseudonym	**PND**	**Baseline avg.**	**Treatment avg.**	**Post intervention avg.**
Bobby	0%	64%	44%	56%
Kelly	67%	28%	38%	67%
Daisy	0%	68%	53%	51%

Table 7

EBPS-2: Results from teachers

	Bobby's Teacher			Kelly's Teacher			Daisy's Teacher		
Subscale (# of items)	T1	T2	Diff.	T1	T2	Diff.	T1	T2	Diff.
Learning problems (12)	58	80	-1.8	56	64	-0.7	31	39	-0.7
Interpersonal relations (12)	17	49	-2.7	54	32	1.8	62	40	1.8
Inappropriate behavior (18)	26	69	-2.4	112	104	0.4	75	72	0.2
Unhappiness /depression (9)	19	42	-2.6	42	34	0.9	37	16	2.3
Physical symptoms/fears (7)	14	17	-0.4	29	22	1.0	27	12	2.1

Table 7, cont.

	Bobby's Teacher			Kelly's Teacher			Daisy's Teacher		
Subscale (# of items)	T1	T2	Diff.	T1	T2	Diff.	T1	T2	Diff.
Social aggression/conduct disorder (21)	27	96	-3.3	127	68	2.8	115	94	1.0
Social/emotional withdrawal/ depression (13)	37	59	-1.7	59	40	1.5	59	20	3.0
Learning/ comprehension (6)	31	38	-1.2	16	26	-1.7	16	24	-1.3
Avoidance/ unresponsiveness (11)	35	56	-1.9	67	63	0.4	28	27	0.1
Aggressive/self-destructive (7)	7	10	-0.4	24	21	0.4	28	15	1.9

Note. T1 represents score in baseline. T2 represents score in intervention. Diff. represents change between intervention and baseline phases.

Table 8

EBPS-2: Results for Parents by Subscales

	Bobby's Parent			Kelly's Parent			Daisy's Parent		
Subscale (# of items)	T1	T2	Diff.	T1	T2	Diff.	T1	T2	Diff.
Learning problems (12)	27	22	0.4	35	28	0.6	20	13	0.6
Interpersonal relations (12)	21	24	-0.3	44	15	2.4	34	28	0.5
Inappropriate behavior (18)	45	50	-0.3	78	32	2.6	89	90	-0.1
Unhappiness /depression (9)	20	21	-0.1	34	15	2.1	37	33	0.4
Physical symptoms/fears (7)	19	15	0.6	22	19	0.4	16	19	-0.4
Social aggression/conduct disorder (21)	46	52	-0.3	96	40	2.7	88	88	0.0
Social/emotional withdrawal/ depression (13)	27	30	-0.2	38	23	1.2	42	43	-0.1
Learning/ comprehension (6)	28	23	0.8	35	27	0.7	23	17	0.5

Table 8, cont.

	Bobby's Parent			Kelly's Parent			Daisy's Parent		
Subscale (# of items)	T1	T2	Diff.	T1	T2	Diff.	T1	T2	Diff.
Avoidance/ unresponsiveness (11)	21	17	0.4	22	11	1.0	18	20	-0.2
Aggressive/self-destructive (7)	9	9	0.0	17	9	1.1	23	18	0.7

Note. T1 represents score in baseline. T2 represents score in intervention. Diff. represents change between intervention and baseline phases.

Table 9

Academic grades for participants by trimester

	Bobby			Kelly			Daisy		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Reading	90	78	80	75	70	55	93	97	96
Language Arts	90	75	72	75	73	77	98	95	99
Mathematics	90	80	85	70	70	70	93	93	94
Science	87	82	86	79	73	71	95	92	98
Social Studies	81	83	86	80	73	79	99	96	94

Note. 1st refers to the 1st nine weeks grades. 2nd refers to 2nd nine weeks grades. 3rd refers to 3rd nine weeks grades.

Table 10

STAAR and diagnostic test results

	Pre-intervention	Post-intervention
Bobby	54%	23%
Kelly	46%	54%
Daisy	64%	100%

Table 11.

Effort evaluation per student by item number

	Bobby			Kelly			Daisy		
	pre	post	Diff.	pre	Post	Diff.	pre	Post	Diff.
1	2	1	-1	4	4	0	3	4	1
2	3	4	1	1	4	3	3	4	1
3	3	4	1	1	3	2	3	3	0
4	3	3	0	2	2	0	3	4	1
5	3	4	1	1	3	2	2	3	1
6	2	2	0	3	2	-1	4	4	0
7	2	4	2	1	3	2	4	4	0
8	2	1	-1	1	4	3	4	4	0
9	0	2	2	4	4	0	4	4	0
10	2	2	0	2	3	1	2	3	1
11	3	4	1	4	3	-1	3	3	0
12	2	2	0	2	2	0	2	3	1
13	2	3	1	3	4	1	3	4	1
14							2	4	2
Sum			+7			+12			+9

Note. Pre represents pre-intervention. Post represents post intervention. Diff. represents change between pre-intervention and post-intervention test. Sum represents the total effort increase or decrease by student when comparing pre-test and post-test.

Table 12

Effort evaluation in percentage per student

	Pre-assessment	Post-assessment
Bobby	55%	69%
Kelly	55%	79%
Daisy	75%	91%

Note. Bobby and Kelly are based on 13 items and Daisy is based on 14 items.

Social Validity

Teachers. The teachers were asked to complete the IRP-15 addressing this intervention's usefulness and acceptability from their perspective. There were a total of 90 points possible from the 15 questions on 6-point Likert scale. The teachers all rated the intervention from 85 to 88 points which means it was perceived as a credible intervention from their perspective. The teachers indicated "strongly agree" on 9 of the items. They marked "agree" or "slightly agree" on six of the items. None of the teachers marked "disagree" on the IRP-15. The only item on which any of the teachers marked "slightly agree" was "this intervention should prove effective in changing the child's problem behavior."

Students. The students completed a student validity survey (see Appendix F). Bobby rated 4 of the 5 questions with "kind of", and in answer to the question 3: Did it

help you with your school work? His answer was “no”. Kelly responded “yes” to all the questions except question 4: Did you learn things to help you stay on-task and work through difficult assignments? Her answer was “kind of”. Daisy answered all the questions with the highest rating of “liked it” or “yes” to all 5 questions.

If a rating score was assigned to the scale with range of possible points being from 5 to 15. The results as shown on Table 15 would suggest that Bobby rated the intervention with the lowest level of acceptability with 9 out of 15 points (60%). Kelly gave the intervention 14 points (93%), and Daisy gave it 15 points (100%). See table 16 for a summary of student responses to the social validity items.

Table 13

Student’s Responses on the Social Validity Measure

	Bobby	Kelly	Daisy
1-What did you think of *Brainology?*	It was OK	Liked it	Liked it
2-Did you learn helpful things?	Kind of	Yes	Yes
3-Did you learn things to help you with your school work?	No	Yes	Yes
4- Did you learn things to help you stay on-task and work through difficult assignments?	Kind of	Kind of	Yes
5- Do you think this program would help other students?	Kind of	Yes	Yes

Some additional social validity information came from the students' journal responses to the *Brainology* program. One of the aspects included in the treatment protocol was a place to notate whether they had to be encouraged in the lesson. None of the students needed to be prompted to finish the lesson. They all appeared to enjoy all aspects of the lessons. Each of them appeared to have found components that appealed to them, which they stated or wrote about during the post-lesson audio recording sessions or in their journals. For example, Bobby indicated that liked the part that talked about exercise helping your brain and connected that to parkour (jumping over fences etc.). He wrote the longest journal entry about that aspect. Kelly took notes during each computer lesson and really connected with the illustrations and examples. She took some of the notes back to class to, as she suggested, use in class. Daisy connected with the journaling and did extra journal entries during each lesson. The journal entries and audio recording gave additional insights into what the students were learning from the lessons. For all measures in which raters were asked to respond, the students were thoughtful and considerate in their answers with none of the responders giving all "yes" responses or highest marks except for the enthusiastic third grader, Daisy. The implications of these results will be addressed in chapter 5.

CHAPTER V: DISCUSSION

There are many challenges for the classroom in this 21st century atmosphere of high academic accountability. Students with EBD being included in general education classes and the heightened educational standards have added to the challenges face by schools and classroom teachers (Vannest et al., 2009). This population has consistently been more unsuccessful academically, behaviorally, and socially (Bradley, Doolittle, & Barolotta, 2004). Students from this population have been found to achieve below expectations (Epstein et al., 1989), below grade and age level (Trout et al., 2003), and are more likely to have greater behavioral difficulties (Bradley et al., 2004). These behavioral difficulties can also affect the progress across social and peer relations, academics and self-esteem (Fitzpatrick & Knowlton, 2009). Students with EBD in comparison to their peers "tend to be less engaged; more likely to display off-task behaviors; and more impulsive, uninvolved, and inattentive" (Fitzpatrick & Knowlton, 2009, p. 253). As a result these students accomplish less school work and demonstrate less academic improvement (Swaggart, 1998). These behaviors ultimately and most importantly become life skill deficits for these students as has been repeatedly proven (Fitzpatrick & Knowlton, 2009; Reid et al., 2005). Clearly, interventions are needed to address these difficulties both academic and social outcomes. The interventions need to be as unobtrusive as possible on classroom time, but must be efficacious for behavior and academic change.

One intervention that shows theoretical promise for the school setting is *Brainology*. Dr. Carol Dweck has created this program to assist students with the "how to think" process by teaching them about their brain through a computer program called *Brainology*. She has coined the terms fixed mindset and growth mindset to describe two attitudes and/or approaches to learning. Chapters 1 and 2 describe these in more detail. One of the key components to her program is helping students understand how their efforts can improve their learning and progress in academics and behavior. They are shown "that they are in control of their brain and its development" (http://www.mindsetworks.com/brainology , "The *Brainology* Program," para. 3) and therefore in control of their behavior (i.e., locus of control). This study attempted to expand on the research that has been completed with the *Brainology* program. This study was guided by the following three research questions:

1) What is the effect of *Brainology* on the behavioral performance of upper elementary school-aged students with EBD?
2) What is the effect of *Brainology* on the academic performance of upper elementary school-aged students with EBD?
3) To what degree do students and their teachers consider the *Brainology* program to be socially valid?

Effects on Behavioral Performance

Findings from chapter 4 regarding the behavioral measures are discussed in the following sections with potential issues and concerns described.

Bobby

Bobby showed no improvement in behavior across all three measures. The direct observation measured no increases in on-task behavior. In fact, on the teacher EBPS-2 rating scale his behavior was rated worse across all 10 subscales. The parent results showed negligible differences when comparing the pre-and post- rating scales. Bobby was recently diagnosed with EBD the end of September. This is the first year that he has received services addressing these behavioral difficulties. This dissertation study involved a total of four weeks of intervention. Throughout this intervention Bobby experienced extraneous factors that may have influenced his behavioral and academic progress during the intervention period.

Kelly

This intervention appears to have been possibly effective with Kelly across all measures. Her score for the on-task observations was a PND measure of 67%, which is questionable effect according to PND standards (Scruggs & Mastropieri, 1998). Even though PND for Kelly rated a questionable effect, her teacher's ratings suggested that greater improvements were made than that which was noted through direct observation. For Kelly, this may speak to the difference between practical and statistical significance. Gresham, Cook, Crews, and Kern (2004) suggest that interventions may not show statistical significance but that these interventions could still retain practical significance in students' typical classroom settings. This may be particularly true for Kelly particularly with regard to the high social validity ratings given by teachers.

Given the questionable effect of the intervention for Kelly based on her time on-task percentages collected through direct observation and the high social validity ratings, it is quite plausible that Kelly made improvements in her classroom behavior that were not captured using direct observation, which may be an artifact of the on-task behavior definition, which would have limited the PND.

Kelly was able to make the improvements that she made and maintain them over the winter holidays and through a move to a new residence. The parent rating scale for Kelly also indicated improvements. No behavioral decreases were shown across all ten scales for the parent scale; yet, the increases were substantial. The consistency across the parent and teacher scales on these measures appears to provide some verification that positive behavioral gains were made during this intervention for Kelly.

Daisy

Direct observational measures for Daisy showed no improvement. It should be noted that it was not possible during week 4 and 10 to get observational measures as noted visually on Figure 3 in Chapter 4. During week 4, the student was having behavioral difficulties and was not in class for math, either because she was either acting out or sleeping. Following that, during week 10, she was hospitalized for a reevaluation and shift in medication. She was also assigned a one-on-one assistant to help her navigate her social environment as prior to beginning this study she had been involved in several physical altercations with other students. No incidents of hitting occurred during this study. These factors, especially those associated with removal from the instructional setting are common for students with EBD (Krezmien, Leone, & Achilles, 2006; Wagner,

Newman, Cameto, & Levine, 2006; Zhang, Katsiyannis, & Herbst, 2004), such factors interfere with data collection and may or may not be indicators as to the effectiveness of an intervention.

In spite of the confounding factors, results of Daisy's teacher's EBPS-2 ratings indicated improvement across 8 subscales with three of these improving by over 2 points. Her parent scores showed a small improvement over 5 areas and a decrease in 4 areas. Unfortunately, because the hospitalization occurred during the intervention phase, none of the improvements in behavior could be associated or not associated with the intervention.

Effects on Academic Performance

Students' academic performances were examined in terms of grades and the STAAR standardized test. Limited academic growth was demonstrated. No effect was observed for any of the students on the academic grades measure. The STAAR test and 2nd grade diagnostic test showed that Bobby and Kelly had not made academic growth. Daisy was the only one to demonstrate academic growth as her score raised 36% from 64% to 100%. Notable however, is that Daisy does not qualify for special education services under the category of LD; whereas, the other two students did qualify with reading and writing for Bobby and reading and math for Kelly.

Daisy also had additional adult help, as required by her IEP, an assistant worked with her in class to monitor behavior. She had been physically violent to other students repeatedly and as a result had an assistant assigned to her when she was in the class. She has only behavioral IEP goals, but the assistant also re-taught concepts to Daisy and other

students in the class as well as kept Daisy on-task. The assistant was part of her environment throughout this experiment. This was true across all phases. However, all but three of the on-task observations were done without the assistant. For the remaining three, Daisy's behavior was not as stable so the assistant remained in class. As long as the researcher and assistant thought she was safe, the assistant would leave the room during the 10 minute observation. The lack of academic growth for two of the three students agrees with previous research results (Nelson et al., 2004), which suggests that deficits in mathematics grow over time.

Behavioral Academic Indicators

Two measures were used in an attempt to quantify aspects of effort in students' academic work. The results of the analysis pertaining to effort (see the task completion graphs, figures 4, 5, and 6) suggested that there was a relationship between percent of work completed and on-task time such that when the observational measure indicated a higher percentage of on-task behavior, more class tasks were completed and the reverse held true as well. This finding is supported by previous research (Harris, Friedlander, Saddler, Frizzelle, & Graham, 2005).

The effort evaluation measure was a researcher-created measure assigning an effort score per item on the STAAR test and equivalent 2nd grade diagnostic test as an attempt to quantify whether differences existed following the intervention using *Brainology*. The effort evaluation suggested a change across all three participants as all three appeared to exert more effort at post-test than during pre-test. This was the only dependent measure on which all three students demonstrated an improvement. Using the

Likert scale rating Bobby improved by 14%, Daisy by 16%, and Kelly by 24%. These are sizeable improvements in effort. Since part of the intention of this study was to address task perseverance, this was one measure for it. It did not translate into improved grades but was that do to classroom instruction and effectiveness?

This was an interesting result because while the effort coincided with a higher score for Daisy this was not true for Bobby and Kelly. Greater effort did not gain them a greater score on the STAAR test. It is quite possible that Bobby and Kelly learned to work more diligently and with effort, but that their mathematics skills did not increase so the effort did not result in higher scores. This might also be an artifact of the learning challenges that Bobby and Kelly experience due to their LDs.

Behavioral and Academic Gains from *Brainology*

A single subject design was selected to investigate whether the use of *Brainology* would be effective with students with EBD to improve behavior and/or academics. From a behavioral standpoint, there appears to be a relationship between use of this computer program and Kelly's results. According to the standards of PND measurement a probable effectiveness was shown in her on-task data for the post intervention stage. The visual analysis of this data was not as clear in suggesting probably effectiveness compared to PND across all three phases. There was a strong improvement indicated by the teacher rating scale and parent rating scale. For these measures to show improvement during just seven weeks of this study in spite of holidays and outside stressors (moving) may serve as credible evidence for the possible effectiveness of this intervention for her. Unfortunately, the findings for the other two students were more consistent with previous

research concerning changes in time on-task and academic performance. Bobby and Daisy's data were considerably more variable and did not evidence as much improvement as Kelly's data did through the intervention phase.

The lack of effect across the other two students brought up further questions and concerns. Was the lack of effect due to the outside mitigating factors? If that is true, these are factors that are constantly interfering when working with this population of children. Situations in the home, hospital, and medication issues as well as weeks with persistent difficulty are all facets that are a regular part of school experiences for students with EBD. Yet, the slight changes for Bobby and Daisy on various measures may be indications of future changes.

Intervention Social Validity

Assessment of social validity is an important consideration in single subject research (Horner et al., 2005). In order for interventions to be widely accepted for school use, acceptability by stakeholders must be high. Overall, this intervention appears to have moderate to strong social validity as rated by students and teachers. Interestingly, teachers and students rated the intervention as useful for behavior change for the participants and appropriate for the problem behavior; yet, the intervention effects for behavior were non-existent to questionable across all participants. The teachers' ratings of acceptability suggest that teachers accepted the intervention and viewed it as worthwhile even though the intervention did not evidence statistically significant behavior change (0% PND to 67% PND).

Implications for Future Research

Using *Brainology* for students with EBD is an intervention that is worthy of continued exploration. Although there was limited evidence in this study, this researcher believes that this is a viable intervention tool for this population of students. As is stated in research again and again, more research is needed concerning methods that effectively intervene with academics and behavior for this population of students as these students struggle in both domains and these variables are inexorably linked (Gunter & Coutinho, 1997; Wehby et al., 1998). *Brainology* offer some promise however slight as a method to improve students' on-task behavior, productivity, and possibly their academic performance.

Researchers might consider using this intervention with the additional classroom based components found on the website and in their curriculum in order to help students use some of the methods during their school tasks. This would also give further practice and interactions with the materials and concepts. It is quite possible that this computer program could be implemented as a small group or targeted intervention involving and individual and small group component. It would also be interesting to make this *Brainology* part of a multicomponent study and use a self-management strategy with it and compare results.

Another line of inquiry would be to consider incorporating additional student validity questions asking students about what they found most useful in the *Brainology* program where they rank the most usefulness aspect of the intervention—that is, giving a "1" for most important to a "4 "for least important. They would rank the characters, the

experiments, the quizzes, and the journal entries. An open-ended question should be included at the end about what could teachers do to help them use these strategies in the classroom. The computer delivery mechanism of this program appeared to be an advantageous feature of this intervention. The program appeared to be inviting and the students all responded and completed all the facets of the program because they were engaged with the characters on the screen. As noted earlier in this section, there was never any need for the researcher to prompt or encourage the students to finish the individual lessons. They finished eagerly and were quite motivated to become a brain master at the end of the four lessons or "brain ninja" as Daisy liked to say. Fitzpatrick and Knowlton (2009) advocate utilizing any and all types of technology to engage and help students with EBD both academically and behaviorally in their study on self-directed intervention practices. Findings from this dissertation study concur with Fitzpatrick's and Knowlton's recommendation.

Another research implication might consider the characteristics of students when determining which students might benefit from *Brainology* specifically. For example, student age or types of problem behavior might be a significant consideration prior to implementing this computer program with these students with EBD. Another question is whether students with dual disability classifications, such as EBD and LD like Bobby and Kelly benefit from such intervention. This study could be replicated with students with EBD in higher grade levels as well in order to assess the most appropriate age at which computer-based *Brainology* might be used as Dweck found some success with the *Brainology* program with students in middle school grades. Perhaps the present study did

not realize a large number of positive effects due to the cognitive level difficulty (Gresham, 2005).

A final research suggestion might be to pursue the effort evaluation component in future studies. Can effort be quantified using this type of measurement? Would it be useful in considering teacher instruction and student effort and understanding? This was an unexpected finding in this study and is worth exploring in other lines of inquiry.

Limitations

There were several limitations to this study. While acceptable for a single subject design the small sample size means that the findings may not generalize to all students with EBD. While randomized controlled studies would allow for more generalization to a larger population, single subject design is appropriate for this type of study as there are a limited number of youth with EBD in school settings—that is, the category of EBD represents only 1% of all children with disabilities (Bradley et al., 2008).

Another limitation of this study was that the intervention was only four weeks long with one session per week. Gresham, Van, & Cook (2006) also suggest that previous intervention studies, particularly in the social skills domain, fail quite possibly due to the limited duration of the intervention program. To extend the intervention the *Brainology* website offers additional more components that could be used for small group instructional sessions. The additional components might allow lessons to be extended in order to provide for additional practice, to process the information, and receive reinforcement for knowledge and practice.

Another limitation of this study was all the changes that took place in the participant's lives during the course of the study. Home issues, holidays, moves, hospital visits, and medication changes that took place during the 15 weeks of the study. Yet, such issues are common for students with EBD (Krezmien et al., 2006; Wagner et al., 2004; Zhang et al., 2004). Given that one student (e.g., Kelly) experienced positive effects from the intervention, a maintenance check would have been beneficial for Kelly to explore whether the positive changes were maintained. Gresham et al. (2006) suggest that failure to program for maintenance and generalization and measure those effects is a common limitation of research among students with EBD. Future studies would benefit from programming for maintenance and measuring outcomes associated with it.

Another limitation of this study was a single intervention when a combined approach might have yielded greater results. Combining *Brainology* with a management technique may yield greater results. As the results showed in the synthesis, self-monitoring has been shown to increase time on-task or task persistence (Blood et al., 20011; Levendoski & Cartledge, 2000).

Summary

This study was completed in order to examine the effect of a computer-based *Brainology* in the school setting with upper elementary-aged students. Using a concurrent multiple baseline in conjunction with Carol Dweck's *Brainology* program as an intervention for three students across 15 weeks, six measures were utilized to examine behavioral and academic effects following the use of this intervention. One student

showed a possible effect in the three behavioral measures while the other two showed no effect across those measures. Overall, student effort appeared to increase using this intervention, which is an important finding given the problems with disengagement that students with EBD experience (Wagner et al., 2004). No direct causal relationships can be drawn from this dissertation study since there was no replication of effect, which is necessary in a single subject design (Horner, 2005). However, this dissertation research does advance research one step closer to examining strategies that can be used for intervention for students with EBD, particularly with regard for improving behavioral and academic performance among this population. Despite the limited results of this study, *Brainology* appears to hold some promise for students with EBD and it is hoped that further research will explore this possibility further.

APPENDIX A: PARENTAL CONSENT

Parental Consent and Parental Permission for Child Participation

Cognitive Intervention Study

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Dr. Andrea Flower

You are being asked to participate in the study and allow your child to participate in a research study. This form provides you with information about the study. The person in charge of this research will also describe this study to you and answer all of your questions. Please read the information below and ask any questions you might have before deciding whether or not to take part. Your participation is entirely voluntary. You can refuse to participate or stop participating at any time without penalty or loss of benefits to which you are otherwise entitled. You can stop your participation at any time and your refusal will not impact current for future relationships with UT Austin or participating sites. To do so simply tell the researcher you wish to stop participation. The researcher will provide you with a copy of this consent for your records.

The purpose of this study is to compare how much academic endurance your child has before and after an intervention. The intervention is a computer program that gives them an idea of how the brain learns and ways that they can help their brain learn. The purpose is to empower them to work harder and have more endurance at academic tasks. There is also a piece in the program that shows them how their emotions can interfere with their learning. The student will be given a test prior to beginning the study and the parent will be asked to fill out a brief survey. After class observations, they will be presented one lesson a week on the computer and then asked to tape record what they

think about the lesson and the program. There are four lessons. After all four lessons the student will be asked to do another test and survey. The parents will also be asked to do a brief follow-up survey.

What is my child going to be asked to do?

- Allow the researcher to observe him or her while they participate in math class 2 to 3 times a week for 20 minutes.
- Participate with a computer based program once a week for four weeks.
- Participate in a *Brainology* survey before and after the 4 week intervention.
- Answer questions about what they think about the computer intervention at the conclusion of each lesson. Their answers will be audio recorded.
- Take a pre and posttest and a survey at the conclusion of the study.
- Allow the researcher to collect math class grades from before and after they participate in the study to see if there is a difference.
- *This is a research study and, therefore, not intended to provide a medical or therapeutic diagnosis or treatment. The intervention provided in the course of this study is not necessarily equivalent to the standard method of prevention, diagnosis, or treatment of a health condition.*

What will I be asked to do?

- Fill out a survey before and after the study.
- Give permission to the researcher to access your child's special education records.

Total estimated time to participate in study is about five to six hours.

Four students will participate in this study. Your child's math teacher will also be asked to take part in this study. If the math teacher does not agree to be in this study or if four students and parents have responded, it is possible that you and your child will not participate. The researcher will inform you if you and your child are not participants.

Risks of being in the study

- One risk of participating in this study is loss of confidentiality. The researcher in charge of this study will make sure to securely store the data and label it using fake names to prevent this from happening. This intervention may involve risks that are currently unforeseeable. If you wish to discuss the information above or any other risks your child may experience, you may ask questions now or call the Principal Investigator listed on the front page of this form.

Benefits

- There may be no direct benefits for you or your child. The student may learn about the brain and gain further information about themselves and how they learn and think. The students may gain new information and skills in the intervention process that may help them in their daily school life. The study will give insight into the cognitive connection for these students and perseverance on a task. This will increase the knowledge of cognitive strategies with the population of emotionally disturbed students.

Compensation:

- Compensation will not be offered to you or your child for participating in this study.

Does my child have to participate?

- Your child does not have to participate in this study. Your decision to participate or not participate will not impact the education or services your child normally received from the district. You decision will not affect your child's grades. If your child does not take part in this study, he/she will continue to participate in normal school activities.

Confidentiality and Privacy Protections:

- The data resulting from your participation may be made available to other researchers in the future for research purposes not detailed within this consent form. In these cases, the data will contain no identifying information that could associate you with it, or with your participation in any study. The data will be kept in a secure locked location with no identifiable names or specific identifiers on either hard copies or audio tapes. All tapes will be destroyed after the important data has been extracted. All data will be kept in a locked file cabinet with access only by the researcher and her associates.

The records of this study will be stored securely and kept confidential. Authorized persons from The University of Texas at Austin, members of the Institutional Review Board, have the legal right to review your child's research records and will protect the confidentiality of those records to the extent permitted by law. All publications will exclude any information that will make it possible to identify you as a subject. Throughout the study, the researchers will notify you of new information that may become available and that might affect your decision to remain in the study.

Contacts and Questions:

If you have any questions about the study please ask now. If you have questions later, want additional information, or wish to withdraw your participation or your child's participation call the researchers conducting the study. Their names, phone numbers, and

e-mail addresses are at the top of this page. If you have questions about your rights or your child's rights as a research participant, complaints, concerns, or questions about the research please contact The University of Texas at Austin Institutional Review Board for the Protection of Human Subjects at the Office of Research Support at (512) 471-8871.or email: orsc@uts.cc.utexas.edu.

You may keep the copy of this consent form.

You are making a decision about allowing your (son/daughter) to participate in this study. Your signature below indicates that you have read the information provided above and have decided to allow him or her to participate in the study. If you later decide that you wish to withdraw your permission for your (son/daughter/child/infant/adolescent youth) to participate in the study, simply tell me. You may discontinue his or her participation at any time. Your child will also be asked to sign an assent form.

_____

Printed Name of (son/daughter/child/infant/adolescent youth)

_____ _____

Signature of Parent(s) or Legal Guardian Date

_____ _____

Signature of Investigator Date

You are making a decision about allowing yourself to participate in this study. Your signature below indicates that you have read the information provided above and have decided to participate in the study. If you later decide that you wish to withdraw your permission for yourself to participate in the study, simply tell me. You may discontinue your participation at any time.

_____

Signature of Parent(s) or Legal Guardian Date

_____

Signature of Investigator Date

APPENDIX B: STUDENT CONSENT

ASSENT FORM

Cognitive Intervention Study

I agree to be in a study about learning to work more in my classes. This study was explained to my (parents or guardian) and he or she said that I could be in it. The only people who will know about what I say and do in the study will be the people in charge of the study.

I will use a computer program about the brain and talk about what I think about the computer program. I will take a survey about my brain before and after I use the computer program for 4 weeks. The person in charge of this study will record what I say after I use the computer I will also take a test before and after the study. The person in charge will also look at my math grades from before and after I was in this study. I will complete a survey at the end of the study to tell the researcher what I thought of the study. I will try my best while I work and can ask the person in charge if I have any questions.

Writing my name on this page means that the page was read (by me/to me) and that I agree to be in the study. I know what will happen to me. If I decide to quit the study, all I have to do is tell the person in charge.

_____ _____

Child's Signature Date

_____ _____

Signature of Researcher Date

APPENDIX C: TEACHER CONSENT

Teacher Consent for Participation

Cognitive Intervention Study

Melissa Todd

The University of Texas at Austin, Special Education

210-744-4108

melissa.todd@utexas.edu

Dr. Andrea Flower

You are being asked to participate in a research study. This form provides you with information about the study. The person in charge of this research will also describe this study to you and answer all of your questions. Please read the information below and ask any questions you might have before deciding whether or not to take part. Your participation is entirely voluntary. You can refuse to participate or stop participating at any time without penalty or loss of benefits to which you are otherwise entitled. You can stop your participation at any time and your refusal will not impact current for future relationships with UT Austin or participating sites. To do so simply tell the researcher you wish to stop participation. The researcher will provide you with a copy of this consent for your records.

The purpose of this study is to compare how much academic endurance your student has before and after an intervention. You will be asked to fill out a rating scale before the intervention and after the intervention. The intervention is a computer program that gives them an idea of how the brain learns and ways that they can help their brain learn. After class observations, they will be presented one lesson a week on the computer and then asked to tape record what they think about the lesson and the program. There are four lessons.

What will I be asked to do?

- Fill out a rating scale before and after the study about students in the study.
- Allow students to be observed in your class 2 to 3 times a week.
- Fill out a 15 item teacher validity rating scale about the intervention at the end of the study.

Total estimated time to participate in study is about one hour for the rating scales and about six hours of class observation time.

Risks of being in the study

- One risk of participating in this study is loss of confidentiality. The researcher in charge of this study will make sure to securely store the data and label it using fake names to prevent this from happening. This intervention may involve risks that are currently unforeseeable. If you wish to discuss the information above, you may ask questions now or call the Principal Investigator listed on the front page of this form.

Benefits

- There may be no direct benefits for the participants. The study will give insight into the cognitive connection for these students and perseverance on a task. This will increase the knowledge of cognitive strategies with the population of emotionally disturbed students.

Compensation:

- Compensation will not be offered to you for participating in this study.

Confidentiality and Privacy Protections:

- The data resulting from your participation may be made available to other researchers in the future for research purposes not detailed within this consent form. In these cases, the data will contain no identifying information that could associate you with it, or with your participation in any study. The data will be kept in a secure locked location with no identifiable names or specific identifiers. All data will be kept in a locked file cabinet with access only by the researcher and her associates.

The records of this study will be stored securely and kept confidential. Authorized persons from The University of Texas at Austin, members of the Institutional Review Board, have the legal right to review your research records and will protect the confidentiality of those records to the extent permitted by law. All publications will exclude any information that will make it possible to identify you as a subject. Throughout the study, the researchers will notify you of new information that may become available and that might affect your decision to remain in the study.

Contacts and Questions:

If you have any questions about the study please ask now. If you have questions later, want additional information, or wish to withdraw your participation call the researchers conducting the study. Their names, phone numbers, and e-mail addresses are at the top of this page. If you have questions about your rights as a research participant, complaints, concerns, or questions about the research please contact The University of Texas at Austin Institutional Review Board for the Protection of Human Subjects at the Office of Research Support at (512) 471-8871.or email: orsc@uts.cc.utexas.edu.

You may keep the copy of this consent form.

You are making a decision about participating in this study. Your signature below indicates that you have read the information provided above and have decided to participate in the study. If you later decide that you wish to withdraw your permission to

participate in the study, simply tell me. You may discontinue your participation at any time.

_____

Signature of Teacher Date

_____

Signature of Investigator Date

APPENDIX D: TREATMENT PROTOCOL

Date: _____ Student name: _____

Location: _____

Brainology Lesson Number ____

Lesson finished in one sitting: yes or no

Time started: _____

Time finished: _____

Total time: _____

Types of assistance provided: reading writing verbally encourages finishing

Qualitative comments:

_____

_____

_____

APPENDIX E: EFFORT EVALUATION

Date: _____ Student: _____

problems	answer	Effort 0-4	comments
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			2nd grade test only

APPENDIX F: STUDENT SOCIAL VALIDITY MEASURES

Student's survey

1- What did you think of the *Brainology?*

Liked it It was OK Didn't like it

2- Did you learn helpful things?

Yes Kind of No

3- Did you learn thing to help you with your school work?

Yes Kind of No

4- Did you learn things to help you stay on-task and work through difficult assignments?

Yes Kind of No

5- Do you think this program would help other students?

Yes Kind of No

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Note. The asterisk (*) indicates that the article was included in the literature review.

VITA

Melissa Todd was born and raised in San Antonio. Melissa attended the University of Texas at San Antonio for her undergraduate degree in elementary education and generic special education. After teaching for five years, she obtained a Master's degree in education at Regent University in Virginia. Melissa became interested in pursuing a doctorate after she began working with students diagnosed with behavioral disorders. The challenges and uniqueness of this population fascinated her. She wanted to discover all that was out there about these students and ultimately become part of the research regarding this group. As a result, she began her classes at the University of Texas in the fall of 2007.

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