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Equipping Minds cognitive development training in learners with neurodevelopmental disorders: Case studies

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Abstract

The *Equipping Minds Cognitive Development Curriculum (EMCDC),* a holistic cognitive intervention program, is based on the theory of Structural Cognitive Modifiability (SCM) and Mediated Learning Experience (MLE) of Reuven Feuerstein. *EMCDC* has been applied with learners of all ages with learning and neurodevelopmental disabilities in the United States and internationally. Five case studies of learners with a neurodevelopmental disorder are presented. Brown utilized the following data collection techniques: clinical observations of the learners, examining and analyzing the psychological and educational documents, and interviewing the parents, the learners, and teachers. Cognitive and academic gains were demonstrated in all of the case studies. The results are consistent with the results of Brown's doctoral research with learners with a Specific Learning Disorder (SLD) and the four -year case study with Marie who had Down syndrome. Family members, therapists, and teachers were included in the therapy sessions and instructed how to interact and instruct using mediated learning. This suggests that a comprehensive intervention program which addresses numerous cognitive functions and includes parents and other professionals in the learner's life allows more opportunities for modification.

Keywords: Cognitive development, Feuerstein, equipping minds, autism, post traumatic concussion syndrome, mediated learning

Introduction

"We know how to test it, you know how to train it" was the consensus of the psychiatric medical residents and faculty who experienced the cognitive development exercises of *Equipping Minds Cognitive Development Curriculum* (*EMCDC)*. While psychiatrists and educators are aware of the discovery of neuroplasticity,

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the methods to modify the brain seem illusive. The neuropsychological and educational reports the author has read contain numerous recommendations for accommodations, medication, academic remediation, and strategies. Though some reports may state that IQ is not static, the majority of reports give no hope for cognitive modifiability if a learner has a neurodevelopmental learning disorder (NLD): ADHD (attention deficit hyperactive disorder), specified learning disorder, motor disorder, communication disorder, autism spectrum disorder, and intellectual disability. The most common therapeutic interventions will be speech therapy, occupational therapy or physical therapy in the schools on a limited basis while parents who want intensive services must find a private provider. Cognitive therapy interventions are rarely mentioned even though the Feuerstein Institute has conducted numerous research studies that confirm cognitive abilities can be modified in learners with a neurodevelopmental disorder (1).

In fact, as the author has spoken to various educational groups, the work of Reuven Feuerstein (1921-2014) is virtually unknown in the United States. Feuerstein, a clinical and cognitive psychologist, believed that intelligence was changeable and modifiable regardless of age, neurodevelopmental conditions, genetics, and developmental disabilities (2). He also disagreed with the accepted concept of the *critical period* or *critical age,* which states that if a person has not reached a particular function by a certain age, he or she no longer has the ability to learn that skill (2). Feuerstein's theory is known as structural cognitive modifiability (SCM). His theory of human development has three basic ideas:

- Three forces shape human beings: environment, human biology, and mediation.
- Temporary states determine behavior: How someone behaves—namely emotional, intellectual, and even habitually learned activities—represents a temporary state, not a permanent trait. This means that intelligence is adaptive. In other words, intelligence can change; it is not fixed once and for all.
- The brain is plastic: because all behaviors are open and developing, the brain can generate new structures through a combination of external and internal factors (3).

Feuerstein insisted that human cognitive abilities can be changed even if the neuro-developmental condition is generally considered irrevocable and irreparable (3). The Feuerstein Institute has conducted research that confirms cognitive abilities can be modified (1). Instrumental Enrichment (FIE) and MLE have been found to enhance cognitive abilities of learners with neurodevelopmental learning disorders (4). Many of these learners also have cultural deprivation and differences. These studies have encompassed many types of student populations using FIE (3).

Mediated learning

The theory of mediated learning experience (MLE) initially grew as part of Feuerstein's theory of structural cognitive modifiability (SCM) (5). Mediation is an interaction in which a mediator who possesses knowledge intends to convey a particular meaning or skill and encourages the child to transcend, that is, to relate the meaning to some other thought or experience. Mediation is intended to help children expand their cognitive capacity, especially when ideas are new or challenging. Feuerstein sees the human mediator as crucial for a learner's development (5).

Cognitive functions

The review of NLDs show a deficit in working memory abilities for learners diagnosed with ADHD, specific learning disorders, motor disorders, communication disorders, autism spectrum disorders, and intellectual disabilities. While this correlation has led many psychologists to focus on working memory training, Reuven Feuerstein takes a broader view and examines the cognitive function underlying intelligence and what is going on in the learner's mind. Feuerstein defines cognitive functions as "thinking abilities" that can be taught, learned, and developed (61). Feuerstein has categorized the cognitive functions according to the three major phases of the mental act: input, elaboration, and output. Although artificially separated into three phases, cognitive functions don't necessarily occur separately in life. However, the subdivision is useful to analyze and describe thinking as well as to determine

what factors might negatively affect thinking (3). Teachers and parents can use this model to better understand and help the learner who is experiencing difficulties with a particular task. By having a working knowledge of the cognitive functions, teachers (6) can differentiate between errors due to a lack of knowledge or from a deficient cognitive function (3). For example, if the learner fails in the task of classification, it is not enough to comment on the learner's poor intelligence or inability to classify, but rather the underlying causes of the difficulty (which can be found in one of the three phases of thinking) should be sought. The inability to classify, for instance, may be due to underlying underdeveloped functions, such as imprecise data gathering at the input phase or poor communication skills at the output phase. A detailed analysis of a learner's cognitive functions requires an in-depth understanding of the three phases of the mental act (7).

Deficient cognitive functions and corrections needed: Input level

The following list identifies and describes the deficient cognitive functions that Feuerstein's Instrumental Enrichment (FIE) seeks to correct in learners with neurodevelopmental learning disorders and learning disabilities. Understanding the degree to which the learner is affected directs the mediation process for cognitive modifiability (3).

1. Blurred and sweeping perception of essential information occurs. The learner struggles to gather the correct information. Correction: The learner learns to focus and perceive the data through his senses.
2. Difficulty in temporal and spatial orientation occurs. The learner lacks the ability to organize information realistically and to describe events in terms of where and when they occur. Correction: The learner learns the critical concepts of right, left, front, and back to know where they are positioned in space.
3. Deficient skills in precision and accuracy are present. Correction: The learner collects the correct information.
4. Inability to identify an object when there is a change in size, shape, quantity, or orientation, though it is the same object. Correction: The learner is able to decide what characteristics stay the same even when change happens.
5. Lack of capacity for considering two or more sources of information at once is present. This is reflected in dealing with data in a piecemeal fashion rather than as a unit of organized facts. Correction: The learner is able to keep two ideas in his mind at the same time and compare them.
6. Impulsive and unplanned exploratory behavior is present. Correction: The learner is able to systematically approach new information and objects (3).

Deficient cognitive functions and corrections needed: Elaboration level

1. Lack of ability to recognize the existence and definition of an actual problem. Correction: The learner can define the problem.
2. Inability to select relevant vs. non-relevant cues or data in defining a problem is present. Correction: The learner can recognize what is relevant to the problem and what can be ignored.
3. Difficulty in comparative behavior is present. This may be due to slow processing and inability to make comparisons between two or more things. Correction: The learner can see the similarities and differences between two things.
4. A narrow mental field is present. There is an inability to combine, group, and coordinate information. Correction: The learner can recall and use several pieces of information.
5. The projection of virtual relationships is impaired. The ability to perceive the relationship between events is difficult. Correction: The learner can understand relationships, apply conceptual labels, and categorize objects. He understands the main idea.
6. The absence of or need for logical evidence, inferential-hypothetical thinking, and hypothesis development occurs. Correction: The learner is able to use hypothetical thinking

to test a hypothesis. He can see cause-and-effect relationships and use logical evidence.
7. Inability to visualize and create mental images is present. Correction: The learner is able to move away from concrete thinking to visualization.
8. Difficulty defining goals, planning behavior, and taking steps in problem solving occurs. Correction: The learner is able to form problem-solving strategies, make a plan, state the steps, and provide the reasons (3).

Deficient cognitive functions and corrections needed: Output level

1. Egocentric communicational modalities are present. It is difficult for the learner to relate to others and to see things from another's perspective. Correction: The learner is able to consider another person's point of view.
2. Lack of ability to repeat an attempt after a failure or blocking is present. Correction: The learner is able to persevere and overcome blocking.
3. Difficulty in projecting virtual relationships. Correction: The student is able to see virtual relationships (such as two women can be cousins or four dots can be a square).
4. Use of trial-and-error responses, which leads to failure to learn from previous attempts, is present. Correction: The learner is able to stop and think through a plan of action.
5. Lack of, or impaired tools for communicating adequately elaborated responses. Correction: The students is able to give a thoughtful response.
6. Lack of, or impaired, need for precision and accuracy in communicating one's responses. Correction: The student is able to be precise and accurate when communicating.
7. Lack of self-control, impulsive, or acting-out behavior is demonstrated. Correction: The student exhibits self-control in speech and behavior.
8. Unable to visually transport information from one place to another, or unable to see the missing part. Correction: The learner is able to see the relationship between things that are not present (3).

Feuerstein has sought to identify and correct these deficits to enable students to reach their full cognitive potential, as well as to increase their internal motivation and personal confidence. By using mediation, these deficient functions can be corrected, formed and modified in significant ways (2).

Equipping minds cognitive development curriculum

The *Equipping Minds Cognitive Development Curriculum* (*EMCDC)* seeks to correct these deficient cognitive functions through cognitive developmental exercises based on the theory of Structural Cognitive Modifiability (SCM), Mediated Learning Experience (MLE), and a biblical worldview of human development (see table 1). In Brown's doctoral research with *EMCDC,* the participants were learners with specific learning disorders (SLD). Learners were randomly assigned into one of two groups. The active control group received small group intervention in academic subjects an hour a day five times a week for seven weeks. The training group received small group intervention in the *EMCDC* an hour a day five times a week for seven weeks. All participating learners continued to receive standard special educational support services as a result of their learning difficulties. Both groups were tested on measures of working memory, verbal and nonverbal ability, and academic attainment before the training and re-tested on the same measures after training. Analysis of the pre-to post-test scores demonstrated a significant ($p < 0.05$) advantage for the training group over the active control group on the *KBIT*-2 in verbal, nonverbal, and IQ composite, as well as far transfer effects in science. Therefore, the implication from the present research is that working memory training does not have a causative effect in relationship to verbal, nonverbal, and academics abilities when using *EMCDC* for 30 hours (4).

While computerized cognitive training programs are prolific, *EMCDC* supports the use of a human mediator, which is rooted in Scripture and Feuerstein's theory of Mediated Learning Experience (MLE) and

affirms that cognitive skills can be developed in the classroom or clinical setting through a human mediator (5-7). The cognitive developmental exercises set aside academic content to target cognitive functions. Learners participate in interactive games and paper-and-marker activities which are organized in a progressive and challenging manner to strengthen working memory, processing speed, perceptual reasoning, and comprehension. A trained mediator encourages the learner to "think aloud" and verbalize what they are processing and thinking. The structure for mediating within the curriculum is specified in the teacher workbook and summarized in table 2. While the model of mediation is the same for all learners, individualization will occur based upon the learner's progression. By using mediation, these cognitive functions can be corrected, formed and modified in significant ways enabling students to reach their full cognitive potential (8).

Furthermore, *EMCDC* employs a holistic approach to cognitive development training through primitive reflex exercises, sensory-motor development exercises, and cognitive developmental exercises. The "*Maintaining brains everyday*" DVD for the primitive reflex exercises (9) and the fear paralysis exercises (10) are done by the participants at home or at school for 15 minutes a day. The sensory-motor development exercises include the use of sound therapy (11) which the participants wear during the *EMCDC* intervention sessions while doing the cognitive developmental exercises. The mediators follow the *EMCDC* full program as the intervention is typically 60 hours over 12–20 weeks (12).

An individual four-year case study was done with the *Equipping Minds Cognitive Development Curriculum* (*EMCDC*) (12) from 2011-2015 on a learner with a neurodevelopmental disorder (Down syndrome) (13-14). The author worked with the learner an hour of every school day. At the end of nine weeks, academic testing demonstrated significant gains in reading, math, science, and language arts. Until this time, the learner had made minimal progress and her academic test scores had remained static. The change in these scores had been achieved through one-on-one cognitive developmental exercises for enhancing processing, working memory, comprehension, and reasoning; this was divorced from academic content. Previously, the learner had received the standard interventions, which included remediation of content, learning strategies, and accommodations. These may have short-term benefits but were not targeting the underlying cognitive deficits in processing and working memory, which would increase her cognitive abilities. Over the next four years the academic test results demonstrated significant gains in academic abilities (13-14).

Single N-back task (1958) and Dual N-back task (2003) have been used in research as a method to train working memory for many years. Some studies have reported near transfer effects but failed to demonstrate far transfer effects confirming that generalization remains elusive (15, 16).

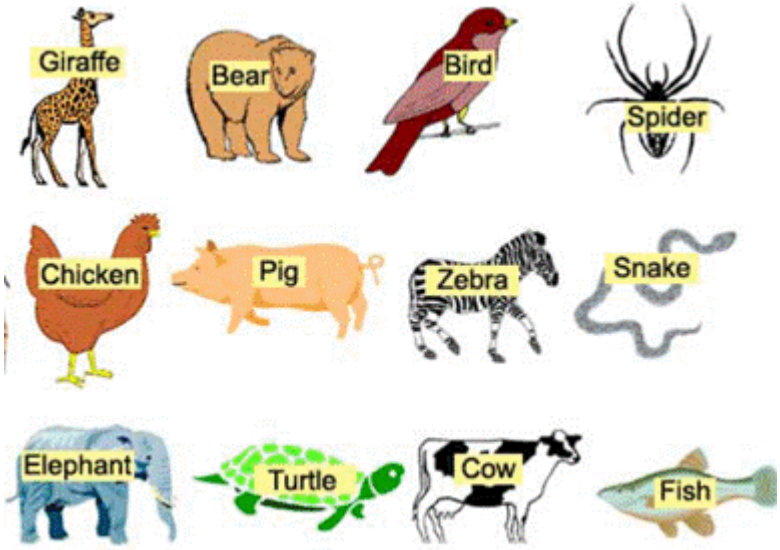
Brown developed an adaptive n-back with six tasks or the "Brown Six N Back" in which learners were asked to associated animals with symbols, letters with sound, symbols and colors, numbers with symbols and colors, recall images and sequence of US presidents, identify colors, and identify directions of left, right, up, and down. To Brown's knowledge, there has not been a Six N-back task which utilizes a human mediator requiring the leaner to hear auditory instructions, use their hands to write or place a cube while holding a pattern for six categories, and saying what they are doing. There are over 40 possible items the learner is retrieving from their long-term memory while using their working memory and regions of the brain which contain letters, numbers, pictures, sounds, directions, and colors. If the learners succeeded at a particular level of n, the task was made incrementally more difficult by increasing the size of n to six. Table 1 describes the exercises in the Brown 6 n-back while figures 1-5 show examples of the exercises (12).

Table 1. Brown Six N Back equipping minds cognitive development curriculum

Cognitive Functions Targeted	Exercise	Description Mediator states 1-2 directions ex: "I see you putting a circle around the one…" What do you see yourself doing? Learner replies, "I see myself putting a circle around the one" and performs the action. Use a page protector and dry erase marker.
Visual processing, auditory processing, working memory, visual motor coordination, receptive and expressive language, visual spatial reasoning, abstract thinking, refraining impulsivity	Animals	Circle around the bear, box around the snake, X on the fish, triangle around the cat, line under the elephant, line above the turtle and continue for 20 directions
Projection of relationships, comparisons, visualization, expressive language	Presidents "Yo Millard Filmore" book	Describe the pictures of the presidents by stating the size, shapes, colors, objects, quantities, location, positions, and relationships. 1 Washington, 2 Adams, 3 Jefferson, 4 Madison, 5 Monroe, 6 JQ Adams, 7 Jackson, 8 Van Buren and continue to 45 Trump
Working memory, visual and auditory processing, long term memory, attention, expressive and receptive language, abstract thinking, visual motor coordination, refraining impulsivity, logic thinking	Numbers 1-5	Use a page protector and dry erase marker. First, place symbols and then cubes with corresponding number. Circle and green cube on 1, x and blue cube on 2, box and red cube on 3, yellow cube and underline 4, black cube and line above 5. Remove page protector and read symbols back by alternating saying the number. Then say number, color. Next, number, color, animal. Then, number, color, animal, letter. Finally, number, color, animal, letter, president: a 5 n back.
Working memory, visual and auditory processing, long term memory, attention, expressive and receptive language, abstract thinking, phonemic processing, refraining impulsivity, logical thinking, spontaneous comparison	Letters a-e	First, place symbols and then cubes with corresponding letter. Circle and green cube on a, x and blue cube on e, box and red cube on i, yellow cube and underline o, black cube and line above u. Remove page protector and read symbols back by alternating saying the letter. Then say letter, and sound. Add letter, sound, color. Next, letter, sound, color, number. Then, letter, sound, color, number, animal Finally, letter, sound, color, number, animal, president: a 6 n back. Also do the 6 n back with the cubes covering the letters.
Spatial concepts of left, right, up, down, Inductive thinking, inductions of rules, seriation, working memory, long term memory, auditory and visual processing, abstract thinking, Systematic approach to new information and object, refraining impulsivity, logical thinking, spontaneous comparison	Colored Arrows	Say the direction of the arrow, then the color, then alternate color, direction. Add the corresponding number and say number, color, direction. Add the corresponding animal and say number, color, animal, direction. Add the corresponding letter and say the number, color, animal, letter, and direction. Add the president sequentially and say the number, color, animal, letter, president, and direction. Use a page protector and dry erase marker and put the symbol on each arrow while saying the number, color, animal, letter, president, and direction. Remove the page protector and read the symbols only saying the number, color, animal, letter, president, and direction. * Add an additional mark at the tip of the arrow when marking the direction. Now use the colored cubes and place them down while saying number, color, animal, letter, president, direction.

Table 2. Equipping minds mediation questions based on Feuerstein's cognitive functions and Aristotle's ten categories of being

Collecting	Processing	Expressing
• What or who do you see, hear, feel, taste, touch, and smell? • What can you visualize or imagine in your mind? • What do you see yourself doing? • What is the name of what you see or are thinking? • Where are you starting? • Do you have the correct materials? • What parts do you need, and what order will you need to follow to make the finished product? • What do you know to be true, or what is constant and does not change? • What is to your right? What is to my right? • If you are facing in this direction, what is to your right? Left? Front? Back? East? West? North? South? Northwest? Southeast? • When do you see this happening – past, present, future? • How long did the event occur? In what order did it happen?	• What am I to do? • Problem, what problem? • What do you need to figure out? • What is relevant to the problem? • What is needed, and what can be ignored/omitted? • What is similar? • What characteristics are different? • Consider: number, color, shape, size, direction, position, and feeling • What different categories do you see? • How are these related to each other? • Ask: What is your plan? What are the steps you will follow and the reasons? • Avoid trial and error! Have a plan. • Does this make sense? • If this is true, then what else must be true? • Are there different possibilities? • How can you see if this is true?	• What does the other person believe and why? • How does the other person feel? • Can you imagine how you would feel in their position? • How would the other person want to be viewed and treated? • Have you thought through what you want to say or write? • Are your words relevant to the situation? • Is your language clear to the audience? • Do you need to take a break and attempt later or tomorrow?



Circle the Bear
Box the Snake
X the Fish
Underline the Elephant
Line above the Turtle

Figure 1. Animal.

Basic US Presidents
1. Washington green
2. Adams blue
3. Jefferson red
4. Madison yellow
5. Monroe black
Advanced US Presidents are said sequentially for n –back
6. Washington
7. Adams
8. Jefferson
9. Madison
10. Monroe
11. John Quincy Adams
12. Jackson
13. Van Buren
14. Harrison
15. Tyler
16. Polk
17. Taylor
18. Fillmore
19. Pierce

Figure 2. US presidents "Yo Millard Fillmore."

2 1 5 4 3 circle the 1 and place a green cube
5 3 5 4 1 X the 2 and place a blue cube
3 1 4 2 5 box the 3 and place a red cube
5 4 3 1 2 line under the 4 and place a yellow cube
4 2 5 3 1 line above the 5 and place a black cube

Figure 3. 1-5 Numbers.

e a u o i circle the a and place a green cube
u i e o a X the e and place a blue cube
i a o e u box the i and place a red cube
u o i a e line under the o and place a yellow cube
o e u i a line above the u and place a black

Figure 4. Letters a,e,i, o, u.

Case studies

This article will present five case studies of learners with a neurodevelopmental disorder. Brown utilized the following data collection techniques: clinical observations of the leaners, examining and analyzing the psychological and educational documents, and interviewing the parents, the learners, and teachers.

Case 1. Joseph: Fetal alcohol syndrome, mixed expressive/receptive language disorder, developmental coordination disorder

Joseph was adopted from Poland at five years of age and lives in the United States. He was removed from his biological mother due to neglect and alcohol abuse. Joseph has fetal alcohol syndrome, a language processing disability with impairments in both expressive and receptive channels, and developmental coordination disorder.

Assessment

At the age of 8 years, Joseph received an extensive evaluation of his cognitive abilities in 2015 and further evaluations in 2016 at 10 years of age. The evaluation procedures used included:

- Clinical observation sessions
- Interview with parents
- Woodcock Johnson-III Academic Skills Index
- Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV)
- Wechsler Intelligence Scale for Children-Fifth Edition (WISC-V)
- Kaufman Brief Intelligence Second Edition (KBIT-2)
- Kaufman Test of Educational Achievement-3rd Edition-Form A
- Test of Variables of Attention (TOVA)

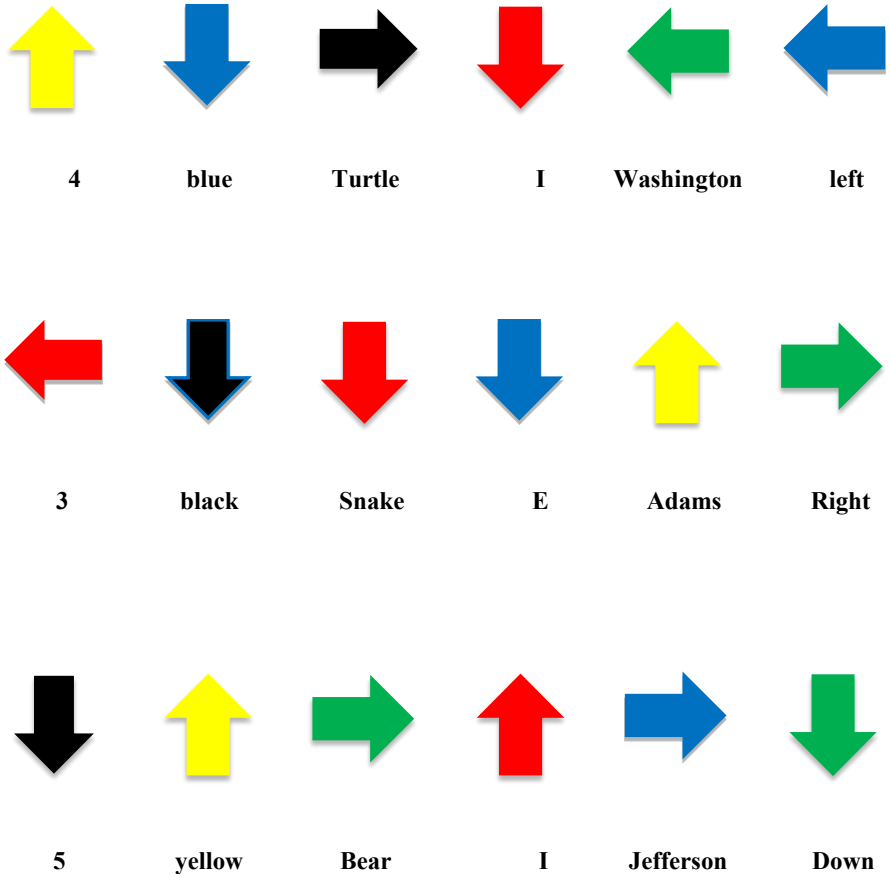
The examiners found him to be a sweet and softly spoken child, who seemed to have a gentle soul. He was polite and friendly, and displayed interest and curiosity about many of the tasks that were administered. The assessment found many other strengths, including:

- Exceptional academic abilities for a child of his age, with a performance at the 92nd percentile on the Woodcock Johnson-III Academic Skills Index, which includes measures of reading, writing, and math.
- Exceptional ability for doing simple reading, writing and math tasks with accuracy, speed and efficiency, with a performance at the 98th percentile on the Woodcock Johnson-III Academic Fluency Index.

It is very impressive that Joseph had such strong academic skills, which is a testament to his desire to work hard, as well as the support of his parents and teachers. It is the examiners impression that it is likely that school-based tasks are easier for him because they are familiar, and he is familiar with what he needs to do. More abstract and less context- rich tasks are much more likely to be challenging. The assessment found significant challenges in his cognitive development, which are likely to negatively impact his future learning as the curriculum becomes more demanding, and when there are higher expectations of independent working. These challenges need to be addressed, and include the following:

1. Very weak language processing skills, for both expressive and receptive language tasks, as well as for simple language (i.e., vocabulary, syntax, and grammar) as well as complex language abilities (i.e., the ability to make inferences or to understand intention). The examiner believes that Joseph's difficulties are consistent with a diagnosis of a Mixed Expressive/Receptive Language Disorder (ICD 10: F80.1). This profoundly impacts his ability to learn in a classroom environment (i.e., receptive language) as well as severely limits his capacity to participate in class or group based activities (i.e., expressive language).
2. Very weak visual-spatial processing skills as well as poor fine-motor control, which is likely to profoundly impact his ability to learn, unless accommodations are made to support this challenge. His difficulties are consistent with a diagnosis of a Developmental Coordination Disorder (i.e., dysgraphia, ICD 10 Code: F82).
3. Some weakness for sustaining attention and executive functioning, that while likely to significantly impact his daily life at school, is likely to be related to the specific learning challenges described above. At this time, although these challenges would typically be indicative of an attention disorder, it is the examiners impression that his learning challenges are a better explanation for why he

has weakness in tasks of Working Memory and Processing Speed.



Say the number, color, animal, letter, president (sequentially), direction.

Use a page protector and dry erase marker say and mark the six items. Place a point at the tip of the arrow for the direction. Remover the page protector and read the symbols: number, color, animal, letter, president (sequentially), direction. Next, place the colored cubes down turned to match the direction of the arrow while saying the number, color, animal, letter, president (sequentially), direction.

Figure 5. Brown Six N Back.

Working Memory is the ability to hold information in your head to be used in that moment (e.g., remembering a telephone number). Joseph's performance was weak with a working memory index score of 80, which is the 13th percentile for the WISC-IV. Processing speed is the ability to quickly complete simple clerical-like tasks and is a measure of how efficiently a person is able to do the task. Joseph's performance was also in the 13th percentile for the WISC-IV for a processing index score of 83. However, it should be noted that on the more worldly and typical tasks of speed and efficiency, such as the reading, writing, and math fluency tasks of the Woodcock Johnson-III, Joseph's performance was incredibly strong at the 98th percentile.

Intervention

In March 2015, Joseph's parents contacted Brown to discuss using *EMCDC* to strengthen his cognitive abilities; visual and auditory processing speed, comprehension, working memory**,** long term memory, and reasoning skills. According to Joseph's parents, despite all the support from Joseph's teachers, an occupational therapist, and a speech therapist, he was not able to work independently in class. Brown reviewed the academic and psychological testing showing cognitive deficits in processing, working memory, comprehension, and perceptual reasoning; she then agreed to begin working with Joseph using

EMCDC. Joseph received cognitive developmental therapy with Equipping Minds Cognitive Development Curriculum from April 2015-January 2017 for 30-minute sessions, 5 days a week for 150 hours. During this time, he also did primitive reflex exercises and listened to sound therapy for a few months.

Results after intervention

In December 2016, another psychological evaluation was given. Previously Joseph's working memory was an index score of 80, which is the 13th percentile. In contrast to the 2015 evaluation, the working memory index score increased to 103 and the 58th percentile in the average range. The Processing Speed is considerably higher on the 2016 evaluation increasing from an index score of 83 to 98 and from the 13th to 48th percentile in the average range.

In March 2017, the Kaufman Test of Educational Achievement-3rd Edition-Form A (KTEA-3) was administered. The KTEA-3 is comprised of subtests that measure a student's academic achievement in the areas of reading, written language, and math. Joseph is performing in the average range in all academic areas. When compared to grade norms, Joseph's scores are higher. While he demonstrated average comprehension abilities when reading expository passages and literal questions, he demonstrated weaknesses when reading fictional passages and answering inferential questions. Math concepts and applications are a relative strength for Joseph while math computations are a relative weakness. Joseph performed equally well with written expression and spelling.

The current scores are in some way similar to previous results and in some ways dissimilar. The WISC-V has a differing format than the WISC-IV, which was used last year. With one exception, each of the index scores has at least one and sometimes two subtests within the average range, suggesting that Joseph's potential is at least in the average range in all of the tested areas, except for one. Joseph's Vocabulary score was in the middle of the average range. Vocabulary is the single best estimate of intelligence and based on that score, it would suggest that he has average intellect. However, as he did on the 2015 WISC-IV, he had extreme difficulty in understanding superordinate concepts. In other words, understanding the relationship to how things are similar. Another way of saying it would be that he had difficulty detecting the conceptual relationship among objects. In the 2015 report, Joseph had very poor visual spatial ability. However, on this measure, there is an addition of another subtest not given on the WISC-IV. On the Block Design subtest, which is a visual spatial task or a task of perceptual analytic reasoning, he scored in the average range (in 2015 he was in the low average range.). The same is true on a task in which he had to analyze and synthesize visual objects. The index score of 92 falls in the average range. Thus, visual spatial reasoning or perceptual analytic abilities are in the average range, albeit at the lower end of average.

Where Joseph had the most difficulty was in Fluid Reasoning. These tasks require him to detect underlying conceptual relationships among visual objects and then use reasoning to identify and apply the rules. Joseph had extreme difficulty. Similarly, as already mentioned, Joseph had difficulty understanding conceptual relationships on a verbal task (Similarities subtest). It should be noted that the examiner who administered the WISC V was not familiar to Joseph and noted significant impulsivity and anxiety during the testing.

However, at 10 years of age, Joseph was administered the Kaufmann Brief Intelligence- 2 (KBIT-2) in September 2016 by Brown who had been working with him on a daily basis for 1.5 years. The test was given over two days. Joseph exhibited no impulsivity or anxiety and was extremely thoughtful in his responses. KBIT-2, a brief intelligence test which measures verbal and nonverbal intelligence for individuals from 4 to 90 years of age. The test yields three scores: Verbal, Nonverbal, and an IQ Composite. The Verbal scale is composed of two subtests that assess receptive vocabulary and general information (Verbal Knowledge) as well as comprehension, reasoning, and vocabulary knowledge (Riddles). Joseph had a standard score of 102 in the 55th percentile and average range. The Nonverbal scale uses a Matrices subtest to measure the ability to solve new problems by accessing an individual ability to complete visual analogies and understand relationships (17). Joseph had a standard score of 112 in the 79th percentile in the average range. The IQ composite had a standard score of 109 in the 73rd percentile also in the average range. This is the only examine administered

by Brown. It is Brown's opinion that the difference in fluid reasoning scores on the WISC V and KBIT 2 are a result of the cognitive training and having a relationship with the examiner allowing Joseph to complete the test in optimum conditions.

In contrast to the 2015 evaluation, the Working Memory Index is in the 58th percentile and solidly in the average range. Both of the measures here are solidly average. Auditory short-term memory is average and visual attention span is also in the average range. The Processing Speed Index also is considerably higher on the 2016 evaluation. His motor response to a visual perceptual task was relatively quick. However, when cognitive tasks are added to the task such as discrimination and scanning, he falters significantly. These gains demonstrate the impact of *EMCDC* on working memory and processing speed.

Furthermore, the psychological examiner notes the Full-Scale IQ cannot be used as a fixed figure. There are a number of indicators on the measure that would suggest average intellect. This would be in agreement with Brown's assessment on the KBIT-2 placing Joseph in the average range.

The Test of Variables of Attention (TOVA) was administered on December 2, 2016. The results are similar to those diagnosed with ADHD. The examiner recommended medication on a trial basis.

In conclusion, Joseph has shown strong cognitive modifiability throughout the program with *ECMDC*. He has an incredible work ethic and maintains a positive growth mindset. Joseph's visual and verbal memory, visual- spatial memory, and reasoning skills have developed significantly. He is giving more attention to detail, following 3-4 step directions, and verbalizing his thought process.

Table 3. Results of WISC IV and WISC V of Joseph

Scale WISC – IV 01-02/ 2015	Percentile	Composite Score	Scale WISC –V 12/2016	Percentile	Composite Score	Composite Difference
Verbal Comprehension	32nd	93	Verbal Comprehension	18th	86	-7
Working Memory	13th	80	Working Memory	58th	103	23
Processing Speed	13th	83	Processing Speed	48th	98	15
Perceptual Reasoning	14th	84	Visual Spatial	30th	92	8
			Fluid Reasoning	8th	79	
			Full Scale IQ	21st	88	

Table 4. Results of KBIT -2 of Joseph

Scale KBIT-2 02/2016	Standard Score	Percentile
Verbal	102	55
Nonverbal	112	79
IQ	109	73

Table 5. Results of KETA-3 of Joseph

Scale KETA-3 03/2017	Standard Score	Percentile
Reading Composite	99	47
Math Composite	96	42
Written-Language Composite	98	45

Case 2. David: Autism, apraxia, anxiety and Hashimoto's disease

David is an eleven-year old boy with a diagnosis of Autism. His mother, a registered nurse, reported that at four months of age, David received the t-dap vaccine and "went limp" at that time. She noted that he had 104-degree fever and also began showing signs of hypotonia. He also reportedly had an undiagnosed salmonella infection at that time. He was diagnosed with Autism and verbal apraxia at two years, eight months of age. He was also diagnosed with Hashimoto's Disease in December of 2010. David's school performance is below average. He has received ABA therapy, speech therapy, and occupational services for many years. He struggles with anxiety, atypical social behavior, and preservation on topics.

Assessment

At the age of 8, David received an extensive evaluation of his cognitive abilities in 2015 and further evaluations in 2016. The evaluation procedures used included:

- Clinical observation sessions
- Interview with parents
- Wechsler Individual Achievement Test-III
- Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV)
- Wechsler Intelligence Scale for Children-Fifth Edition (WISC-V)
- Kaufman Brief Intelligence Second Edition (KBIT-2)
- Kaufman Test of Educational Achievement-3rd Edition-Form A

In 2015 the processing speed index (PSI) of the WISC IV was given to David with a PSI of 73. The Kaufmann Brief Intelligence- 2 (KBIT-2) was also given in 2015. The verbal scale is composed of two subtests that assess receptive vocabulary and general information (Verbal Knowledge) as well as comprehension, reasoning, and vocabulary knowledge (Riddles). David had a standard score of 61 in the below average range. The Nonverbal scale uses a Matrices subtest to measure the ability to solve new problems by accessing an individual ability to complete visual analogies and understand relationships (17). David had a Nonverbal standard score of 66 in the below average range. The IQ composite had a standard score of 58 also in the below average range.

The Wechsler Individual Achievement Test-III was given to David in 2015. The examiner noted severe difficulties academically with severely impaired scores in early reading, math problem and listening comprehension. Spelling was in the low average range and alphabet writing in the average range. Word reading and numerical operations were in the moderately impaired range. David made significant gains in reading abilities.

Intervention

In December 2014, David's parents contacted Brown to discuss using *EMCDC* to strengthen his cognitive abilities; visual and auditory processing speed, comprehension, working memory**,** long term memory, and reasoning skills. According to David's parents, despite all the support from teachers, occupational therapist and speech therapist his IQ composite was a 58 showing an intellectual disability. Brown reviewed the academic and psychological testing showing an intellectual disability with deficits in processing, working memory, comprehension, and perceptual reasoning; she then agreed to begin working with David using *EMCDC*. David has received cognitive developmental therapy with Equipping Minds Cognitive Development Curriculum from February 2015- May 2017 for 20-30 minute sessions, 5 days a week for 160 hours.

Results after intervention

In September 2016, David was referred for a psycho-educational re-evaluation to determine continued special education eligibility and placement. He was previously identified as a student with an Autism Spectrum Disorder. He had most recently attended private school. With his recent move into the public school, a psychological and educational assessment was done in the first month of school. David was seen

for one assessment session. Though David had no relationship with the examiner, rapport during testing was easy to establish and maintain. He was a willing and cooperative test participant, although quiet at the beginning. David was generally polite and responsive to the examiner and worked steadily on those tasks that were presented to him. During the testing situation, David utilized a moderate work pace. He maintained inconsistent eye contact and displayed decent interpersonal skills. He was persistent on most tasks and showed some interest in the tasks presented. David displayed a normal activity level for his age. He responded with realistic confidence in his ability, not becoming overly upset or frustrated when a question or task was perceived as challenging/ difficult. David required some encouragement throughout testing. He tended to respond with general or vague responses and benefitted from queries to improve upon his answers. Visual tasks that included a model were particularly beneficial. Overall, the results of this evaluation are considered to be a valid indication of David's current potential and general levels of ability.

After receiving cognitive intervention with EMCDC for 1.5 years, the WISC-V was given in 2016 to assess David's performance across five areas of cognitive ability. As measured by the WISC-V, his overall FSIQ score fell in the Below Average range when compared to other children his age (FSIQ = 72). However, this was an increase of 14 points from the FSIQ of 58 in 2015. Furthermore, he showed average performance when working with primarily visual information and the VSI demonstrates an area of strength relative to his overall ability (VSI = 97). When compared to his fluid reasoning (FRI = 85), working memory (WMI = 74), and processing speed (PSI = 77) performance, visual spatial skills emerged as a particular strength.

The language skills assessed appear to be one of David's lowest areas of functioning. He showed very weak performance on the Verbal Comprehension Index (VCI = 62). The verbal results are similar to the 2015 KBIT-2 with a score of 66. Verbal scores emerged as an area of need when compared to his performance on fluid reasoning (FRI = 85), working memory (WMI = 74), and processing speed (PSI = 77) tasks. Ancillary index scores revealed additional information about David's cognitive abilities using unique subtest groupings to better interpret clinical needs. On the Nonverbal Index (NVI), a measure of general intellectual ability that minimizes expressive language demands, his performance was Below Average for his age (NVI = 82). He also scored in the Below Average range on the General Ability Index (GAI), which provides an estimate of general intellectual ability that is less reliant on working memory and processing speed relative to the FSIQ (GAI = 75). David's low performance on the Cognitive Proficiency Index (CPI) suggests that he struggles to efficiently process cognitive information in the service of learning, problem solving, and higher order reasoning (CPI = 73). David achieved an average score on the VMI, which measures visual motor integration skills.

However, at 10 years of age, David was administered the Kaufmann Brief Intelligence- 2 (KBIT-2) in September 2016 by Brown who had been working with him on a daily basis for over 1.5 years. The test was given over two days. David exhibited no anxiety and was extremely thoughtful in his responses. The KBIT-2, measures verbal and nonverbal intelligence for individuals from 4 to 90 years of age. The test yields three scores: Verbal, Nonverbal, and an IQ Composite. The Verbal scale is composed of two subtests that assess receptive vocabulary and general information (Verbal Knowledge) as well as comprehension, reasoning, and vocabulary knowledge (Riddles). David had a verbal standard score of 69 in the 8th percentile and in the below average range. This score was similar to his verbal comprehension index score of 62 on the WISC V and the verbal score on the KBIT -2 in 2015 of 61. The Nonverbal scale uses a Matrices subtest to measure the ability to solve new problems by accessing an individual ability to complete visual analogies and understand relationships (17). David had a standard score of 122 in the 56th percentile in the average range which is a substantial gain of 56 points from the 2015 KBIT-2 with a Nonverbal score of 66. As noted on the WISC V, David's visual spatial skills emerged as a particular strength with a score of 97. The IQ composite had a standard score of 95 in the 37th percentile also in the average range. This is the only exam administered by Brown. It is Brown's opinion that the difference in IQ on the 2016 WISC V (FSIQ-72), 2015 KBIT 2 (FSIQ-58), and 2016 KBIT 2 (FSIQ 95) are a result of the

cognitive training and having a relationship with the examiner allowing David to complete the test in optimum conditions.

Results of standardized achievement testing on the Kaufman Test of Educational Achievement-3rd Edition-Form A given in 2016 suggest that David is performing within the average range for the area of spelling. The areas of letter/word recognition, silent reading fluency, reading comprehension, math computation, and math concepts/applications were found to be within the below average range. The assessment instruments used provide a comprehensive set of individually administered norm-referenced tests for measuring academic achievement. It should be noted that norm-referenced assessments do not test curriculum benchmarks or the amount of instruction needed to achieve benchmarks. These tests provide a measure of David's academic achievement as compared to same age peers using a standard score. His test performance can be generalized to similar, non-test, age-level tasks.

In analyzing the results on the Wechsler Individual Achievement Test-III given in 2015 and the Kaufman Test of Educational Achievement-3rd Edition-Form A given in 2016, David made significant gains in reading abilities, letter/word recognition, silent reading fluency, reading comprehension, math computation, and math concepts/applications moving from severely impaired in 2015 to below average range 1.5 years later. Spelling moved from below average to the average range.

In conclusion, the academic and cognitive gains which David has shown indicate strong cognitive modifiability in many areas. While the verbal skills have not increased at the same rate as the Nonverbal, nonetheless, there has been progress. Brown would note that whereas the processing scores are in the below average range, David is very diligent and precise when completing processing exercises. He is typically 100% accurate but works slowly. Brown was not surprised by the slower processing score. David continues to increase in his reading abilities, writing, and enjoys cognitive exercises which employ visual logic puzzles.

Table 6. Results of WISC IV, WISC V and KBIT-2 of David

Scale WISC – IV 01/2015	Composite Score	Scale WISC –V 09//2016	Composite Score	Difference	
		Verbal Comprehension	62		Below average
		Working Memory	74		below average
Processing Speed	73	Processing Speed	77	4	Below average
		Visual Spatial	97		average
		Fluid Reasoning	85		Average
KBIT-2 IQ Composite	58	Full Scale IQ	72	14	below average

Table 7. Results of KBIT 2 of David

KBIT-2 01/2015	Standard Score	KBIT-2 09/2016	Standard Score	Difference	
Verbal	61	Verbal	69	8	below average
Nonverbal	66	Nonverbal	122	56	Average
IQ Composite	58	IQ Composite	95	37	Average

Table 8. Results of WIAT III of David

Scale WIAT-III 01/2015	Standard Score	Scale KETA-3 09/2016	Standard Score	Difference
Early Reading Skills	40	Reading Composite	73	33
Word Reading	70	Letter and Word Recognition	77	7
Listening Comprehension	53	Reading Comprehension	71	18
Receptive Vocabulary	66	Silent Reading Fluency	78	12
Expressive Vocabulary	55	Math Composite	73	18
Math Problem Solving	51	Math Concepts and Application	68	17
Numerical Operations	71	Math Computation	81	10
Spelling	83	Spelling	86	3

Case 3. Kay: General learning disorder

Kay was born six weeks early with respiratory distress syndrome. She weighed less than six pounds, walked at 19 months, and began speaking between 30-36 months. Her parents have been concerned about her cognitive abilities since the first evaluation when she was 7 years of age. At that time, her Full-Scale IQ on the WISC-IV was 72. Kay performed much better on nonverbal than verbal reasoning tasks. Her Verbal Comprehension Index is 79, Perceptual Reasoning is 94, Processing Speed is 73, and Working Memory 56. Kay performs better on nonverbal than verbal skills.

At the age of 15 years, Kay had another educational evaluation. On the Slosson Full – Range Intelligence test, Kay received a Full –Range IQ score of 85. The verbal index score was 88, the memory index standard score is 80, and the performance index standard score is 84. All three of these index scores: 88, 84, and 80 are consistent with Kay's overall IQ score of 85.

Academic testing has been done with the Woodcock Johnson Test of Achievement III (WJ-III) from 2005- 2016. In April 2005, the WJ-III results indicated Kay was in the average range in broad math and math calculations. Oral expression, basic reading, and math reasoning, and listening comprehension were in the low average range. She has been home-schooled by her mother for her academic career. In 2013, the Peabody Individual Achievement Test was given. Kay had a standard score of 84 (14th percentile) in general information, standard score of 71 (3rd percentile) in reading recognition, a standard score of 70 (2nd percentile) in reading comprehension, standard score of 67 (1st percentile) in total reading, standard score of 74 (4th percentile) in mathematics, standard score of 76 (5th percentile) in spelling, stand score of 69 (2nd percentile) for the total test, a standard score of 71 (3rd percentile) in written language, and written expression was in the low range.

Assessments

- Universal Nonverbal Intelligence Test (UNIT)
- WISC-IV
- Slosson Full Range IQ Test
- Woodcock-Johnson Tests of Achievement - Third Edition (WJ-III)
- Peabody Individual Achievement Test

Intervention

In July 2015, Kay's parents contacted Brown to discuss using *EMCDC* to strengthen her cognitive abilities; visual and auditory processing speed, comprehension, working memory**,** long term memory, and reasoning skills. Kay is 17 years of age. According to Kay's mother, she was struggling to process information in a one-on-one homeschool setting. Brown reviewed the academic and psychological testing showing cognitive deficits in processing, working memory, comprehension, and perceptual reasoning; she then agreed to begin working with Kay using *EMCDC*. Kay received cognitive developmental therapy with

Equipping Minds Cognitive Development Curriculum from September 2015- May 2016 for 30 minute sessions, 5 days a week for 60 hours.

Results after intervention

After completing 60 hours with *EMCDC,* Kay took the Woodcock Johnson Test of Achievement III as she does every year. In analyzing the results from 2010-2014, Kay typically made gains of 6 months to 1 year. At a 9.8 grade level in 2014, Kay's scores ranged from 4.2 – 7.0 in the majority of subjects putting her 2 to 5 years below grade level. However, Kay made significant gains in Grade Equivalent (GE) and Age Equivalent (AE) on the 2016 assessment where she was 11.8 GE and 18.2 AE in the following areas:

- Oral language went from a 4.4 GE to >17.6 GE for a gain of 13.2 years and >21 AE
- Written expression went from 7.6 GE to 12 GE for a gain of 4.4 years and >17.6 AE
- Understanding Directions which is similar to working memory went from 4.5 GE to 18 GE for a gain of 13.5 years and >21 AE
- Math Calculations went from 9.5 GE to 11.2 GE for a gain of 1.7 years and 16.8 AE
- Writing Sample went from 8.7 GE to 11.4 GE for a gain of 2.7 years and 16.11 AE
- Story Recall went from 5.6 GE to 13 GE for a gain of 7.4 years and 20 AE.

Table 9. Results of WISC IV for Kay

Scale WISC –V 12/2005	Composite Score	Percentile	
Verbal Comprehension	79	8	low
Working Memory	56	.2	low
Processing Speed	73	4	low
Perceptual Reasoning	94	34	average
Full Scale IQ	72	3	low

Table 10. Results of Slosson for Kay

Scale 03/2013	Composite Score	Percentile	
Verbal Index	88	8	low
Memory Index	80	.2	low
Performance Index	84	4	low
Full Scale IQ	85	3	below average

Table 11. Results of Universal Nonverbal Intelligence Test (UNIT) for Kay

UNIT 05/2006	Standard Score	Percentile
Memory Quotient	89	23
Reasoning Quotient	95	37
Symbolic Quotient	91	27
Nonsymbolic Quotient	93	32
Full Scale IQ	91	I

Table 12. Results Woodcock Johnson III Normative Tests of Achievement of Kay

	GE:5.8	GE:6.8	GE:7.8	GE:9.8	Score after intervention Grade: 11.8	Difference
	2010	2011	2012	2014	2016	
Oral Language	3.7	3.5	4.6	4.4	17.6	13.2
Brief Achievement	3.2	3.7	4.2	4.6	6.5	1.9
Broad Reading	2.8	3.1	3.9	4.7	6.6	1.9
Broad Math	5.2	5.7	6.3	7	7.2	0.2
Broad written language	3.3	4.3	4.8	6.3	8.9	2.6
Brief Reading	2.9	3.3	4.1	4.8	7	2.2
Brief Math	5.1	5.5	6.3	6.6	7.2	0.6
Math Calc Skills	6	6.4	8.1	9.2	9.2	0
Brief Writing	3	4.1	4.7	5.9	8.1	2.2
Written expression	3.9	5.1	5.5	7.6	12	4.4
Acad Skills	3.6	4	5.1	5.5	7.8	2.3
Acad Fluency	3.6	4.3	4.7	6.4	7.6	1.2
Academic Apps	3.6	4.5	4.7	5.9	6.7	0.8
Academic Knowledge	3.4	3.4	4.5	4.8	7.1	2.3
Letter Word ID	3	3.2	4.2	4.3	7.2	2.9
Reading Fluency	2.4	2.4	3.2	4.3	5.5	1.2
Story Recall	3	8.8	3.7	4.2	6.8	2.6
Understanding Directions	4.1	2.4	5.1	4.5	18	13.5
Calculations	6.4	6.4	9.5	9.5	11.2	1.7
Math Fluency	5.4	6.7	6.6	8.7	7.5	-1.2
Spelling	2.7	3.4	3.7	4.8	6.9	2.1
Writing Fluency	3.9	4.9	4.9	7	13	6
Passage Com	2.7	3.5	3.9	6	6.7	0.7
Applied Prob	4.2	4.7	4.5	4.8	5.2	0.4
Writing Sample	3.8	5.5	6.7	8.7	11.4	2.7
Story Recall	1.8	17.8	2.7	5.6	13	7.4
Academic Knowledge	3.4	3.4	4.5	4.8	7.1	2.3

The same examiner has given the test for numerous years and indicated that gains of this magnitude had not been seen and is untypical of someone with Kay's long academic history of learning challenges. The gains correspond with the cognitive developmental therapy with *EMCDC* which Kay received during September 2015-May 2015. She had previously been receiving academic tutoring alone. In conclusion, the academic gains which Kay has shown indicate strong cognitive modifiability in many areas after using *EMCDC.*

Case 4. Steven: Fetal alcohol spectrum disorder, post-traumatic stress disorder, autism, mixed receptive-expressive language disorder, specific learning disorder, anxiety

Steven was adopted from Russia at 5 years of age. He has a history of mild alcohol related neurodevelopmental disorder in addition to psychosocial growth failure. He has been evaluated by a pediatric endocrinologist for growth issues as he has been below the 10th percentile which was consistent with the initial neuropsychological evaluation. Steven is on medication for attentional problems and has Lyme disease. He has a history of strabismus with residual exotropia which was addressed in developmental optometry. The diagnostic conclusions

indicated a mixed receptive-expressive language disorder; multi-sensory neuropsychologically-based processing deficits related to an alcohol related neurodevelopmental disorder/static encephalopathy in addition to multiple learning disabilities in the category of developmental dyslexic disorder. Steven certainly had a great deal of anxiety which is very commonly seen in children who have multi-sensory neurocognitive deficits.

Steven's overall neuropsychological history indicates that he was evaluated at the age of 10 years of age with a pattern of global weaknesses in receptive and expressive language as well as processing and learning deficits. Many of these issues were related to mild alcohol-related neurodevelopmental disorder with some quasi-autistic characteristics in addition to multisensory information processing impairments. Subsequent to the neuropsychological evaluation, Steven received special education services throughout his school years and was re-evaluated at the start of his tenth-grade year in January of 2012.

Assessments

Steven received extensive evaluations of his cognitive abilities from 2005-2015. The evaluation procedures used included:

- Wechsler Adult Intelligence Scale – Fourth Edition (WAIS-IV)
- Childhood Autism Rating Scale – Second Edition (CARS) (Higher-Functioning Version)
- Gilliam Autism Rating Scale – Third Edition (GARS)
- Test of Visual-Perceptual Skills – Third Edition
- Test of Auditory Processing Skills – Third Edition
- Test of Adolescent and Adult Language – Fourth Edition
- Wide Range Achievement Test – Fourth Edition (WRAT-4)
- Wechsler Individual Achievement Test – Third Edition (WIAT-III)
- Wechsler Memory Scale – Fourth Edition
- Cognitive Assessment System
- Category Test
- Wisconsin Card Sorting Test
- Thematic Apperception Test
- Minnesota Multiphasic Personality Inventory – Second Edition (MMPI-2)
- Adult and Family Sentence Completion Series
- Adult Neuropsychological History
- Adult Neuropsychological Questionnaire
- Review of Records

Steven's initial intellectual testing completed in 2005 yielded a Verbal Comprehension IQ Score of 75; Perceptual Reasoning IQ Score of 92; Working Memory IQ Score of 77; Processing Speed IQ Score of 97; Full Scale IQ Score of 81. All of these scores are generally within the Average Range. Gaps and inconsistencies in nonverbal learning aptitudes and abilities as well as receptive and expressive language were evident.

In the updated evaluation in 2012, Steven was administered the Wechsler Intelligence Scale for Children – Fourth Edition and obtained a Verbal Comprehension IQ Score of 79 (Borderline Range); Perceptual Reasoning IQ Score of 88 (Low-Average Range); Working Memory IQ Score of 83.

Steven also showed ongoing indications of a mild Autistic Disorder given his difficulties in relating to others as well as anxiety, stress and struggles with adapting to change, in addition to expressive pragmatic language. Steven also had definite problems in comprehension and higher-level listening responses in addition to gaps and inconsistencies in attention, memory, learning and overall information processing and problem solving.

Steven's overall language abilities indicated major weaknesses in comprehension, processing and expressive semantic-pragmatic-syntactical expression. Academic-achievement abilities indicated weaknesses in reading style, rate and written language with relative strengths in mechanical math but difficulties in mental calculations and word problems. Steven always struggled with expressive writing in addition to memory processing and consolidation in both auditory and visual spheres. He also had significant patterns of executive dysfunction. Over the years, Steven has been receiving special education services through his school district and has made gradual progress.

Intervention

In October of 2014, Steven's parents contacted Brown to discuss using *EMCDC* to strengthen his cognitive abilities; visual and auditory processing speed, comprehension, working memory**,** long term memory, and reasoning skills. According to Steven's parents, he was finishing his senior year in high school and continuing to struggle in social awareness, math sense, communication skills, executive functioning, and academics. Brown reviewed the academic and psychological testing showing cognitive deficits in processing, working memory, comprehension, and perceptual reasoning; she then agreed to begin working with Steven using *EMCDC*. Steven received cognitive developmental therapy with Equipping Minds Cognitive Development Curriculum from January 2015-May 2015 for 60 minute sessions 5 days a week for 60 hours. Steven also did 15-20 minutes of primitive reflex integration therapy and 60 minutes of sound therapy on a daily basis for a few months.

Results after intervention

After completing cognitive developmental therapy with *EMCDC,* his parents stated that Steven showed reduced anxiety, increased eye contact, more social awareness, had a sense of humor and math sense. His overall language and language arts abilities have improved with cognitive therapy, and he is definitely improved in his overall high school performance even though there are some gaps and inconsistencies in memory, learning and overall speech and language and pragmatics. Steven did begin a job working at a plant nursery where he can use his landscaping skills.

Further testing was done in July 2015. Steven remembered the examiner quite well and was very polite and cooperative. He displayed very good attention, concentration and focus as there were no major difficulties evident. Steven no longer needs to take ADHD medication. Psychologically, Steven is a hands-on visual assimilative learner and is much more reality-based. Steven does much better with hands-on mechanical aptitude skills. He has developed better social reciprocity but still has some food selectivity as well as some subtle self-stimulatory behaviors. There are times that he can be rather rigid and inflexible in his thinking and easily overstimulated.

There were certainly some indications of ongoing "performance anxiety" which impacts testing. Steven continued to work very hard at all times but had the most struggles with higher-level language processing and lengthy and sequential memory, learning and recall which are longstanding issues and directly related to his low-grade Alcohol-Related Neurodevelopmental Disorder in addition to his mild autistic patterns.

Steven was administered the Wechsler Adult Intelligence Scale – Fourth Edition and showed a more stable pattern in his overall intellectual abilities which are now within the Average Range although he has a 21-point discrepancy between verbal comprehension and perceptual reasoning which indicates an ongoing language weakness pattern. He also has ongoing weaknesses in his expressive communications as he is not always clear and connected in his semantic-pragmatic-syntactical expression.

As a general summary statement, there is no question that Steven has improved on a global perspective in terms of neurocognitive or neuropsychiatric functioning. He is much more alert, oriented, interactive as well as motivated to do well with a lessening of the neurocognitive effects of a fetal alcohol spectrum disorder in addition to his autistic spectrum disorder which has always been at the "higher-functioning spectrum." In terms of pure academic-achievement abilities, Steven is at the middle school level in overall reading, reading comprehension, spelling and written language and mathematics. This certainly is a significant improvement as it shows that he has enough neurocognitive and academic skills in order to function at the technical-vocational training level as his strengths are in the areas of hands-on visual assimilative learning which is his area of interest.

Table 13. Results of WISC IV for Steven

Scale WISC – IV 01/2012	Composite Score	Scale WISC –IV 07/2015	Composite Score	Difference
Verbal Comprehension	79	Verbal Comprehension	76	-3
Working Memory	83	Working Memory	80	-3
Processing Speed	94	Processing Speed	106	12
Perceptual Reasoning	88	Perceptual Reasoning	97	9
Full Scale IQ	81	Full Scale IQ	89	8

Case 5. Bryant: Post traumatic concussion syndrome

At 18 years of age Bryant experienced a head injury during a rugby game. The doctors recommended antidepressants and extended rest. As the symptoms increased, he tried various treatments over the next four years from acupuncture to chiropractic treatments. However, the symptoms were not alleviated. He then took one year off and had given up. At this time, he was 23 years of age.

Assessment

- Interview with learner
- Learning Screening Checklist
- Primitive Reflex Checklist

Below is a list of the most prominent symptoms Bryant experienced after the concussion.

- Fogginess: One of my most prominent symptoms is what can only be described as a feeling of fogginess. When in this state, it is hard to complete most mental tasks. It felt as if my neurons were trying to fire and make connections but didn't have a clear pathway to do so according to Bryant.
- Difficulty with concentration and attention: Within this state Bryant had a difficult time concentrating on tasks and paying attention for extended periods of time.
- Poor working memory: Difficulty following multiple step directions
- Long term memory retrieval: Difficulty remembering names of people
- Language retrieval and processing: Difficulty recalling vocabulary
- Extreme physical and mental fatigue: Mental fatigue is like the fogginess but manifests itself in fatigue-like symptoms. For example, during reading Bryant would have to fight off an intense desire to sleep and could no longer concentrate on whatever was being read.
- Depression

Intervention

In October of 2016, Bryant contacted Brown to discuss using *EMCDC* to strengthen his cognitive deficits as a result of Post Traumatic Concussions Syndrome. According to Bryant he has tried numerous interventions over the last 5 years with little relief. Brown agreed to have an *EMCDC* mediator begin working with Bryant using *EMCDC*. Bryant received cognitive developmental therapy with *EMCDC* from September 2016-April 2017 for 30-60 minute sessions 5 days a week for 100 hours. Bryant also did 15-20 minutes of primitive reflex integration therapy and 60 minutes of sound therapy on a daily basis during this time.

Results after intervention

- Decreased fogginess: After working with *EMCDC,* the periods and intensity of fogginess have significantly decreased. The

exercises we focused on strengthened those connections and helped my brain work around its deficits according to Bryant.

- Increased concentration and attention: Bryant reports having a much easier time holding attention and concentrating on specific tasks.
- Increase in working memory: Able to follow multi-step directions
- Long term memory: Able to store information and retrieve information much easier
- Increased stamina and energy: His stamina and energy has significantly improved while performing cognitive task.
- Enjoying reading and learning
- Spending extended time outside without being symptomatic

Discussion

In the case studies, Brown examined the effects of *EMCDC,* a holistic cognitive development program, with children and adults in a one-on-one setting. Brown utilized clinical observations of the learners, examination and analyzation of the psychological and educational documents, and interviews with the parents, the learners, and teachers. Cognitive and academic gains were demonstrated in all of the case studies. The results are consistent with the results of Brown's doctoral research with learners with a Specific Learning Disorder and the four-year case study with Marie who had Down syndrome. Family members, therapists, and teachers were included in the therapy sessions and instructed how to interact and instruct using mediated learning. This suggests that a comprehensive intervention program which addresses numerous cognitive functions and includes parents and other professionals in the learner's life allows more opportunities for modification.

Conclusion

While the case studies showed cognitive gains in each learner, case reports lack the strength of a controlled quantitative research study. However, single case research is accepted in neurorehabilitation scientific literature for neurodevelopmental disorders. The case histories suggest the importance of further research with learners with neurodevelopmental disorders such as Fetal Alcohol Syndrome and Autism as well as Post Traumatic Concussion Syndrome using the *Equipping Minds Cognitive Development Curriculum* (*EMCDC).* When implementing the *EMCDC,* it is essential to implement the program with fidelity using mediated learning. The success of the doctoral research with *EMCDC* and the case studies suggest that cognitive skills can be developed in the classroom or clinical setting through a human mediator which will increase verbal, nonverbal, IQ, and impact academics.

References

[1] Tan O, Seng A. Cognitive modifiability in learning and assessment: International perspectives. Singapore: Cengage Learning, 2008.

[2] Feuerstein R, Feuerstein R, Falik L. Beyond smarter: Mediated learning and the brain's capacity for change. New York: Teachers College, 2010.

[3] Feuerstein R, Feuerstein R, Falik L, Rand Y. The Feuerstein Instrumental Enrichment Program. Jerusalem: ICELP Publications, 2006.

[4] Brown C. Equipping minds: Applying a biblically based curriculum for improving working memory. Dissertation. Louisville: KY: Southern Baptist Theological Seminary, 2016.

[5] Kozulin A, Lebeer J, Madella-Noja A, Gonzalez F, Jeffrey I, Rosenthanl N, et al. Cognitive modifiability of children with developmental disabilities: A multicenter study using Feuerstein's Instrumental Enrichment-Basic Program. Res Dev Disabil 2010;31:551–9.

[6] Feuerstein R, Lewin-Benham A. What learning looks like: Mediated learning in theory and practice, K–6. New York: Teachers College Press, 2012.

[7] Feuerstein R, Falik L, Feuerstein R. Changing minds and brains. New York: Teachers College Press, 2015.

[8] Mentis M, Dunn-Bernstein M, Mentis M, Skuy M. Bridging learning: Unlocking cognitive potential in and out of the classroom. Thousand Oaks, CA: Corwin, 2009.

[9] Johnson K. Maintaining brains every day DVD. URL: http: www.pyramidofpotential.com.

[10] Bloomberg H. Dempsey M. Movements that heal: Rhythmic movement. Sunnybank Hills, Australia: Book Pals, 2011.

[11] Joundry P, Joundry R. Sound therapy: music to recharge your brain. Sydney, Australia: Success Stream Books, 2009

[12] Brown C. Equipping minds cognitive development curriculum. Danville, KY: Self Published, 2015.

[13] Brown C. Equipping minds for Christian education: Learning from neuroscience for Christian educators. Christian Educ J 2016;13(1):147-68

[14] Brown C. Equipping minds for Christian education or learning from neuroscience for Christian educators. In: Maddix M, Bevins D, eds. Neuroscience and Christian formation. Charlotte, NC: Information Age Publishing, 2016:153-170.

[15] Jaeggi S, Buschkuehl M, Jonides J, Perring W. Improving fluid intelligence with training on working memory. Proceed Natl Acad Sci 2008;105:6829–33

[16] Jaeggi S, Buschkuehl M, Shah P, Jonides J. The role of individual differences in cognitive training and transfer. Mem Cogn 2014;42(3):464-80.

[17] Kaufman A, Kaufman N, Kaufman Brief Intelligence Test, 2nd ed. Bloomington, MN: PsychCorp, 2004.

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