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Pedagogical Preparedness: Understanding Executive Functioning and High Functioning Autism

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Abstract

We set out herein to understand executive functioning for learners with autism. We focus on learners with high functioning autism (HFA) and explore a common goal for an Autistic Spectrum Disordered (ASD) population is to increase independence, thus enabling access to experiences and opportunities similar to neuro-typical individuals. We suggest in a somewhat counterintuitive manner, educators may be preventing this development by being overly supportive. This can inhibit ASD learners by denying tools and opportunities to enable themselves. Executive functioning (EF) skills can be taken for granted by neuro-typical learners but are essential skills that need to be explicitly taught to those on the autism spectrum. Herein we support educators and understand the deficits that learners with high functioning ASD experience with EF skills and encourage all to set goals and design programming for students.

1. Introduction

Being prepared pedagogically seems mandatory if one is to teach effectively; therefore, having a good understanding of general pedagogical knowledge is vital for all educators. Voss, Kunter and Baumert (2011) developed a model almost a decade ago that seems even more applicable today as it includes general pedagogical knowledge that embraces both pedagogical and psychological elements. Of particular interest herein is the sub-dimension that requires knowledge of student characteristics and needs. Voss, Kunter and Baumert (2011) believe educators should be aware of student cognitive, motivational and emotional traits that may include, ADD, anxiety, ADHD, dyslexia, giftedness, autism as well as ethnicity and culture. The Voss, Kunter and Baumert (2011) model of general pedagogical knowledge includes social context, and psychological constructs which distinguish it from other models yet shares some elements of Carroll (1963) and Slavin (1984) models. These models of general pedagogical knowledge are known globally and have guided both teachers in training and teachers in the field world-wide however there is more to learn..

Globally we know that "autism is a complex developmental disability that typically appears during the first three years of life: it is the result of a neurological disorder that affects the

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functioning of the brain" (Autism Ontario, 2013a, para. 1). Autism Spectrum Disorder frequently referred to as ASD involves a diagnosis of ASD for individuals who exhibit abilities and deficits in communication, social functioning, sensory sensitivity, and self-regulation. Autism is a spectrum disorder because abilities and deficits among those with ASD vary from case to case: no two individuals with ASD are the same. This childhood diagnosis is a lifelong disorder with an uncertain course (Howlin, 2005). Although individuals do not receive an official diagnosis of "high functioning autism" it is a term commonly used. According to Robinson, Curwen, and Ryan (2012), high functioning autism "…refer[s] to a diagnosis of an Autism Spectrum Disorder alongside having average to above average IQ" (p. 4).

We distinguish ASD from Asperger herein since there is a current shift from the use of the term Asperger's to the use of ASD as the umbrella term that includes all levels of functioning on the spectrum. Indeed, the division between HFA and Asperger's as diagnoses remains problematic hence proposals for DSM-V would remove Asperger's as a separate diagnosis (Wing, Gould, & Gillberg, 2011). We also point out from the onset that executive function (EF) "…describes processes such as working memory, planning, inhibition, mental flexibility, and emotional control" (Kalbfleisch & Loughan, 2012, p. 390). Herein we address deficits in EF such as; "self-regulation difficulties, poor attention, distractibility, and problems in behaviors involving organization and planning" (Watson & Westby, 2003, pp. 195-6).

2. Background

There are many students on the autism spectrum who are higher functioning learning at grade level with their peers. They may also have very unique and advanced talents or abilities. They may also have the same aspirations of attending college or university, establishing a successful career, raising a family, and living independently. While these learners may be "smart enough" and with the support of an Educational Assistant (EA) nearby for most of their elementary school years, they are able to keep up with their chronological aged peers, they may find themselves completely lost once the support is removed. These learners will need to manage their time, organize their lecture notes, finances, self-regulate, among other everyday experiences.

According to Autism Ontario (2013b) "the prevalence rate of Autism Spectrum Disorder is 1 in 94. There is an estimated 100,000 individuals with ASD in Ontario" (para. 3). Among these statistics are the many students we have in our regular classrooms with or without EAs. Today it is rare that an educator has not encountered a student with ASD. In 2011, over 800 students with ASD registered for support at Ontario colleges and universities (Monsebraaten, 2012, para. 3). There are young people with ASD who are attending post-secondary education as well as those who trying to enter the workplace immediately after graduating from high school: "A U.S. study last year found in the first two years after high school, young autistic people had a greater than 50-percent chance of being unemployed" (URL1, 2013, para. 6). Satisfying daily quotidian in higher education, the workplace, and in life requires use of executive function skills; something that individuals on the Autism Spectrum lack. "Difficulty with independent functioning impacts the overall outcomes for individuals with ASD. Several studies claim that adults with autism, despite IQ scores, rely heavily on others for support in employment, living, and relationships" (Hume, Loftin, & Lantz, 2009, p. 1). Students with high functioning ASD, however, can learn these social skills through appropriate goal setting, research-based strategies, and consistency to improve their ability to function more independently.

3. Review of Literature

Our inquiry was inspired by personal experiences teaching high functioning ASD students in Ontario, Canada. While students had the cognitive ability to learn the Ontario provincial curriculum at or slightly below grade level, social and emotional functioning was lacking. We focused programming on achieving differentiated Ontario curriculum expectations through positive reinforcement and teaching self-regulation tools as our main goals. We found that

students demonstrated very weak executive functioning skills. The lack of ability to organize and plan as well as encountering significant struggles with inhibition was obvious. Next steps would include identifying individual deficits in executive functioning and locating teaching tools to strengthen these skills for both student and family.

Considering the high prevalence rate of ASDs in North America (Centers for Disease Control and Prevention, 2013, "ASDs", para. 1) it is not surprising to discover great deal of literature on this subject. Studies on executive function and Fetal Alcohol Syndrome Disorder (FASD) sporadically surfaced during our search due to the commonalities in executive function deficits shared by ASD and FASD populations. Among the literature, common inquiries related to executive function and individuals with high functioning autism included; gender comparisons, implications for life transitions, relationship to social functioning, and strategies for management and improvement. Educator resources (guides, government documents) although very helpful in defining and explaining other key terms related to ASD, did not provide information on executive function and high functioning ASD that is not covered in scholarly journal articles.

Four key themes were revealed when reviewing literature: deficits in executive functioning, implications for personal success, implications for educational and professional success, and finally strategies and tools for improvement were investigated.

3.1. Deficits in executive functioning

As defined earlier, EF refers to working memory, planning, inhibition, mental flexibility, and emotional control (Kalbfleisch & Loughan, 2012, p. 390). It is likely that neuro-typical learners could provide a list of situations and ways that they have used their working memory and had to use planning skills to complete a task (whether for personal or professional purposes). Neuro-typical learners could provide examples of experiences in which they had to block out stimuli that were distracting to the activity they were engaging in (inhibition) as well as numerous instances where they have had to control their anger, sadness, excitement, etc. to accomplish a task. It cannot, however, be generalized that the entire neuro-typical population demonstrate complete ability to perform these skills without challenge. It is very probable, that every learner (regardless of the presence of exceptionality) has experienced difficulty in one or more area of EF.

Kalbfleisch and Loughan (2012) claimed that studies reported that children with HFA experienced difficulties in EF compared to typically developing peers (p. 391). Landa and Goldberg (2005) also concluded that "executive dysfunction has been proposed as a core deficit in autism, and consequently has been proposed to give rise to the communication and social impairments in this disorder" (p. 558). Meanwhile, typically developed individuals may not suffer from social and communication impairments resulting from minor difficulties in EF. Implications that deficits in EF have for socialization for HFA learners were methodically addressed in our next section. From a neuro-scientific perspective, deficits in executive functions for ASD learners were linked to the functioning of the frontal lobes of the brain, which manage EF operations (Darretxe & Sepulveda, 2011; Kalbfleisch & Loughan, 2012). Landa and Goldbery (2005) concluded; given this impairment, children with HFA "…cannot keep up with their age peers in frontally mediated task performance as the frontal lobes mature" (p. 569).

Abilities and deficits in EF vary among each learner with HFA as autism is a spectrum disorder. Kalbfleisch and Loughan (2012) hypothesized that IQ discrepancy which "…refers to the distance between measured verbal (VIQ) and performance intelligence (PIQ) quotients" (p. 397) results in higher abilities in EF (p. 392). Their study of 16 males and 3 female children with HFA between the ages of 9-16 years, revealed, that "…when IQD lies within one standard deviation…" (Kalbfleisch & Loughan, 2012, p. 397) deficits in EF were substantial (Kalbfleisch & Loughan, 2012, p. 397). This suggested a link between IQD and EF for learners with HFA: Deficits in EF may be linked to lower IQD. Of importance, this lower IQD does not imply that the individual scored within the low range since individuals with HFA implies that that have "…a diagnosis of Autism Spectrum Disorder alongside having average to above average IQ" (Robinson, Curwen & Ryan, 2012, p. 4).

In Kalbfleisch and Loughan's (2012) study, lower IQD is referred to in comparison of learners who have HFA.

Hendricks (2010) determined that despite having average or above-average intelligence individuals with HFA exhibited deficits when meeting new task challenges due to impairments in EF. Individuals with HFA encounter difficulties adjusting to new situations and teachers today, specifically in elementary schools where students spend most of their day in one classroom, commonly discuss this issue; many teachers and educational assistants (EAs) make efforts to prepare students with HFA for upcoming changes to the schedule, activities, and transitions. Lacking the skills to work through tasks that require EF often results in frustration and loss of emotional control. What little emotional control an EF learner with HFA may have can be lost due to the absence of other EFs.

It can be valuable to examine how exceptionalities and deficits within these exceptionalities are similar or differ between genders. The Hospital for Sick Kids in Toronto, Ontario, Canada found that "…autism spectrum disorder affects four times more boys than girls…" (Mack, "Sick Kids study could shed light", 2012, para. 1). Although there is little evidence as to why boys are more affected by autism than girls, currently, Mack (2012) reported that the same study by The Hospital for Sick Kids suggested that some females may carry a specific gene (SHANK-1) that protects them from developing autism ("Sick Kids study could shed light").

In terms of how deficits in EF are experienced between males and females with HFA, a study by Lemon, Gargaro, Enticott, and Rinehart (2010) provided insight. Lemon et al. (2010) focused on measuring and comparing response inhibition among a sample of boys and girls with ASD. Response inhibition is the "…ability to deliberately inhibit dominant, automatic, or proponent responses when necessary" (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000, p. 57). This ability allows us to control our actions and impulses when needed. Educators might find some students with HFA to behave quite impulsively which relates to deficits in executive function, specifically response inhibition. Lemon et al. (2010) found through their stop task study in which participants were tested on their ability to control and make appropriate action responses according to the color of light flashed (green indicates go, red indicates stop) that females with ASD displayed evidence of stopping impairments where boys with ASD in the study did not (p. 355). While these findings have not been generalized, it should be noted that this study does not include children with HFA specifically; the study does demonstrate that gender may indeed be a factor in abilities and deficits of executive functioning skills for learners on the autism spectrum.

3.2. Implications: Personal and social living

Perhaps one of the most notable impairments associated with the HFA population is difficulty with social interaction or social skills. Commonly discussed in much of the literature reviewed are the implications that deficits in EF have for the social lives of individuals with HFA. Landa and Goldberg (2005) explained that executive dysfunction in those with autism gives "…rise to the communication and social impairments in this disorder" (p. 558). An example of the link between EF and social impairment is increased deficits in cognitive flexibility which can make it difficult for learners with ASD to follow social conversation especially when figurative language is used or when topics shift (Landa & Goldberg, 2005, p. 559). Difficulties managing so many challenges in social interactions can result in anxiety and frustration for those with HFA.

> Parent reports . . . showed that 5% of their Autism Spectrum sample met the diagnostic criteria for Social Anxiety Disorder [and] that the severity of social anxiety symptoms in the Autism Spectrum group was significantly higher than the other three samples: clinical, special education, and the normative samples. (as cited in Robinson et al., 2012, p. 6)

Robinson et al. (2012) concluded that many with Asperger's Disorder (HFA) demonstrated anxiety levels high enough to be diagnosed with anxiety disorders; many were undiagnosed (p. 14) and do not receive treatment. As educators we observed this and as a result numerous strategies trialed to help support seemed ineffective. The literature is ripe with negative

implications due to deficits in EF. For instance, Landa and Goldberg's (2005) research on working memory (WM), suggested EF and social dysfunction are related however, this particular area of inquiry still requires more research we believe.

As part of emotional control, learners with HFA often struggle with self-regulation yet they may experience deficits in different ways. Some educators might witness a student with ASD experience what is often referred to in schools as a "meltdown." How this affects a learners progress in education will be discussed later however, meltdowns (or tantrums) can affect those with ASD in very personal ways. Hume, Loftin, and Lantz (2009) noted that "the ability to regulate or manage behavior is considered to be one subdomain of executive function" (p. 1330). Hume et al. (2009) discussed the lack of independence individuals with HFA experience due to the need for direct support (Educational Assistant or parent) to work through their emotional meltdowns to maintain safety (p. 1330). Such constant, close support may also result in a dependence on others and be detrimental towards the individual developing a sense of autonomy (Hume et al., 2009, p. 1332).

Although not a common "sub-theme" discussed within the literature there were inferences that deficits impacted not only the person, but also family life. Epstein, Saltzman-Benaiah, O'Hare, Goll, and Tuck's (2008) examined the effects of parenting a child with HFA had on their level of stress. This research involved a parental questionnaire for children aged 5-12 with a diagnosis of Asperger's Syndrome. The questionnaire focused on stress related to the role of parenting exclusively and did not touch on other possible areas of stress (Epstein et al., 2008, p. 506). The data from the questionnaire resulted in 75.7% of mothers and 75% of fathers reporting high stress levels (Epstein et al., 2008, p. 507). Epstein et al. (2008) explained that even though children with Asperger's Disorder are HF, parents still experience a high level of stress due to the challenging behavior and cognitive abilities based on their intellectual and language abilities (p. 508).

The questionnaire also included questions regarding the parents' perceived level of EF in their child with Asperger's Disorder. "92.1% of mothers and 81.8% of fathers rated their children as having clinically elevated levels of executive dysfunction" (Epstein et al., 2008, p. 508). Based on the results revealing both high stress levels from parents as well as high executive dysfunction in the children, a connection between this data is evident. However, Epstein et al. (2008) discovered that only the mothers' stress levels were directly connected to the children's level of dysfunction (p. 508). "No significant correlations were found between fathers' levels of parenting stress and their ratings of their children's difficulties in the domains of executive functioning or sensory sensitivities" (Epstein et al., 2008, p. 508). Epstein et al. (2008) were not able to determine, for certain, reasons behind the correlation differences (p. 509). In terms of attributing higher stress levels in parents to higher executive dysfunction in their child with Asperger's Syndrome, Epstein et al. (URL2, 2008) were also careful to point out that such a conclusion cannot definitively be made due to the lack of observation, which would provide valuable data. Epstein et al. (2008) do note the possibility that the study sample included parents who tend to experience higher levels of stress in general (p. 509). Nonetheless, such literature draws attention to possible negative implications that impaired EF in learners with HFA may present in personal and social contexts.

3.3. Implications: School and workplace

Based on intelligence quotient (IQ) alone, learners with high functioning autism inhibit the same educational and workplace potential that their neuro-typical peers do. As we know, however, success in school and the workplace are based on a wide variety of skills and abilities working together simultaneously. Both school and workplaces demand that learners and employees follow direction, stay organized, and take initiative, among other tasks. Many skills and abilities outside of IQ fall under the executive function category. The literature reviewed in this research project has consistently revealed that individuals with HFA experience significant deficits in EF. The literature reviewed also discusses in depth the implications of these deficits in educational and workplace

contexts. In the context of education, literature was found that discusses how these deficits affect the learner in mainstream classroom settings as well as post-secondary programs.

Darratxe and Sepulveda (2011) illuminate numerous aspects of functioning in the mainstream classroom that pose substantial challenges for learners with Asperger's Syndrome. Among these challenges are: coping with changes in schedule and physical surroundings, beginning and ending tasks, and poor imitation. Darratxe and Sepulveda claimed that changes in the physical environment were difficult for those with Asperger's to cope with therefore, educators need to ensure that schedules and general classroom surroundings are organized and as consistent as possible to avoid confusion for these learners (p. 880). Although HFA learners may experience challenges in multiple subject areas/aspects of the school day, Darratxe and Sepulveda (2011) provided an example in mathematics noting how individuals with HFA have difficulty understanding complete instructions and struggle with sequencing (Darratxe & Sepulveda, 2011, p. 883-884). Hume, Loftin, and Lantz (2009) agreed that this is an important area of challenge for HFA learners and may extend beyond academic context and also refer to other aspects of the regular school day ". . . when the expectations of others are unclear or ambiguous, individuals with ASD may not understand that they are expected to initiate a particular behavior" (p. 1331). Hume et al. (2009) further explained that such areas of impairment significantly affect independence for HFA students. Many students with HFA require additional adult support in the classroom other than the teacher, commonly an EA. As mentioned earlier, direct support may be necessary for these students; however, direct support may also result in over-dependence.

In the context of post-secondary education, Shumulsky and Gobbo (2013) provided insight for college instructors; they contend that, "…executive functions that allow a student to focus and shift attention…" (p. 491) are among the areas of deficit that affect the success for HFA college students. Shumulsky and Gobbo (2013) also claimed that EF impairments can cause inappropriate social behavior in class as well as spending too much time on assignments focusing on details (p. 492). Following a review of the literature concerning the issues connected to independence for learners with HFA, it was not surprising that Shumulsky and Gobbo (2013) identified that this can be a problematic area in college as well (p. 492) (as it is often an area of difficulty for neuro-typical individuals). Where these learners may have had an organized, manageable home and school life prior to enrolling in a post-secondary program, campus life may involve living away from home in a college residence, the environment of which is unpredictable as living space is often shared with other students and students change classrooms, buildings, and instructors frequently throughout their day. College programs and living also require that students adequately plan for themselves, which is another area where students with HFA experience great difficulty (Shumulsky & Gobbo, 2013, p. 492). These learners were easily distracted by other stimuli and limited their ability to properly plan their study schedule and become frustrated when they fall behind in their schoolwork due to this trait (impairment).

Robinson et al. (2012) found that statistics regarding employment rate of individuals with ASD range from low employment (50% unemployed) to high employment (86% employed) (p. 11). The Robinson et al (2012) literature review included studies that focused on reasons for successful or unsuccessful employment for this population. With regards to successful employment, they revealed that modifications that employers made for people with ASD were what made the difference for success in the workplace (Robinson et al., 2012, p. 11). Hendricks (2010) research found that employment of individuals with ASD does not just benefit individuals with this diagnosis but all citizens in general as employment of people with HFA means that they will be less reliant on government financial assistance (p. 126). In contrast to some of the significant challenges adults with HFA experience in the workplace such as taking directions and staying organized, Hendricks (2010) explained:

> Once employed, individuals with ASD often demonstrate particular strengths, such as attention to detail and intense focus that result in increased work output and enjoy

> performing jobs often shunned by other due to social isolation or the repetitive nature of the task. (p. 126)

Given a role that is the "right fit" for the individual, areas of deficit may actually be an area of strength. Despite some areas of strength, Hendricks (2010) did find that impairments in EF in the workplace were a definite obstacle to successful employment for HFA adults. "Many exhibit difficulties in task execution due to problems with attention, motor planning, response shifting, and working memory" (Hendricks, 2010, p. 127). As discussed earlier, emotional control resulting sometimes in "meltdowns" which can be a factor for HFA learners in school also pose as an obstacle for HFA adults in the workplace. Despite the deficits in EF and the hindrance that these deficits have for individuals with HFA in their educational and workplace endeavors, the literature pointed towards common ground indicating that with the appropriate training, support personnel, and modifications/accommodations, those with HFA can experience success in school and the workplace (Darratxe & Sepulveda, 2011; Hendricks, 2010; Robinson et al., 2012; Gobbo & Shumulsky, 2012).

3.4. Strategies: Tools for improvement

In addition to providing extensive information as a foundation to better understand the deficits and implications of EF skills for HFA learners, the articles reviewed recommend numerous strategies, which educators, families, and affected individuals themselves can use to improve their skills in this area. Furthermore, the strategies recommended in the readings were very consistent. Among the most common group of strategies evident in the literature is maintaining a well-structured, consistent environment. For school settings, this includes: providing a consistent schedule, predictable routines, organized physical space, and establishing clear classroom boundaries (Lock & Cooper-Swanson, 2005; Darretxe et al., 2011; Shumulsky & Gobbo, 2013). Hendricks (2010) also noted that these strategies were effective for the workplace for individuals with ASD and should be considered when placing such individuals in a job (p. 128). Cooper-Swanson (2005) discussed how consistent schedules can be used in a variety of environments for the individual and can be presented in a variety of different ways depending on what works best for the learner. For instance, some individuals may only require a weekly schedule while others may work better with a daily schedule that breaks the day into hours (p. 182). Shmulsky and Gobbo (2013) further recommend, in addition to detailed syllabi, professors should use consistent assessment/evaluation methods. This may include using rubrics specific to each assignment or detailed checklists (p. 492). As planning is a deficit of EF for those with ASD, a consistent and organized environment helps support the individual in preparing for tasks that lay ahead at home, school, and in the workplace as well as alleviate stresses that may be experienced with unpredictable events.

Used to strengthen and bring future clarity to organized environments for HFA learners, much of the literature addressed the effectiveness of using visual aids (Lock & Cooper-Swanson, 2005; Darretxe & Sepulveda, 2011; Shmulsky & Gobbo, 2013). Visuals for both home and school use may include labeling drawers, shelves, as well as modifying schedules to communicate through more pictures than words (Shmulsky & Gobbo, 2013). Darretxe and Sepulveda (2011) concluded that organizational enhancements should be "…presented visually in order to highlight the most important information and to help in understanding what is to be done" (p. 880). While recommending the use of visual aids, Lock and Cooper-Swanson (2005) was also careful to mention that environments should not be overwhelmed with visual aids; visual aids should be limited to include only the essentials (p. 182). To identify what visuals are considered "essential" is determined by observing the individual and his/her use of visual aids over time and in various environments.

A strategy to assist HFA learners in school environments included "work systems." Darretxe and Sepulveda (2011) explain in simple terms that "work systems are used to show what jobs are to be carried out; when one must finish; what will happen when one finishes" (p. 880). Lock and

Cooper-Swanson (2005) used the term "to-do/finished boxes" (p. 184) however, the description of the system is the same. Hume et al. (2009) go into more detail describing these work systems as a left-to-right system (similar to the directionality of reading) "where students complete all activities placed to their left (in any order) and move them to a 'finished' location on the right "(p. 1334-1335) (see Appendix 1). Hume et al. (2009) emphasize work systems' effectiveness in presenting tasks in an organized fashion as well as a way to increase independence for learners with HFA. The concept of "work systems" is further explored in the discussion and recommendations.

One of the supports available to some individuals with HFA in schools and workplaces that Robinson et al. (2012) and Hendricks (2010) discuss is the role of support workers. The articles provide accounts of how support workers were experienced in the school environment as opposed to the work environment. According to Hendricks (2010) support in the workplace includes the help of supervisors and co-workers who understand Autism as well as both the needs and capabilities of those with HFA (p. 129). However, Hendricks (2010) issued a cautionary note when discussing intensive individualized training:

> …workers with ASD may need extended support to avoid later deterioration in work performance which can lead to employment failure…Personal accounts by adults with ASD recommend ongoing vocational services that would help prepare for and negotiate the types of challenges that arise from day to day. (p. 130)

An example of such ongoing support that is available in the United States is "…the Treatment and Education of Autistic and related Communication-handicapped Children (TEACCH) supported employment program" (Hendricks, 2010, p. 128). This support includes the TEACCH program that instructs workers visiting and monitoring individuals receiving the support in their workplace environment (Hendricks, 2010, p. 131).

The accounts of workers with ASD, as described by Hendricks (2010), are interesting to compare to those found by Robinson et al. (2012) in the school environment. According to the literature reviewed by Robinson et al. (2012), many students disliked having an Education Assistant (EA) all day. Instead, students felt more comfortable when the EA assigned to them also spends time helping other students in the classroom (p. 10). Robinson et al. (2012) noted that these attitudes were due to "…the attention that the students receive by having Educational Assistants (EA)" (p. 10). Although this information does not necessarily suggest the removal of EAs from students with HFA, it does inspire questions concerning the practices of EAs, direction given to EAs by administration, and issues surrounding possible social/emotional limitations related to students with EAs.

4. Summary

Common themes and areas of inquiry are evident in the literature on executive function and high functioning autism. The authors of this literature are all careful to identify elements of deficits in executive function for individuals with HFA and differentiate these deficits from other commonly discussed impairments connected to ASD. Particular elements of executive function of particular focus in the literature included: inhibition, planning, organization, and emotional regulation. These areas of focus were fairly consistent in the literature reviewed for this project and a plurality of authors agreed that these are deficits for learners with high functioning autism. The literature differed according to the contexts in which these deficits are examined.

In the context of personal and social living, it was widely agreed that deficits in executive function contribute to further impairment in social functioning and personal living due to high anxiety, lack of emotional control, and cognitive flexibility despite average to above average intelligence quotient (Epstein et al., 2008; Hume et al., 2009; Landa & Goldberg, 2005; Robinson et al., 2012). The study by Epstein et al. (2008) in particular, identified possible connections between executive function deficits and high stress experienced by parents of children with HFA. Concerning the implications that these deficits have for education and the workplace for those with HFA, difficulties with sequencing, planning, and mental flexibility pose problems for these

learners both in school and in the workplace (Darretxe & Sepulveda, 2011; Hendricks, 2010; Hume et al., 2009; Robinson et al., 2012; Shumulsky & Gobbo, 2012). In particular, challenges following instructions that may be ambiguous as well as adjusting to changing environments and schedules can be substantial for students with HFA and may result in emotional meltdowns (Darretxe & Sepulveda, 2011; Hume et al., 2009). According to Hendricks (2010) however, preference to very sequential tasks may make these individuals well suited for jobs that are based on repetition. Regarding statistics connected to the success of HFA individuals in the workplace, it was found that statistics ranging from high to low rates of employment apply (Robinson et al., 2012).

The most consistent findings and information were evident among the literature that focused on strategies and tools that are effective in improving executive function. Providing structured environments, work systems (for school use), consistent schedules, and implementing visuals were discussed as effective strategies to aid learners and workers with HFA (Darretxe & Sepulveda, 2011; Shmulsky & Gobbo, 2013). It was also discovered that where support workers are welcomed and perceived as helpful by employees with HFA in the workplace, students who have EAs sometimes experience negative feelings towards this support being prescribed to them exclusively (Hendricks, 2010; Robinson et al., 2012).

4. Conclusions and Recommendations

Research has illuminated deficits and elements of EF for individuals with HFA. Studies conducted as well as discussions on implications that these deficits have on several aspects of life provided practical and useful insight. The literature focusing on strategies and tools effective in addressing these impairments provides teachers, community partners, employers, and families with examples that can easily adapted for implementation in a variety of environments in order to support those with HFA. Reviewing current literature and connecting this to special educator practice has raised questions for us that may provide direction for future research in respect to EF and HFA. First, the review provided by Robinson, et al. (2012) raised the issue of students with autism disliking the attention they receive by having an EA in their vicinity (p. 10). We have observed the close proximity issue with EAs who supported students with HFA. This situation is common and we wonder if other students begin to perceive the student and EA as "one" so to speak. That is, the student and EA are rarely seen apart. We believe that this closeness can impact students emotionally, socially, and wonder how it is affecting the student's development of independent skills.

We were pleased to learn of the emphasis that some of the authors placed on the effectiveness of the "left-to-right work system" (Hume et al., 2009, Appendix 1). Following Applied Behaviour Analysis (ABA) methods, we implemented these work systems with students with high functioning autism, which has resulted in greater independence, calmness, and compliance during school.

We hope to investigate the effectiveness (or ineffectiveness) of implementing these work systems and/or modifying these work systems to meet the EF needs for home and workplace tasks. Although we presented strategies to apply to the workplace for HFA employees, left-to-right work systems were absent from reviewed research. Research will provide families and employers with an effective strategy to aid those with HFA in different environments or limit this strategy as one that is best suited for school contexts. All affected (directly and indirectly) would benefit from our future research we believe; that next step will include conducting another search and review of literature to ensure that we have included all studies that either dismiss or approve of using left-to-right work systems in the home and workplace.

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Appendix 1. Left-to-right work system