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Executive Function: What It Is and How It Affects Reading Comprehension

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MSUM
Capstone Project for
Masters in Special Education
Focus on Learning Disability

Executive Function: What It Is and How It Affects Reading Comprehension

Capstone Project
Literature Review & Intervention Plan

Minnesota State University
Moorhead
Special Education

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Abstract

Executive function is a very key component of development. Awareness of executive function has become more prominent in education. Research has been able to determine how the executive function develops in children versus adults. Specific areas of executive function have been identified. When the area was identified and how they influence behavior, interventions and strategies could be developed to counter the deficit. In the education world, assessing students with the purpose of identifying the deficits was difficult. Administering assessment naturally took care of the need for EF skills. New assessments needed to be developed. Companies have made those developments. Affective interventions for executive function have been developed. They are successfully implemented. Affective interventions for reading deficits have been successful. Data has been collected on both individually. Research needs to combine the interventions on both working together.

Executive Function and Intervention

Introduction

Executive function (EF) comprises key regulatory processes that are essential for health and cognitive skill formation, chosen goals, and are critical for the transition from child to adult-like thoughts and behaviors. Because of the importance of EF for life outcomes, researchers have been interested in understanding the relations of EF to academic skills, as well as the neural bases of normative EF maturation (Banich, 2009; Church, Bunge, Petersen, & Schlaggar, 2017; Engelhardt, Harden, Tucker-Drob, & Church, 2019; McKenna, Rushe, & Woodcock, 2017). Specialists find researching executive functions very frustrating as there are many working definitions in place.

Definition of Executive Function

Although a definition of executive function is defined differently across disciplines, there are generally agreed on components. These include inhibiting actions, restraining and delaying responses, attending selectively, setting goals, planning, and organizing, as well as maintaining and shifting set. Most acknowledge the relationship between executive functions, attention, and working memory (e.g., Barkley, 1996, 1997; Esslinger, 1996; Pennington, Bennetto, McAleer, & Roberts, 1996). EF is being identified as a possible influence on academic learning and behaviors. EF skills are the attention-regulation skills that make it possible to sustain attention, keep goals and information in mind, refrain from responding immediately, resist distraction, tolerate frustration, consider the consequences of different behaviors, reflect on past experiences, and plan for their future (Zelazo & Blair 2000). The term “Executive Function” is an umbrella term which encompasses most cognitive items that take place in the prefrontal regions. These regions are associated with other neural pathways, which allow the execution of targeted behaviors to be intended, flexible, relevant, scheduled, and appropriate.

What does executive function affect?

Research has shown that a deficit in executive function has an effect on learning and behaviors in children. EF is central to school readiness and early school achievement (Blair 2002; Blair and Raver 2015). Research has found that EF measured in childhood predicts a wide range of important outcomes, including readiness for school (e.g., McClelland et al. 2007) and the successful transition to kindergarten (e.g., Blair and Razza 2007); school performance and social competence in adolescence (e.g., Mischel, Shoda, and Rodriguez 1989); better physical health; higher socioeconomic status (SES); and fewer drug-related problems and criminal convictions in adulthood (Moffitt et al. 2011).

Executive function affects a student's academic success. Academically EF can affect a student's ability to attend to instruction, follow classroom management, organization of school materials, reading comprehension, word decoding or inferencing. EF is a specific set of attention-regulation skills involved in conscious goal-directed problem solving. These skills include cognitive flexibility, working memory, and inhibitory control (e.g., Blair and Diamond 2008; Carlson, Zelazo, and Faja 2014; Diamond 2013; Garon, Bryson, and Smith 2008; Hughes 2011; Jacques and Marcovitch 2010; Meuwissen and Zelazo 2014). Executive functions can also be considered the decision-making and planning processes that are invoked at the outset of a task (Singer, 1999). These skill areas use neural circuits located in the prefrontal cortex and other areas of the brain. These skills are responsible for controlling and activating along with intentionally controlling attention to complete a goal, like holding a question in mind.

Children, who struggle with learning, reading and writing skills, or mathematics, have met the criteria for a specific learning disorder. The disorder usually is an indication that

genetics or environmental factors are contributing to the deficit in these skills. These factors usually involve brain functions that are responsible for receiving and responding to information. Executive functions generally include psychological functions, organizing functions, working memory, attention, problem solving, verbal reasoning, cognitive flexibility, planning, and initiation as well as monitoring of activities (Fadaei, Tovakoli, Tahmasebi, Narimani, Shiri, & Shiri, 2017).

Why is it important to identify executive function?

Researchers have found readers who are successful with reading comprehension have an understanding of how to read single words or to decode. Children must have a basic understanding of the parts of speech, which consists of the ability to manipulate the sound structure of speech and to understand that words are composed of phonemes. If a child is having difficulty learning how to decode, they have a deficit in phonological processing, the ability to manipulate the sound structure of language. Children need to understand their letter sounds to help them build and decode words. The ability to decode words has a direct effect on reading comprehension. It is difficult to glean information from text without the ability to sound out words accurately, particularly for young children just learning to read (Sesma, Mahone, Levine, Eason, & Cutting, (2009). Fluency is also key in reading comprehension, especially for older children, who are required to use reading continuously to further their learning. Struggling readers are over working their cognitive processing skills when they try to decode words as they read. Decoding words is difficult if phonological skills are under developed. Working memory is needed to access letter sounds to assist with decoding words. Therefore, decoding is difficult and takes time which disrupts reading fluency. Studies have shown that improvements in fluency are associated with accompanying improvements in reading comprehension (e.g.,

Berninger, Abbott, Vermeulen, & Fulton 2006; Cates, Thomason, Havey, & McCormick, 2006; O'Connor, White, & Swanson, 2007).

How does executive function influence reading comprehension?

Reading comprehension is complex. It is layered with multiple layers of language comprehension. Knowledge and skills involving vocabulary, background information, grammatical structures, metaphorical language, and inferential reasoning must be applied in a coordinated manner to understand connected text (Sesma, Mahone, Levine, Eason, & Cutting, (2009). One large study examining the relation between oral language skills and reading comprehension found that children identified as poor readers in second grade were three to five times more likely to have a history of oral language problems in kindergarten than competent second grade readers (Catts, Fey, Zhang & Tomblin, 1999). Kindergarten oral language skills also accounted for significant variance in second grade reading comprehension after controlling for phonological awareness and rapid naming skills (Catts et al., 1999).

Another layer of reading comprehension skills requires a higher level of cognitive processes i.e., working memory. Limited working memory, poor inference making and ineffective comprehension monitoring will influence reading comprehension. Executive function is a broad term that encompasses many higher order skills necessary for independent, goal-directed behavior, including holding and manipulating information in working memory, planning/sequencing multi step tasks, and ascertaining the “big picture” from a complicated set of details (Deneckla, 1989).

Reading is accomplished by a combination of visual and language brain processes to decipher written words. The knowledge of how the brain works while reading is very well

documented. The brain uses three bilateral swaths of the cortex: (a) a ventral system involving the occipital region extending to the basal surface of the temporal lobe (occipito-temporal) that permits rapid processing of orthographic (visual) features of words; (b) a dorsal sub lexical system involving the posterior portion of the superior and middle temporal gyri, extending into inferior parietal areas (temporo-parietal), that is thought to map phonemes and graphemes (sound correspondence to letter forms); and (c) inferior frontal lobe regions, which are thought to be critical to subvocal articulation processes (Dehaene, 2009; Proice, 2012; Pugh et al., 2000). Readers with poor decoding abilities usually have an under activated ventral and dorsal system. Studies have tried to differentiate which regions of the brain are activated in a struggling reader. Therefore, they have noticed an overlap with the right frontal region and the inferior parietal cortex. These studies have piqued the interest of researchers.

Assessments

How are formal assessments used to assess reading ability?

Reading instruction is focused on word decoding or “learning to read prior to third grade. In third grade, reading comprehension or reading to learn is focused on. There are many formative assessments that can be administered repeatedly. Each of these assessments focus on assessing the student’s ability in a particular reading skill. These assessments are used in many studies to support their findings. The BASC Attention Scale is a broad band parent behavior rating scale that allows parents to report on the relative frequency of a wide variety of adaptive and maladaptive behaviors (Reynolds & Kamphaus, 1992). Woodcock Reading Mastery Test-Revised Word Attack (WRMT-R) is a comprehensive battery designed to measure multiple aspects of reading, including pre reading skills (e.g., letter identification), single word reading,

and reading comprehension (Woodcock, 1987). The Word Attack subtest measures a child's word reading accuracy by presenting a series of pseudowords that the child must decode using phonetic and structural analysis skills (Sesma, H. W., Mahone, E. M., Levine, T., Eason, S. H., & Cutting, L. E., 2009). The Gray Oral Reading Test-Fourth Edition (GORT-4) is a standardized measure of oral reading fluency and comprehension that requires participants to read a paragraph aloud and then to answer a series of questions based on the information they just read (Wiederholt & Bryant, 2001). The Peabody Picture Vocabulary Test-Third Edition (PPVT-III) measures where participants hear a series of words spoken by the examiner and just respond to each word by pointing to the appropriate picture among a field of four black and white line drawings (Dunn & Dunn, 1997). The Wechsler Intelligence Scale for Children - Third Edition (WISC-III) is a standardized instrument measuring intellectual ability in children (Wechsler, 1991). There are 13 subtests which assess a wide range of both verbal and visual spatial problem-solving abilities. There are four components: Verbal Comprehension, Perceptual Organization, Processing Speed and Freedom from Distractibility (FDI). The results from the FDI are reviewed heavily due to its use of verbal working memory. The test does look at other skills but for the purpose of seeing the effect of EF in verbal directions, mental computation and the concentration is followed (Sattler, 1992). The Tower of London is a visual problem - solving tasks commonly used to assess planning skills (Anderson, Anderson, & Lajoie, 1996; Shallice, 1982). The WIAT-II Reading Comprehension and Word Reading is a comprehensive instrument developed to assess academic achievement in reading, writing, mathematics, and oral language (The Psychological Corporation, 2001). Within this study, controls were put in place for inattention and decoding skills, reading fluency (i.e., GORT-4 Fluency), Vocabulary (PPVT-III), working memory (WISC-III FDI), and planning Tower excess moves, each made a significant

unique contribution to prediction of Reading Comprehension (Sesma, H. W., Mahone, E. M., Levine, T., Eason, S. H., & Cutting, L. E., 2009).

How are formal assessments used to identify executive function?

According to Dawson & Guare (2004), attempting to assess executive skills in the context of a formal evaluation is difficult, however, because so many of the factors that demand the use of executive skills on the part of the student are removed from the equation. The examiner and the way standardized assessments are administered naturally take away the EF skills needed to process information. Therefore, the best practices for EF assessment go beyond the using formal standardized measures.

Assessments for executive function have advanced over the 20th century. The neuropsychological assessments of so-called frontal lobe functions, which were the predecessors of current conceptualizations of EF, were limited to adults. This was due to an early belief that frontal lobe development in childhood was limited (Golden 1981). In the field of studying the brain, it was established that the frontal lobes continued to develop from infancy through early adulthood. This shift in understanding was pivotal in initiating modern research on EF in children (reviewed by Hughes 2011; Teeter et al. 2009).

Both informal and standardized information can benefit the collection of information on EF deficits such as, a detailed case history/interview, classroom observations, work samples, and standardized behavior rating scales (Dawson and Guare, 2004, 12). Informal assessments can provide a close look at a student's skills by interviewing the person who knows the student best. The purpose of using a detailed case history/interview type of information collection is because it is useful in identifying strong or weak executive skills, identifying the antecedent for problems

that are most or least likely to occur, determining which interventions are successful or unsuccessful, and adapting to the changing of people and/or an environment. For example, knowing that a parent is organizationally challenged or that a teacher already feels overwhelmed by demands on her or his time can lead to different decisions about intervention (Dawson and Guare, 2004, 13). A second form of informal intervention assessment is classroom observations. The classroom is the setting where discrepancies in EF are first identified. This observation can provide the data needed to set the first intervention needed. Work samples are the third informal assessment. Work samples include tests, writing assignments and agenda. Observing the student's organization of backpack and desk can also provide useful information on a students' abilities.

Behavior checklists are used to rate behaviors with regard to executive skills in students. The Psychological Assessment Resources, the Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) was normed on children ages 5-18 and includes both parent and teacher versions. This assessment measures executive function along with two indexes, Behavioral Regulation and Metacognition, and eight scales assessing individual executive skills. The Behavior Regulation Index includes three subscales: Inhibit, Shift, and Emotional Control, while the Metacognition Index includes five scales: Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor (Dawson and Guare, 2004, 15). Three additional behavioral assessments are Brown ADD Scales -Adolescent Version, Comprehensive Behavior Rating Scale for Children, and Child Behavior Checklist-Teacher Report Form.

Formal assessment measures are meant to provide information on other variables such as cognitive abilities, emotional status, and academic skills that may well impact and be impacted

by executive skills. There are a few tests designed to assess the expanse of executive skills. They are as follows: NEPSY, Porteus Mazes, matching familiar figures test, Trail Making test, Wisconsin card sorting test, Mesulam Tests of Directed Attention, Conners Continuous Performance Test-II, Delis-Kaplan Executive Function Scale and Cognitive Assessment System.

Behavioral observations on EF during a formal assessment must touch on each of these areas: self-regulation of affect, metacognition, goal-directed persistence, flexibility, sustained attention, working memory, response inhibition, planning/prioritization, time management, organization, and task initiation (Dawson & Guare, 2004,18-20). Each of these areas will address a specific EF skill.

The National Institutes of Health (NIH) put together several assessment tools. The first is the Toolbox for the Assessment of Neurological and Behavioral Function. These assessments are designed to be able to be given repeatedly to the same individuals. This allows them to be used in clinical trials and large-scale epidemiological and longitudinal studies. Three measures of EF are available. Zelazo, Blair, and Willoughby defined each measure: The *Dimensional Change Card Sort* (Zelazo 2006) requires children to match a series of bivalent test pictures (e.g., yellow balls and blue trucks) to target pictures, first according to one dimension (e.g., color) and subsequently to a second dimension (e.g., shape). The ability to successfully switch the sorting rule is an indicator of cognitive flexibility. In the *Flanker* task (Eriksen and Eriksen 1974; Rueda et al. 2005) individuals are asked to identify the direction of a centrally presented stimulus while inhibiting attention to stimuli (fish for ages 3-7 or arrows for ages 8-85) that are flanking it. Sometimes the central stimulus is pointed in the same direction as the “flankers” (congruent) and sometimes in the opposite direction (incongruent). Responses to the incongruent items are an indicator of inhibitory control. In the *Toolbox List Sorting Working Memory Test*, pictures of

different foods and animals are displayed with accompanying audio recording and written text (e.g., “elephant”). Individuals are instructed to repeat the items back in size order from smallest to largest, first within a single dimension (either animals or foods, called 1-List) and then on two dimensions (foods, then animals, called 2-List). The proportion of correctly recalled items is an indicator of working memory. The NIH Toolbox also includes brief measures of processing speed (90 seconds) and vocabulary.

Interventions

What interventions are used to assist in correcting EF in reading comprehension?

Reading interventions are necessary for young students with reading difficulties. There is agreement surrounding effective remediation characteristics, including systematic and explicit instruction of graded intensity and a focus on extending the range of print materials (National Early Literacy Panel, 2008; Wanzek & Vaughn, 2007). These practices are beginning to show that they are not as effective with older students. A possible reason for them being less effective is the increasing emphasis on comprehension of complex materials, failure to respond to earlier interventions and/or relying on reading skills that are underdeveloped like inference-making or background knowledge.

There are three core EF skill areas: cognitive flexibility, inhibition (self-control, self-regulation), and working memory. The more complex EFs are problem solving, reasoning, and planning. There is scientific evidence supporting six approaches for improving EFs in the early school years (Diamond, 2011). They are computerized training, a hybrid of computer and non-computer games which, aerobic exercise, martial arts and mindfulness practices, classroom curricula, tools, and add-ons to classroom curricula. Researchers have found action videogames

to affect multiple aspects of cognition, including aspects of attention, such as enhanced visual search skill and a faster attentional blink, as well as faster reaction time and improvements to EF (Bavelier et al, 2012; Granic et al. 2014; Zelazo, Blair and Willoughby, 2017-2000). One randomized controlled experiment with children with dyslexia found that 12 hours of action videogame playing improved reading ability (phonological decoding of pseudo-words and word text reading) relative to a control group playing non-action games (Franceschini et al. 2013; Zelazo, Blair and Willoughby, 2017-2000). Research on aerobic exercise helped with behaviors but not academics (Zelazo, Blair and Willoughby, 2017-2000). The following are a couple of the more successful interventions

- 1.) Studies of curricula and curricula add-ons demonstrate that EF can be improved, even at 4 to 5 years of age by regular teachers (given training and support) in regular classrooms without expensive equipment.
- 2.) There are suggestions that computer training and martial arts may benefit children of 8 to 12 more than children of 4 to 5.
- 3.) Computer training has been shown to improve working memory and reasoning, but it is unclear whether such training can improve inhibitory control. Other (non-computer-based) approaches report improvement in inhibitory control as assessed by selective attention or response inhibition, but none report improvement in the inhibitory control needed to delay gratification.
- 4) EF training appears to transfer, but the transfer is narrow. Working memory training improves working memory but not inhibition or speed. If the training was only with visual-spatial items, there is little transfer to verbal material. EF gains from martial arts or school curriculum may be wider because the programs themselves address EF more globally, the transfer may not be wider, but rather the programs address more EF components (Diamond, 2011).

How is an effective intervention planned for a student?

The intervention approach presented for each student will reflect the individual needs of that student. For the intervention to work it must reflect the specific skill that was identified for the student. Authors Singer and Bashir gave some ideas of how to start a framework along with the components of interventions. “To get started it is crucial to consider these points: 1. Understand a student’s abilities and needs using the results of standardized tests; a picture of strengths and needs is fundamental to designing sound language intervention programs. 2. Conduct a careful student interview to reveal the specific problems the student encounters with communication and academic performance. Formulate, confirm, and refine hypotheses about the presenting problems with the student. 3. Use information obtained from formal and informal assessments to help the student acknowledge the influence of different settings, contexts, and content demands on performance. 4. Clarify for the student the insights derived from integrating interview and assessment data. Discuss strengths and needs in different domains (e.g., communication, language, executive functions, self-regulation, and cognitive), and set relevant intervention goals. 5. Assist the students with recognizing how intervention processes will enhance his or her day-to-day performance. Have the student commit to achieving intervention goals. Now that we know what we need to get started, it is important to set up a framework to put the interventions into place. A suggested framework would look like this:

- Promote an understanding of the processes involved in oral and written language, guide the flexible use of strategies to facilitate academic and communicative performance, and create new habits of communication, thinking, and problem-solving that promote independence.

- Base intervention on dialogic and interactive teaching approaches that serve to help students understand and develop active problem-solving through self-reflection (self-monitoring, self-evaluation, and behavioral adjustment).
- Address the language underpinnings of metacognitive functioning and support the development and appropriation of language for verbal mediation and regulation of behavior.
- Address issues of self-efficacy and motivation directly by helping students to understand their current problems with learning, know what they can do to alleviate their problems, and realize their developing capacity to control their performance and their learning environments.” (Singer & Bashir, 1999).

There are possibly five components of intervention to be considered. The first would be to design intervention goals that address the linguistic, executive, self-regulatory, and strategic learning needs of students explicitly and systematically. Second, avoid decontextualized interventions. Goals of intervention are not isolated from the day-to-day demands for communication and learning that students encounter. Thirdly, assist students with understanding where, when, why, and how to use context-specific strategies that can be applied across social and curriculum content areas as well as spoken and written language systems. Teach students to recognize when tasks require mindful use of executive functions and self-regulating behaviors. Fourth, support students to take risks in order to become effective communicators and learners, and help them adapt strategies to fit their own styles and needs. Last, provide frequent and systematic conferencing with students in order to help them realistically appraise their academic and personal growth, and set goals accordingly (Singer & Bashir, 1999).

How to check for progress on an intervention plan?

While the intervention plan is in place, observe and take note of how progress on the overall goal set is occurring. The components to check are the EF behavior skill and the academic skill. This observation is completed informally. Observational notes taken on a daily basis will help with understanding the progress whether successful or unsuccessful.

Intervention Plan for Executive Function Deficits and Reading Comprehension

Working Memory

Working memory description is the ability to hold information in mind while performing complex tasks. It incorporates the ability to draw on past learning or experience to apply to the situation at hand or to project into the future (Dawson & Guare, 2004). Environmental modifications can be implemented to assist with working memory. Tools to be used to lend support would be agenda books, calendars, or electronic devices. Support staff can implement cues worked into a student's day. For example, arranging for verbal reminders (teacher, aide, or peer), visual cues displayed in a prominent place (post-it, desktop), use naturally occurring cues already present in the student's schedule. For these cues to be successful they must not blend into the student's surroundings. In teaching the skill, the student should be a participant for setting up their cues. Steps to follow for designing cues are as follows: explain the problem as a student sees it and give them the opportunity to choose from a range of options and pick one that they like. Students should also be aware of how the cue and the working memory support each one. They would also need to devise a system to track the implementation of the cues. Simply ask, "Did you use the cue? Yes/No. How well did you do? (Dawson & Guare, 2004, 49). As stated previously, reading comprehension requires the ability to recognize words visually as well

as the ability to apply sound to the letter forms process words, therefore, providing support with the knowledge of working memory to learning sight words, reading sentences fluently, and then understanding the meaning of words and sentences as a whole will benefit a student. When teaching sight word recognition, practicing in different formats will ensure progress. Some tools to use are flashcards, embedded practice within a reading passage, visual imagery, or letter sound supports (alphabet chart, vowel chart, blends and digraph chart). Students will have exposure to flashcards for the sight words as well as other words from the passage. If possible, have visual flashcards with words to promote independence in identifying the words and assisting with word meaning. It was also previously stated, repeated practice is a successful intervention for reading comprehension.

Cognitive Flexibility

The ability to learn to spell in English requires working memory to hold multiple representations of letter-sound correspondence in mind. Therefore, academically we use cognitive flexibility to identify letters and apply the sounds they make to create words. When learning words an intervention commonly used is to assist students with breaking down words to individual or blended sounds. To visually assist students with this task, the teacher can identify individual sounds with a dot under them and blended sounds are identified with a line below them. The student will practice the individual breakdown and gradually build on how fast the sounds are blended to create the word. The teacher provides verbal support after implementing “wait time” to see if the student can be successful.

Inhibitory Control

According to Zelazo, Blair and Willoughby (2017-2000) inhibitory control are the ability to deliberately process any repressed attention to something. For example, a conscious choice to ignore a distraction or controlling an impulsive answer. Based on the research findings that yoga improves behaviors and learning in students of different ages and disabilities, it is important to explore the effectiveness of yoga based Get Ready to Learn (GRTL), a manualized yoga-based program (Koenig, Buckley-Reen, & Garg, 2012), program as a therapeutic approach to improve executive functions in young children with disabilities (Garg, 2016). Attentional control, information processing, cognitive flexibility, and goal setting are four executive domains of Anderson's model of executive function development (2002). Key elements of attentional control are attention and inhibition and that of cognitive flexibility is working memory. Since the model suggests that attentional control greatly influences the functioning of the other executive domains, it can be hypothesized that the yoga based GRTL program promotes relaxation and reduced anxiety, which improves attentional control (Eysenk et al., 2007; Smith, 1999). This improved attentional control will then lead to improved attention, working memory and inhibition (Anderson, 2002). Teacher or aide can cue a student to use (previously chosen by the student) a yoga breathing exercise to assist getting them back on task. Eventually, the student should be able to access the need for the yoga without the cue from the teacher or aide.

What should future research focus on?

There is a clear need for more work to further delineate how EF, whether manifested in brain metrics or behavioral performance, plays a role in the reading process (Church, Cirino, Miciak, Juranek, Vaughn, & Fletcher, 2019). There are discrepancies in the research on EF and

reading. EF training studies show interventions are put in place to work on working memory to support the underlying cognitive skill (memory) not the academic skill. Therefore, no data is collected on the academic outcomes. Future research should focus on providing research that compares EF interventions to reading interventions. The studies need to be sure to use larger sample groups to be able to see patterns develop. Future research should continue to explore the differences between children whose difficulties with reading comprehension stem from a more primary deficit in single word reading and those children who experience reading comprehension problems even though their basic word reading skills are intact (Sesma, H. W., Mahone, E. M., Levine, T., Eason, S. H., & Cutting, L. E., 2009). It is important to compare neuropsychological profiles of strengths and weaknesses and how they respond to different types of reading interventions. The interventions will focus on either phonological or executive approaches to reading interventions. Another area of concern would be to study the benefits from measuring executive skills of interest using many methods including behavioral testing, parent and teacher report and classroom observation to identify different executive skills.

Conclusion

In conclusion, EF plays a very crucial part in our brain's development. I have confirmed that EF is very key in academic and social learning for all students. Students with disabilities usually have lagging EF skills. Teachers and support staff often touch on these deficits without knowing they are. Having an understanding of what makes up EF would help support students in their ability to acquire their academic knowledge and use appropriate behaviors in all environments. Teaching staff can support all students with disabilities by understanding what the different skill areas of EF are. General education and special education teachers having an

understanding of EF skills can help students become successful academically along with becoming socially successful with peers and the expectations in school.

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Appendix 1
Intervention Plan

<p>Day 1</p> <p>Describe the procedure for the next 10 days. Introduce 6 words on flashcards. Discuss possible words meaning.</p>	<p>Day 2</p> <p>Review word flashcards. Discuss word meaning. Preview the reading passage by having students look at the pictures. Ask them to give ideas based on pictures.</p>	<p>Day 3</p> <p>Review word flashcards, introduce other words from the passage. Discuss word meaning. Read the passage. Mark any words that the student struggles with saying.</p>	<p>Day 4</p> <p>Review word flashcards that were identified in previous reading. Practice the reading passage.</p>	<p>Day 5</p> <p>Review word flashcards. Practice reading the reading passage. Allow some free time for students to use picture cards to sequence events. Informal assessment on mastery of the reading passage and sight words.</p>
<p>Day 6</p> <p>Mastered last week - Introducing 6 new word flashcards from a new reading passage. Discuss word meaning. Reading passage was not mastered - Review flashcards from passage. Practice passage again. Introduce the use of tiles to promote a new memory building the words.</p>	<p>Day 7</p> <p>Review word flashcards. Discuss word meaning. Preview the reading passage by having students look at the pictures. Ask them to give ideas based on pictures.</p>	<p>Day 8</p> <p>Review word flashcards, introduce other words from the passage. Discuss word meaning. Read the passage. Mark any words that the student struggles with saying.</p>	<p>Day 9</p> <p>Review word flashcards that were identified in previous reading. Practice the reading passage.</p>	<p>Day 10</p> <p>Review word flashcards. Practice reading the reading passage. Allow some free time for students to use picture cards to sequence events. Informal assessment on mastery of the reading passage and words.</p>

Appendix 2

Student A

Student A is a 2nd grader. She is not performing at 2nd grade level academically. She has difficulty with her short-term memory, task completion, and attentiveness. She is excited about learning. She is engaged when she is working 1 to 1. Her standardized test support reading and math skills are at a first-grade level. In phonics, her strengths are letter identification, letter sounds, and vowel sounds. She is progressing with her digraphs and phonemes. Her weak areas are CVC and nonsense words. It is difficult for her to apply her letter sounds to words. Her sight word recall is inconsistent from day to day. Her reading is not fluent. She has to pause to decode words in her reading. In the student interview, she was able to complete tasks completely with a first, then, and then set of tasks. Each task was modeled or was hands on. For example, she was given flashcards to pre-teach key words within the reading passage. When pre-teaching the words, draw attention to each sound by using dots under each individual sound and a line under a blended sound. As we move into reading the passage, data will be kept on her progress for the week. A goal for her success will be set with her input and a reward will be set. In order to assist her with her attentiveness, we implemented the use of a timer. We agreed on how long each task should take. She would earn a small reward for completing each task within the allotted time.

Materials needed: notecards, marker, sight word reading passage, picture cards matching the words

Dialogue for Intervention Plan

Day 1-3

Teacher: This week we will be creating word flashcards. Each word flashcard has a visual aid to help you decode the word. You can also use the alphabet, digraph and blend charts to help you decode the words.

Student: Any question?

Teacher: We will be adding the dots and line system to help sound out the words. Do you remember how they work?

Student: I am not sure.

Teacher: Okay, let's review. The dot is for a single sound and the line is for a digraph or a blended sound. Does this sound familiar?

Student: Yes.

Teacher: We will begin with 6-word flashcards. The first one is "the." Do you recognize this word? Do you recognize the blended sound and single sound?

Student: Yes. 'th' is a blended sound 'e' is a single sound

Teacher: Great job Let's add our dot and line to the notecard. What is the word?

Student: 'the'

Teacher: Great job! You are correct "the." Let's try another (show card don't say) "and." Do you recognize this word?

Student: 'and' /a/ /nd/

Teacher: Great job! You are correct "and." Let's try another (show card don't say) "dog."

Student: d - o - g /d/ /o/ /g/

Teacher: Are these sounds blended or single sounds?

Student: These sounds are single sounds. Do you recognize this word?

Teacher: Great job! You are correct “the.” Let’s try another (show card don’t say) “cat.” Do you recognize this word?

Student: c - a - t /c/ /a/ /t/

Teacher: Are these sounds blended or single sounds?

Student: These sounds are single sounds.

Teacher: Great job! You are correct “cat.” Let’s add our dot and line to the notecard. Let’s try another “friends.” Do you recognize this word?

Student: fr - ie-n-d-s /f/ /r/ /ie/ /n/ /d/ /s/

Teacher: That was a really good attempt. Let’s look at the matching picture card. What does it look like?

Student: /friends/

Teacher: Do you hear blended or single sounds?

Student: Both. I think.

Teacher: Let’s identify them on the notecard with our dot and line system.

Teacher: Great job! Let’s You are correct “friends.” Let’s try another “house.”

Student: h-o-u-s-e /h/ /o/ /s/ /e/

Teacher: Very close. The ‘ou’ makes a different sound that is blended. Let’s look at the matching picture card. What does it look like? Are these sounds blended or single sounds?

Student: These sounds are single sounds.

Teacher: Nice try. Let’s identify the sounds on the notecard with our dot and line system.

Teacher: Great job! You are correct “house.” Let’s try another “black.” Do you recognize this word?

Student: bl - ack /b/ /l/ /a/ /ck/

Teacher: That was a really good attempt. Let's look at the matching picture card. What color does it look like?

Student: /blak/

Teacher: Do you hear blended or single sounds?

Student: Both. I think.

Teacher: Let's identify them on the notecard with our dot and line system.

Student: I think I am understanding. That last one was easy.

Teacher: Great Job! Now let's read through the passage. Remember the words we have been working on. Let's look at the pictures that are on the passage. "What are your thoughts on what this passage will be about?"

Student: I think it will be about a cat and a dog.

Teacher: Is there anything specifically about the cat and the dog? Hint: Remember the words we learned.

Student: I think they may be friends!!!

Teacher: Nice job! Now let's try to read through the passage.

Dialogue for middle of Intervention

Teacher: Let's begin by reviewing our word flashcards for this passage. (Hopefully by this day most of the words would be mastered.)

Student: I think I can read all of them. (Students will read through all 18 words.) (Remind students to use the dot and line system as needed.)

Teacher: You did a nice job. I love how you have mastered these flashcards. Now let's try to read the passage. Would you like to see how many words you can read in one minute?

Student: What if I don't read enough?

Teacher: It will be okay. You have been practicing very hard on your flashcards.

Student: Okay. I will do my best.

Teacher: Wow!! Look at how many words you read (total words read minus missed words)!!!

How should we keep track of how you are doing?

Student: Maybe we can just write it down on a list.

Teacher: What if we did a graph to show your progress?

Student: That sounds good. I can't wait to see how I do next week!

Teacher: Let's preview the words for the next passage.

Student: Yes!!!

Dialogue for the end of the Intervention

Teacher: Review the flash cards for the second week's passage.

How do you feel about your progress on the flash cards? How many do you think you know?

Student: I feel good. I predict I will be able to read all of them.

Teacher: Let's see what you can do!

Student: (Students will read through each flashcard.)

Teacher: Wow!! You did great. Let's read the passage now that you have practiced the flashcards.

Student: Okay.

Teacher: How would you like to see how many words you can read in one minute?

Student: What if I can't do it?

Teacher: You will do your very best. That is all we need for you to do. This is why we practice.

Student: (Students will read the passage.)

Teacher: Let's add your score (total words read minus missed words) to your graph. Do you know what we will do with the dots on the graph?

Student: We will connect them!!

Teacher: Yes, we will! We will be able to see the progress go up and down as you read different passages.

Rationale for the intervention plan

EF Rationale: The EF deficit skill is working memory. The deficit of working memory is having difficulty applying learned skills to new skills. It is difficult to access learned skills to apply to new skills. Students need to have access to materials that will provide support to learn the new skills. Students will use the Alphabet, blend or a digraph chart to help trigger the learned sounds for letters. While working with the student, a strategy to implement is "wait time." Another strategy is to provide an image to go with a word, because numerous studies support the powerful effects of associating mental images or symbolic representations with words being learned (Marzano, Pickering, Pollock, 2001). Children with low EF skills experience negative self-perceptions and lack of motivation (Zelazo, Blair, and Willoughby, 2017-2000, 24).

Therefore, identifying the deficit and addressing the needs is very important to a student's academic success and well-being.

Academic rationale: It is recommended for LD students to only work on 6 words at a time. The type font easiest for LD students to read is Arial font. The flashcards are done in Arial font. The words in the reading passages are focused on using the most frequently used words in the

English language. A student can build fluency by exposure to these sight words. A strategy to implement is repeated practice to promote recall (Zelazo, Blair, and Willoughby, 2017-2000).

Appendix 3

the	and	cat
dog	friends	they
is	black	brown
blue	likes	play

Appendix 3

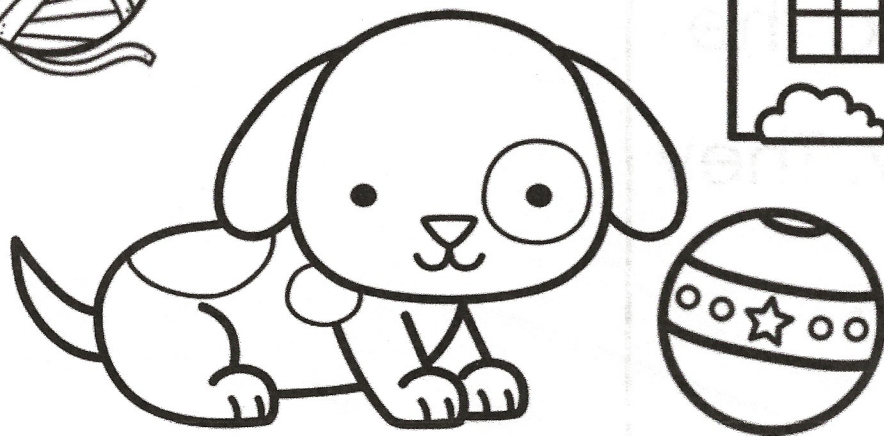
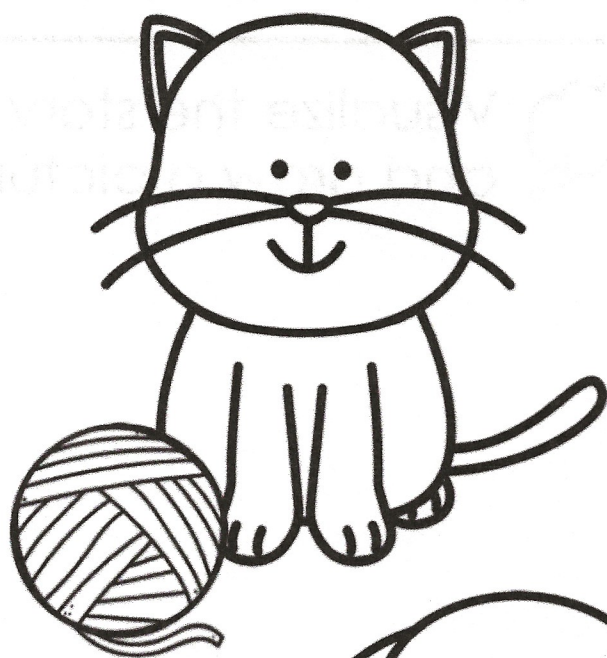
with	ball	yellow
yarn	house	in
live	are	

The Friends

the

Read.  Write "the". Color. Highlight "the". 

The dog and the cat are friends. They live in the blue house. The cat is black. The dog is brown. The dog likes to play with the blue ball. The cat likes to play with the yellow yarn.



A Piece of Food



of

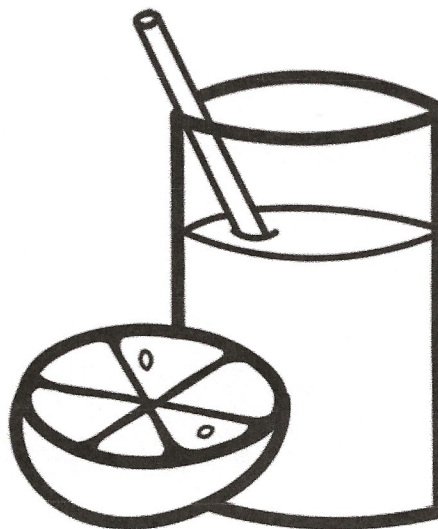
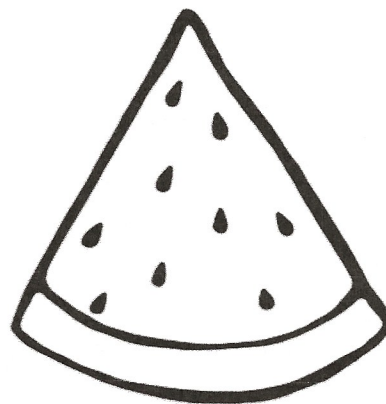
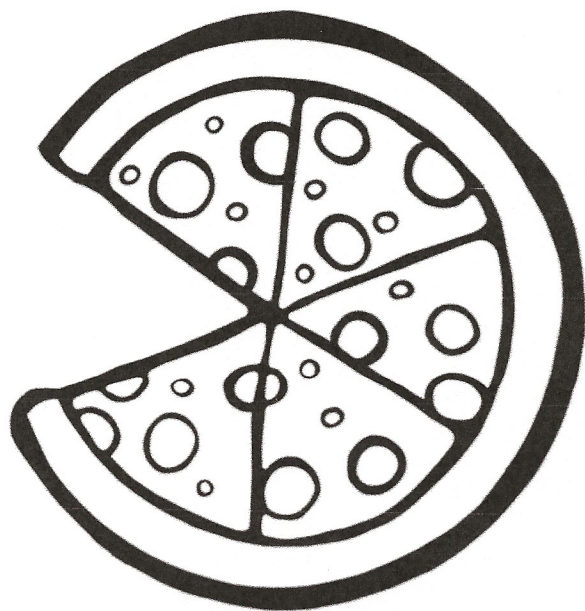
Read.

Write "of".

Color.

Highlight "of".

He will eat a piece of the big pepperoni pizza! He will eat a piece of the pink watermelon. He will take a bite of the purple cupcake. He will have a drink of the orange juice.



Executive Function

What is it

and

How it affects reading comprehension.

By Abegail Harthun

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Capstone Project

Masters Degree in Special Education with Learning Disability

Importance of Executive Function

Executive function is the set of key components of development from birth to adulthood.

Executive function is an umbrella term which encompasses most cognitive items that take place in the prefrontal regions.

Executive function skill deficits are found in these disability areas: specific learning disability, autism spectrum disorder, conduct disorder, obsessive-compulsive disorder and attention deficit hyperactivity disorder.

These key components of development are focused in the pre-frontal lobes of the brain.

The key components are inhibiting actions, restraining and delaying responses, attending selectively, setting goals, planning and organizing as well as maintaining and shifting set.

There is a relationship between executive functions, attention, and working memory.

EF skills are the attention-regulation skills.

- Make it possible to sustain attention
- Keep goals and information in mind
- Refrain from responding immediately
- Resist distraction
- Tolerate frustration
- Consider consequences of different behaviors
- Reflect on past experiences
- Plan for their future

What does executive function affect?

Researchers have determined executive function is key to school readiness and early school achievement.

Executive Function measurements predict how a child will perform in readiness, the transition to kindergarten, school performance and social competence in adolescence, better physical health, higher social economic status.

Specific learning disorder indicates there is a genetics or environmental factors that contribute to the deficit in these skills.

Executive function skills use psychological and organizing functions, working memory, attention, problem solving, verbal reasoning, cognitive flexibility, planning and initiation as well as monitoring of activities.

Why is it important to identify executive function?

Executive function is identified as a possible influence on academic learning and behaviors.

Executive function influences the academic areas of in reading, writing, and math.

Reading comprehension requires to have an understanding of how to read single words and decode.

Difficulty in decoding words is a direct indication of a deficit in phonological processing; therefore, the ability to decode words has a direct effect on reading comprehension.

How does executive function influence reading comprehension?

Reading comprehension requires many skills:

- Vocabulary skills
- Background information
- Grammatical structures
- Metaphorical language
- Inferential reading

Reading comprehension assessments are used to identify executive function deficits.

These are assessments used:

- BASC Attention Scale
- Woodcock Reading Mastery Test-Revised Word Attack
- Gray Oral Reading Test-Fourth Edition
- The Peabody Picture Vocabulary Test-third Edition
- Wechsler Intelligence Scale for Children – Third Edition
- Tower of London

These assessments are focused:

- identifying the ability to attend
- multiple aspects of reading
- word reading accuracy
- measure of oral reading fluency and comprehension
- word association to appropriate pictures
- verbal working memory
- planning skills.

Reading comprehension requires the use of cognitive processes; such as, the higher order skills of executive function consists of are the ability to work independently, use of goal-directed behavior, including holding and manipulating information in working memory, planning/sequencing multi step tasks, and ascertaining the “big picture” from a set of details.

Three primary influences of executive function skills

Working Memory – ability to hold information in mind while performing complex tasks.

Cognitive Flexibility – ability to learn to spell in English requires working memory to hold multiple representations of letter-sound correspondence.

Inhibitory Control – ability to deliberately process any repressed attention to something.

Assessments

Standard assessments used for identifying the need for students to meet criteria for a disability area do not address finding deficits in executive function.

Executive function deficit skills are not activated in these assessments due to how the assessments are administered.

They naturally take away the need for executive function skills for all students during the assessment.

Assessment for identifying executive function deficits:

Informal Assessment

- identify strong or weak executive skills and identify an antecedent to problems in a specific setting
- Detailed case history/interview
- Classroom observations
- Work samples
- Standardized behavior rating scales

Formal Assessment

-identifies cognitive abilities, emotional status, and academic skills that may impact or be impacted by executive function

- **A Developmental NEuroPSYchological Assessment (NEPSY-II)**
 - The 32 subtests and four delayed tasks included in the NEPSY–II are divided into six content domains: Attention and Executive Functioning, Language, Memory and Learning, Social Perception, Sensorimotor, and Visuospatial Processing
 - This is one of eight other assessments suggested by researchers.

Behavior checklists

- used to rate behaviors with regard to executive skills

- Psychological Assessment Resources
- Behavior Rating Inventory of Executive Function
- Brown ADD Scales-Adolescent Version
- Comprehensive Behavior Rating Scale for Children
- Child Behavior Checklist Teacher Report Form

Behavioral observations on executive function focus on:

- Self-regulation of affect
- Metacognition
- Goal-directed persistence
- Flexibility
- Sustained attention
- Working memory
- Response inhibition
- Planning/prioritization
- Time management
- Organization
- Task initiation

Interventions

Standard interventions of remediation characteristics and extending the focus on the range of print materials has been shown to not be affective due to the underdeveloped skill of inferencing-making or background knowledge.

Intervention Plan

An intervention plan must reflect the specific skills areas found to have deficits from the formal and informal assessments results.

An intervention plan will be individualized for each student.

Intervention plan should be progress monitored by collecting observational notes as well as data on the designated goal.

Intervention Instruction

- The intervention plan designed was to address deficits in reading comprehension.
- Creating an opportunity to practice sight words which are frequently used in the English language. Practice only six words at a time.
- Design the practice for the individual students way of learning.
- Promote self-confidence by promoting self-esteem
- Repeated practice
- Extra emphasis on learned strategies

Intervention Plan for a week

Day 1	Day 2	Day 3	Day 4	Day 5
<p>Describe the procedure for the next 10 days.</p> <p>Introduce 6 words on flashcards</p> <p>Discuss possible words meaning</p>	<p>Review word flashcards</p> <p>Discuss word meaning</p> <p>Preview the reading passage by having students look at the pictures. Ask them to give ideas based on pictures.</p>	<p>Review word flashcards, introduce other words from the passage</p> <p>Discuss word meaning</p> <p>Read the passage. Mark any words that the student struggles with saying.</p>	<p>Review word flashcards that were identified in previous reading</p> <p>Practice the reading passage.</p>	<p>Review word flashcards.</p> <p>Practice reading the reading passage.</p> <p>Allow some free time for students to use picture cards to sequence events.</p> <p>Informal assessment on mastery of the reading passage and sight words.</p>

Reading Passage

ame: Appendix 4

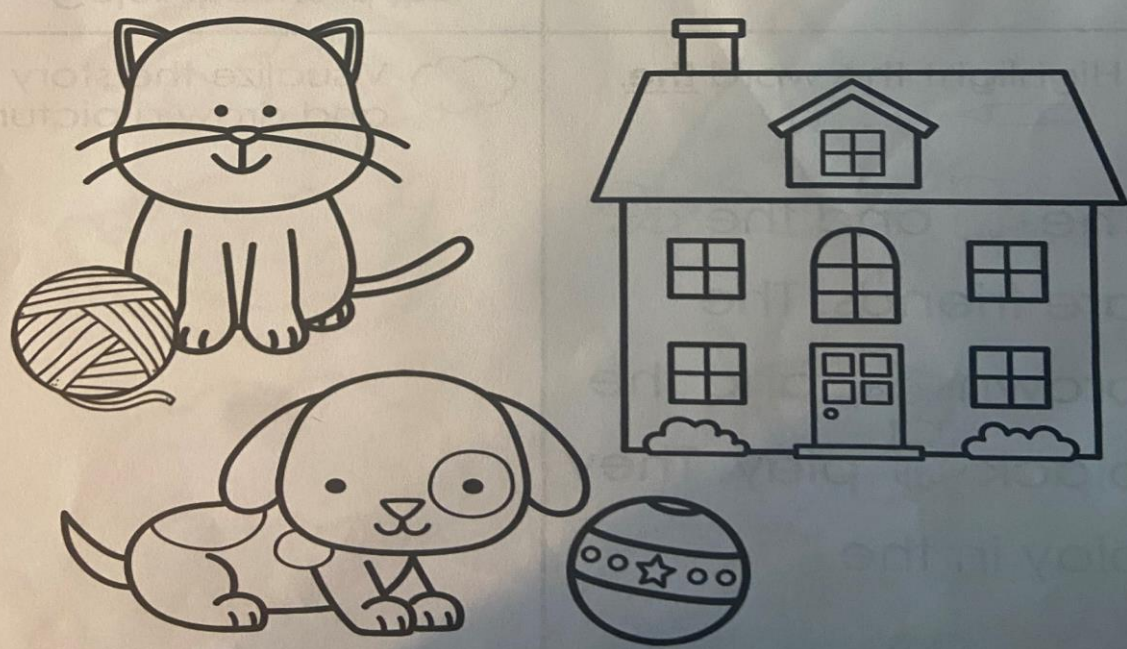
The Friends

Read. (eye icon) (eye icon) Write "the". (pencil icon) (pencil icon)

Color. (pencil icon) Highlight "the". (pencil icon)

the

The dog and the cat are friends. They live in the blue house. The cat is black. The dog is brown. The dog likes to play with the blue ball. The cat likes to play with the yellow yarn.



EDUCATION
TO THE CORE

Flashcards

the	and	c <u>at</u>
d <u>og</u>	<u>fr</u> <u>iends</u>	<u>th</u> <u>ey</u>
is	<u>bl</u> a <u>ck</u>	<u>br</u> <u>ow</u> n
blue	likes	play

How to implement in with my colleagues?

Now that I have a better understanding of executive function, it is apparent to me that I need to incorporate interventions and assessments for executive function.

Sharing my findings with co-workers

Inquiring with ASEC on availability of assessments for executive function