

Full Length Research Paper

Executive functions, gender, and personality traits in students with and without specific learning disabilities

Bishara Saied

Department of Special Education, Faculty of Education, Beit Berl College and Open University, Israel.

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This study examined the associations between executive functions, gender and personality traits in students with and without specific learning disabilities (SLD). In this study, 80 sixth-grade students were sampled. Of these, 40 were students diagnosed with learning disabilities, 22 boys (55%) and 18 girls (45%) and 40 with no such diagnosis, 23 boys (57%) and 17 girls (43%). All students were tested using two instruments, one for executive functions and the other for personality traits. The present study found a significant difference between students with and without specific learning disabilities on all measures of executive function and personality traits. Also found, was a significant gender-related interaction on measures of attention and time management (executive function) and on measures of neuroticism and of agreeableness (personality traits). Significant associations were also found between executive functions and personality traits on some of the tested measures in the study population. Of the Big Five personality traits, this study found the following significant correlations with executive functions: Response inhibition with extraversion and neuroticism, emotional control with extraversion, task initiation with openness, organization with neuroticism, meta-cognition with conscientiousness, goal-directed persistence with neuroticism and agreeableness, and the overall index with neuroticism. The marked disparities found between the two populations of students suggest that it is important to pay special attention to the population with specific learning disabilities and make an effort to bolster these students in the areas indicated by the measures tested in this study. Such action could have a positive impact on a variety of other pedagogical-related phenomena, such as dropout rates, academic achievements, and social interactions if gender-related aspects are addressed.

Key words: Executive function, gender, personality traits, specific learning disability

INTRODUCTION

Executive functions, personality traits, and the neurological system are currently areas of great interest in brain and behavior science. Executive functions are the psychological structure that forms the high-order

cognitive and self-regulation processes which organize thinking and action. Executive functions include planning, working memory, impulse control, inhibition, shifting between tasks, initiating, and control (Brown, 2006;

E-mail: saiedbs@gmail.com.

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Salehinejad et al., 2021). Personality traits are the collection of characteristics that are typical of and unique to an individual, and they are the product of cognitive and social abilities. The Big Five Personality Traits model proposes five fundamental dimensions of personality: neuroticism versus emotional stability, extraversion versus introversion, openness versus relying on intellect, agreeableness versus antagonism, and conscientiousness versus competitiveness (Cattell and Mead, 2008). Specific learning disability (SLD) is a neurodevelopmental disorder which affects basic learning functions (like reading, writing, mathematics), and interferes with the ability to acquire skills and express abilities as expected by age and IQ. Specific learning disabilities do not derive from intellectual disability, emotional disorders, or vision, hearing or motor disabilities. Individuals with a diagnosed specific learning disability can expect it to affect many aspects of their lives, at school, at the workplace, and in social settings. Specific learning disabilities are often divided into three categories: reading (dyslexia), writing (dysgraphia), and mathematics (dyscalculia) (American Psychiatric Association - APA, 2013).

There are several current explanations of gender-related differences in specific learning disabilities, but as some of these differences have been ascribed to instrument bias, there is need for further research on this question (Ashraf and Najam, 2017). The literature describes the prevalence of reduced function, performance, achievements, and skills in students with learning disabilities and a link between this prevalence and executive functions (Tannock, 2013; Trainin and Swanson, 2005). It is therefore important to examine how to best improve executive function, as a way to combat the resulting drop in motivation and persistence, frustration and anxiety, and low self-esteem that these students experience. Current research also indicates that personality traits affect these difficulties, either promoting or hampering coping mechanisms (Krieger et al., 2020). Recently, fascinating studies of the interaction between two fundamental structures of individual differences have shown that personality and cognition are linked on both the phenotypic and genetic levels (Curtis et al., 2015; Rammstedt et al., 2018; Nikolašević et al., 2021). At least superficially, executive function as a cognitive measure shares many of the conceptual characteristics of several personality traits reported in the literature, and similar terms are used to define strategies in both domains: personality traits and executive function. A recent study found, on the one hand, that greater conscientiousness and extraversion together with lower neuroticism predict better working memory, and on the other hand, greater conscientiousness and agreeableness together with lower extraversion predict better inhibition. These insights suggest that these measures of individual differences share many common points, both on the psychological and the neuro-biological level. Executive functions are

therefore almost certain to play a key role in the development of psychopathological personality function, but there is insufficient data regarding the differential association of executive function with normative personality structures (Nikolašević et al., 2022). Although there are studies of executive function in populations with specific learning disabilities in relation to either gender or personality traits, it seems there is no previous study examining the relationship between specific learning disabilities and all three variables-executive function, personality traits, and gender-as compared with populations without specific learning disabilities. Nor is there a similar study in the age group tested in the present study: sixth-grade students who are in their final year of elementary school before they move on to high school.

This study therefore aimed to examine the associations between executive functions, gender, and personality traits in students with and without specific learning disabilities. Understanding these associations may help educators design better curricula, identify problem areas in the educational system, and offer students with specific learning disabilities interventions that include necessary adjustments for gender.

THEORETICAL BACKGROUND

Executive functions

Executive function is a term used to describe a group of mental processes that connect past experience with present actions. These processes allow individuals to respond flexibly to their environment and integrate action with goal-oriented thought. Executive functions create the basis for abilities such as problem solving, and are most often applied when external direction is absent and in new situations (Cragg and Gilmore, 2014). Executive functions manifest in a person's ability to plan, organize, use strategies, think flexibly, pay attention to detail, prioritize, focus, maintain and shift attention between tasks, maintain effort, regulate alertness, regulate emotions, use working memory, grasp abstract ideas, and self-monitor (Anderson and Catroppa, 2005; Brown, 2006; Kave et al., 2007; National Joint Committee on Learning Disabilities - NJCLD, 2005). As such, executive functions are part of the cognitive abilities that form adaptive function and that facilitate goal-oriented behavior, flexibility and autonomy (Spinella, 2005). These skills first appear in infancy and continue developing into adulthood (Stadskleiv et al., 2017). People with impaired executive functions have difficulty planning, organizing, and managing their time and space. They often present weak working memory, which is an important tool in guiding a person's actions. As with specific learning disabilities, executive function disorders can be hereditary. The signs are evident at any age, but become

clearer in children when they start elementary school. For example, requiring a child to do their homework independently may expose difficulties in this area (Bishara and Kaplan, 2016; NJCLD, 2005). These processes are more often impaired in people diagnosed with ADHD and hyperactivity, autism spectrum disorders, dyslexia and dyscalculia, as well as in people with depression, anxiety, and sleep disorders (Best et al., 2009; Monetten et al., 2011; Serfaty, 2016). As noted in the introduction, recent research has found evidence of associations between cognition and personality (Curtis et al., 2015; Rammstedt et al., 2018; Nikolašević et al., 2021), and it seems that links between personality traits and executive functions support the mechanisms of daily functioning (Nikolašević et al., 2022). Executive function as a cognitive measure shares conceptual characteristics with personality traits, presented in the study.

Personality traits

A personality trait is a cluster of typical characteristics that people have to different degrees and that affect constructs at the root of personality. The goal of personality theory is to formulate a matrix of an individual's characteristics that is predictive of that person's behavior (Cattell and Mead, 2008). Despite the diversity of sources reporting personality traits and of measuring techniques, there is agreement about five central features of personality, as proposed by the McCrae and John Big Five model (McCrae and John, 1992; Waller and Zavala, 1993). Currently, it is the most widely accepted model and there is broad consensus about its efficacy (Etzion and Walski, 1998). It describes five bipolar personality dimensions that encompass specific traits. Each of the five dimensions is composed of six highly intercorrelated sub-dimensions. The first dimension is neuroticism (N) vs. emotional stability. Neuroticism reflects the frequency and intensity at which a person experiences unpleasant feelings such as self-consciousness, worry, inferiority, as opposed to feelings of confidence, serenity, and satisfaction. Persons with high N tend to worry, be afraid, depressed, experience mood swings, emotional distress and unrealistic thinking, be extremely passionate, and have difficulty delaying gratification. People with low N tend to be emotionally stable which typically presents as being satisfied with life, and free of depression and emotional difficulties. N sub-dimensions are: anxiety, aggressive anger, depression, self-awareness, impulsivity, and vulnerability. The second dimension is extraversion (E) vs. introversion. It represents the tendency to have social interactions, be assertive, active, and seek stimulation as opposed to being introverted, reserved, and distant. People with high E tend to have positive feelings, are sociable, active, talkative, and well-liked. Low E people tend to be introverted, composed, detached, independent, and

quiet. Introverts are not necessarily unfriendly or pessimistic, but they do not exhibit the same exuberance as extroverts. E sub-dimensions are warmth, preference for social environment, assertiveness, active temperament, seeking stimulation, and positive affect. Openness to experience vs. relying on intellect is the third dimension. It represents the tendency to creativity, imaginativeness, quick perception, discernment, and consideration. Strong O people are curious, have highly developed imaginations, and support unconventional opinions and values. People with low O tend to have rigid beliefs and opinions, and are resistant to new ideas and experiences. Sometimes they do not respond to emotional stimuli, do not give up easily or change behavior patterns. O sub-dimensions are: a tendency to follow imagination, a sense of esthetics, emotional open-mindedness, being ready to act, openness to other ideas and values.

The fourth dimension is agreeableness vs. antagonism. High A personalities are kind, pleasant, trusting, giving, forgiving, and altruistic. Low A personalities are egocentric, manipulative, cynical, suspicious, competitive, and less considerate. The A sub-dimensions are ability to trust others, directness, altruism, responsiveness, modesty, and caring.

The fifth dimension is conscientiousness. C personalities are on the one hand reliable, cautious, organized, efficient planners, and on the other end, they are competitive, ambitious, and goal-oriented. High C persons are organized, ambitious, heavily-invested in their job, self-motivated, and responsible. Low C persons are lazy, irresponsible, apathetic, and driven by the search for pleasure. The C sub-dimensions are competitiveness, order, responsibility, ambition, self-discipline, thinking before acting (Maertin et al., 2006). In general, conscientiousness displays the most interaction with planning or executive control processes, and neuroticism, agreeableness, and extraversion are associated more clearly with reactionary or motivational control processes. Conscientiousness is also linked with curbing impulses, effortful attention, planful behavior, organization and achievement orientation. Krieger et al. propose that the "overarching inhibitory component of conscientiousness is associated with self-regulation, probably reflecting some kind of top-down regulation process" (Krieger et al., 2020). Many researchers have addressed the role that the five personality traits play in academic success in an educational setting (Abd Hamid et al., 2020; Angelkoska et al., 2016). Jensen (2015) suggests that a person's more prominent personality traits have a discernible effect on academic success. Indeed, individual differences in personality affect the way learners approach and process learning materials, which in turn affects their learning (Spinath et al., 2014). For example, when appearing together, openness and conscientiousness were found to be positive predictors of grades in mathematics (Levpušček et al., 2013).

However, despite the broad application of the Big Five model, a literature review conducted for this paper found very few studies that examined these traits in students with learning disabilities. One of the few is the Brown and Cinamon (2016) study which describes a lower prevalence of extraversion and openness in adolescents with learning disabilities compared with adolescents with no academic difficulties. In addition, many parents of adolescents with learning disabilities make decisions for their children and adolescents who are in school, particularly in academic matters. This makes it likelier that growing up, these children will have less experience setting themselves goals, developing initiative, and planning activities, i.e. fewer opportunities of developing their conscientiousness.

Personality traits and gender

There are gender-related differences in personality structures. Men are often perceived as motivated by external factors such as financial security, salary, and occupational status; whereas women are frequently perceived as motivated by convenience and the need to combine a career with family life, particularly after they become mothers (Maertin et al., 2006). Often in the literature, men as a group are assigned physical qualities (strong, courageous, untroubled), functional qualities (protector, breadwinner), sexual qualities (aggressive, experienced, confident), emotional qualities (unemotional, reserved, hides weakness), intellectual qualities (logical, learned, rational, practical), and interactive qualities (leader, dominant, independent, individualist), and manly personality meaning being successful, ambitious, aggressive, competitive, arrogant, egocentric, and adventurous (Krieger et al., 2020). However, much has changed since then in the way researchers perceive personality and male qualities (Offer and Kaplan, 2021). Historically, women were defined as submissive, gentle, modest, and obedient by a patriarchal world that perceived them as weak. Today, modern dialog surrounding feminine qualities counts feminine traits such as collaboration, caring, courage, intuition, vision as meaningful and necessary in positions of leadership, and in life in general (Maertin et al., 2006). Evidence of gender differences in personality can be seen in a modern study based on the Big Five model of personality traits, where researchers found that women in general scored higher than men on neuroticism, extraversion, and agreeableness (Weisberg et al., 2011). Studies of gender differences in learning disabilities have shown that reading and writing difficulties are less common among girls (fewer girls are diagnosed with these disabilities than boys). To date, there are several explanations for gender-related differences in learning disabilities, but as some of these have been ascribed to instrument bias there is need for further research (Ashraf

and Najam, 2017). The present study tested personality traits and gender differences in populations of school children with and without learning disabilities. As personality and gender traits have been tested largely in adults, the results of this study of younger students are of particular interest.

Specific learning disabilities

The DSM-5 defines a specific learning disability as a specific learning disorder in three separate academic areas: reading, writing, and mathematics. The definition of specific learning disorder first appeared in the DSM-5, which is an indication of the need to pinpoint the difficulty. The requirement for specificity reflects the progress made in the study and treatment of learning disabilities, because the specific definition facilitates focused intervention (APA, 2013; Tannock, 2013). The DSM-5 definition of specific learning disability signifies that specific learning disabilities are of neurological-cognitive rather than environmental origin. Similarly, sensory and emotional disorders, and physical or intellectual disability are excluded as a cause of specific learning disability. The DSM-5 definition also includes marked gaps between a student's IQ and academic achievements (APA, 2013). The DSM-5 recommends diagnosing a specific learning disability based on lists of skills. Specific learning disorder with a reading disability manifests as inaccurate, slow, or labored reading of words, and reading out words incorrectly, slowly, or hesitantly, guessing words, having trouble enunciating, or difficulty understanding the sequence, relationship, conclusions, or deeper meaning of the text. A specific learning disorder with a writing disability may manifest as illegible handwriting, effortful writing, difficulty in constructing paragraphs, and frequent spelling, syntax, and punctuation errors. A specific learning disorder with a mathematics disability is likely to manifest in difficulty understanding numbers, extracting facts or calculations, applying concepts, facts, or mathematical procedures when solving math problems (APA, 2013; Tannock, 2013). In Israel, the Ministry of Education (2009) applies two of the DSM-5 criteria: significant and persistent gap between actual academic achievements and expected achievements by age and class, and marked discrepancy between actual academic achievements and intellectual abilities as measured in objective IQ tests.

Association between executive functions, gender, and personality traits in students with and without specific learning disabilities

Executive function research has shown that students with specific learning disabilities have difficulty completing tasks that rely on executive functions. As a result, they

are unable to achieve the required knowledge and skills for their age. Impaired executive function makes the demands of the standard curriculum more complicated for this population: As they fail challenges they are given, students with specific learning disabilities may develop frustration and anxiety followed by reduced self-efficacy and resilience, ultimately resulting in reduced motivation, effort, and persistence (Tannock, 2013). It seems that both impaired executive function, which makes it harder to meet challenges, and the reduced motivation due to this failure may produce a consistent pattern of lower than expected academic achievements (Trainin and Swanson, 2005). The multi-component model of working memory (Baddeley, 2007) is one of the prominent cognitive frameworks that has been linked with executive function. This model proposes one cognitive component that specializes in conserving speech-based phonological knowledge, another component for visual and spatial information, and a third component which the model assumes is the central control structure. This third component is called the central executive and it regulates frontal lobe cognitive processes and executive functions. A qualitative Swedish study examined the relationship between the quality of instruction in school and executive functions by looking at students with and without learning disabilities, their teachers and parents. This study found that students with learning disabilities had impaired executive functions and pointed out both to the importance of adapting teaching practices for these students, and to the need for close collaboration between teachers, parents, and domain experts (Verdier et al., 2018). Another study looked at how motor disorders are linked with dyslexia and executive function in children and adolescents by testing for change following motor exercise. This study showed that exercise reduced error rates in students both with and without learning disabilities (Marchand et al., 2017). A study that examined the connection between executive function and handwriting skills compared students with and without learning disabilities and showed that executive function was significantly better in student without learning disabilities and this affected handwriting (Bishara and Kaplan, 2016; Schuck and Crinella, 2005).

Krieger et al. (2020) tested executive function and personality traits in adolescents with ADHD. Their findings show that ADHD greatly affected adolescent behavior and actions, by making them more industrious. The implication is that hyperactivity can be harnessed together with personality traits to improve academic and social functioning. According Krieger et al., the Big Five personality traits, executive functions, and the symptoms of ADHD are linked in many ways, such as inattention associated with executive functions and conscientiousness and hyperactivity-impulsivity is associated with agreeableness, neuroticism and reactive control. They also suggest that these varying patterns of association may reflect mediation by two different pathways:

either a top-down process influenced by executive function or a bottom-up process affected by automatic influences. If individual differences in executive function reflect top-down differences in control, this could explain the links between personality traits and ADHD symptoms in situations which require controlled responses rather than automatic ones. It is noted that despite the wide application of the Big Five model of personality traits (McCrae and John, 1992), a review conducted for this paper found very few studies that examine these traits in students with learning disabilities. Such a study could be of great interest because some of the personality traits in the Big Five model reflect skills and abilities that are affected by the existence of a specific learning disability, for example, planning, organization, persistence, curiosity, or seeking excitement. Specific learning disabilities have also been linked to gender; boys are diagnosed with specific learning disabilities and specific reading and writing disorders more than girls. As noted, some explanations ascribe these gender differences to instrument bias, but some differences remain unexplained (Ashraf and Najam, 2017). Consequently, this study aimed to examine the associations between executive functions, gender, and personality traits in students with specific learning disabilities and compare them to students without specific learning disabilities. It is important to understand whether and how these factors are linked, so that personality traits can be exploited to develop executive functions in students with specific learning disabilities and improve their academic achievements (Figure 1).

Research questions

1. Is there a difference between students with and without specific learning disabilities in executive function? Does the expected difference vary consistently with gender?
2. Is there a difference between students with and without specific learning disabilities in personality traits? If present, does this difference vary consistently with gender?
3. Is there an association between executive function and personality traits in the study population?

Study hypotheses

1. There is a significant difference in executive function between students with and without specific learning disabilities. Students with specific learning disabilities will have weaker executive function compared with students without specific learning disabilities.

Reasoning: A review of the literature has shown that students with specific learning disabilities have weaker effective executive functions; in these students self-regulation, flexible thinking, and ability to grasp abstract ideas are reduced.

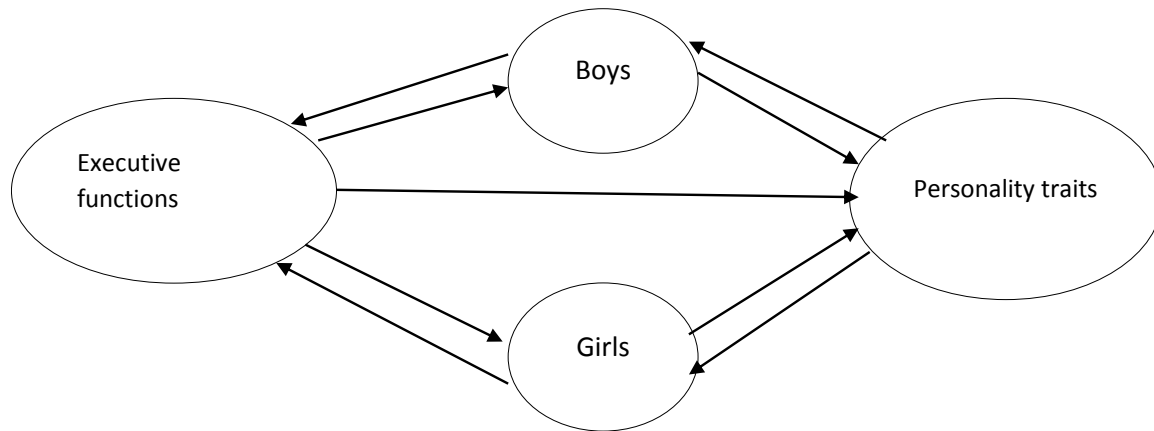


Figure 1. Study model.
Source: Author.

2. Executive function, gender, and specific learning disability are interrelated.

Reasoning: The literature has shown that girls with specific learning disabilities have stronger executive functions than boys with specific learning disabilities.

3. There is a significant difference in personality traits between students with and without specific learning disabilities. Students with specific learning disabilities will have different personality traits than students without specific learning disabilities.

Reasoning: No trend or feature of this difference can be proposed as this is a pilot study.

4. There is significant interaction in gender-related personality traits between students with and without specific learning disabilities.

Reasoning: The literature does not discuss differences in personality traits between boys and girls, but there are studies that point to differences and these need clarifying.

5. There is an association between executive functions abilities and personality traits in the study population.

Reasoning: As this is a preliminary study, it is not yet possible to specify which executive functions may be associated with which personality traits.

MATERIALS AND METHODS

Participants

Eighty sixth-grade students (aged 11 to 12 years) from two different elementary schools participated in this study. The children attend integrated classes in general education schools. In the first group there were 40 students with specific learning disabilities (50%) of which 22 (55%) boys and 18 (45%) girls. The second group had 40 students without learning disabilities at all (50%), of which 23 were boys (57%) and 17 (43%) girls. All students come from middle-class homes with large families, where mothers are homemakers, and fathers are employed and earn an average wage. All participants with specific learning disabilities underwent a psychological evaluation by the Counseling Services in their area irrespective of

this study. This evaluation includes a psychologist's diagnosis of the type of disorder, a Wechsler IQ test (WISC), and didactic assessment for reading, reading comprehension, mathematics, and English by qualified didactic evaluators using accepted instruments. These evaluations also test for visual-motor and visual, hearing, language, memory, thinking, and attention and concentration skills. Based on the information in these evaluations, the participants in this study had an IQ in the normal range (85 to 115 on the Wechsler scale) and comprehensive learning difficulties. Their cognitive abilities were in the normal range and they had no overt or underlying sensory impairment.

Research instruments

Executive functions questionnaire

The study used executive skills in children and adolescents questionnaire developed by Dawson and Guare (2018) with 36 questions relating to twelve types of executive functions. Each item scores agreement on a Likert scale of 1 (disagree completely) to 5 (agree strongly). Overall reliability for the questionnaire was $\alpha=.86$. A higher score indicates a higher level of executive function. The twelve types of executive functions tested were: Response inhibition (items 1, 2, 3), such as "I don't jump to conclusions," $\alpha=.55$. Working memory (items 4, 5, 6), such as "I have a good memory for facts, dates, and details," $\alpha=.71$. Emotional control (items 7, 8, 9), such as "My emotions seldom get in the way when performing on the job," $\alpha=.60$. Task initiation (items 10, 11, 12), such as "No matter what the task, I believe in getting started as soon as possible," $\alpha=.66$. Sustained attention, (items 13, 14, 15), such as "I find it easy to stay focused on my work," $\alpha=.72$. Planning/prioritizing (items 16, 17, 18), such as "When I plan out my day, I identify priorities and stick to them." $\alpha=.61$. Organization (items 19, 20, 21), such as "I am an organized person." $\alpha=.65$. Time management (items 22, 23, 24), such as "At the end of the day, I've usually finished what I set out to do." $\alpha=.72$. Flexibility (items 25, 26, 27), such as "I take unexpected events in stride," $\alpha=.73$. Metacognition (items 28, 29, 30), such as "I routinely evaluate my performance and devise methods for personal improvement." $\alpha=.63$. Goal-directed persistence (items 31, 32, 33), such as "I think of myself as being driven to meet my goals." $\alpha=.68$. Stress tolerance (items 34, 35, 36), such as "I enjoy working in a highly demanding, fast-paced environment." $\alpha=.68$.

Personality trait questionnaire

The personality trait questionnaire is a condensed version of the 1992 McCrae and John BFI (Big Five Index) questionnaires, translated into Hebrew by Etzion and Walski (1998). Respondents were asked to rank their agreement with 44 personality trait items on a 5-point Likert scale (1-strongly disagree, 5-strongly agree). Overall reliability for the questionnaire was $\alpha=.89$. The questionnaire addresses five personality traits.

Extraversion facets: Strong social needs ability to connect, assertive, talkative, and active. The opposite end of this scale is introversion. There were eight items for this sub-dimension (6, 11, 16, 21, 26, 31, 36). Two items were reversed so that a high score indicates being highly extroverted (21, 31), for example: "inhibited and reserved" reliability $\alpha=.83$.

Neuroticism facets: Anxiety, depression, anger, self-consciousness, worry, emotionality, and vulnerability. The other end of this scale is emotional stability. There were eight items for this sub-dimension (4, 9, 14, 19, 24, 29, 34, 39). Three items were reversed to test neuroticism rather than emotional stability. For example: depressed and tends to be irritable. Reliability was $\alpha=.85$.

Agreeableness facets: Being courteous, flexible, reliable and trusting, easy-going, collaborator, forgiving, tolerant. The opposite end of this scale is antagonism and hostility. There were nine items for this sub-dimension (2, 7, 12, 17, 22, 27, 32, 37, 42) of which four were reversed (2, 12, 27, 37). For example: "Tends to criticize and find fault in others." Reliability $\alpha=.87$.

Conscientiousness facets: Being cautious, thorough, responsible, organized and planned, hard-working, persistent, and self-disciplined. The opposite end of this scale is undirectedness. There were nine items for this sub-dimension (3, 8, 13, 18, 23, 28, 33, 38, 43) of which four were reversed (8, 18, 23, 43). For example: "Does a thorough job." Reliability $\alpha=.86$.

Openness to experience facets: Being imaginative, curious, original, having wide interests, highly intelligent, and artistically sensitive. The other end of this scale is closeness to experience. There were ten items for this sub-dimension (5, 10, 15, 20, 25, 30, 35, 40, 41) and one item was reversed (41). For example: "Is original, has new ideas." Reliability $\alpha=.87$.

Research method

80 sixth-grade students who attend integrated classes in two general-education elementary schools participated in this study in coordination with the schools' educational authorities. Twenty students were selected from each class (ten with and ten without specific learning disabilities). Participants responded to an executive functions questionnaire and a personality traits questionnaire. Students were told that their information would remain confidential, that there is no single correct answer, and that for each statement they should select the answer with which they most agree. Participants were asked to state their age, gender and class but to refrain from providing their name. Statements were read to the students out loud and students marked their responses on their sheets. Both questionnaires were administered at the same time, and the process took about half an hour.

Data processing methods

Averages and standard deviations were calculated. The associations between variables were tested by Pearson correlation.

Differences in executive function and personality traits were tested with t-tests for independent samples. The interaction between gender and group type was tested using two-way ANOVA in a 2X2 matrix. Data was processed using SPSS version 21.

FINDINGS

Differences in executive functions between students with and without specific learning disabilities

The findings regarding differences in executive functions between students with and without specific learning disabilities (Hypothesis 1) are shown in Table 1. Table 1 shows that on most measures (response inhibition, working memory, task initiation, attention and concentration, planning/prioritizing, organization, time management, flexibility, meta-cognition, goal-directed persistence, and stress tolerance) students with specific learning disabilities scored significantly lower than students without specific learning disabilities. On emotional control, students with specific learning disabilities scored significantly higher than students without specific learning disabilities.

Interaction between executive functions in boys and girls with and without specific learning disabilities

According to the second hypothesis, this study analyzed gender-related differences in executive function between students with and without specific learning disabilities. Only two measures attention and concentration and time management were statistically significant. Table 2 shows average, SD and two-way ANOVA. The information in Table 2 and in Figures 2 and 3 shows significant interaction for attention and concentration and for time management. For both functions, on average, students (boys and girls) without specific learning disabilities scored significantly higher than the students with specific learning disabilities. The data also show that the gaps in attention and concentration are greater for boys than for girls in the group with specific learning disabilities, and in time-management they are greater for girls than for boys. In other words, boys without specific learning disabilities have less attention and concentration problems than girls, and girls without specific learning disabilities are better at time management than boys.

Differences in personality traits between students with and without specific learning disabilities

The findings regarding differences in personality traits between students with and without specific learning disabilities (Hypothesis 3) are shown in Table 3. The averages shown in Table 3 indicate that on most measures (extraversion, agreeableness, conscientiousness, and openness) the students with specific learning disabilities scored significantly lower

Table 1. Average, standard deviation, and t-test for executive functions in students with and without specific learning disabilities.

Variable	Group type	M	SD	t
Response delay	With specific learning disabilities	3.61	0.28	9.92**
	Without specific learning disabilities	4.40	0.40	
Working memory	With specific learning disabilities	1.38	0.34	14.58**
	Without specific learning disabilities	3.50	0.33	
Emotional control	With specific learning disabilities	2.57	0.33	12.58**
	Without specific learning disabilities	1.65	0.31	
Initiate a task	With specific learning disabilities	3.60	0.38	-12.70**
	Without specific learning disabilities	4.63	0.33	
Attention and concentration	With specific learning disabilities	3.70	0.27	-12.12**
	Without specific learning disabilities	4.63	0.40	
Planning/ Prioritize	With specific learning disabilities	3.72	0.24	-10.38**
	Without specific learning disabilities	4.51	0.41	
Organization	With specific learning disabilities	3.66	0.30	-12.18**
	Without specific learning disabilities	4.58	0.36	
Time management	With specific learning disabilities	3.57	0.37	-13.54**
	Without specific learning disabilities	4.60	0.30	
Flexibility	With specific learning disabilities	3.70	0.29	-12.38**
	Without specific learning disabilities	4.60	0.34	
Meta cognition	With specific learning disabilities	3.73	0.33	-11.71**
	Without specific learning disabilities	4.58	0.31	
Goal-directed perseverance	With specific learning disabilities	3.70	0.28	-12.07**
	Without specific learning disabilities	4.60	0.37	
Resistance to pressure	With specific learning disabilities	3.75	0.27	-10.17**
	Without specific learning disabilities	4.55	0.41	

*p<.05, **p<.01, ***p<.001.
Source: Author.

Table 2. Average executive functions, standard deviation, and two-way ANOVA by research group and gender (N=80).

Variable	With specific learning disabilities		Without specific learning disabilities		Group F(1, 76)	Gender (F)	Interaction			
	M	SD	M	SD						
Factors of executive functions										
	Attention and concentration	Boys	3.66	0.23	4.78	0.29	152.80**	3.59**	8.46**	F
		Girls	3.74	0.31	4.43	0.45	0.66	0.045	0.100	η ²
Time management		Boys					195.46**	0.967**	0.204	F
		Girls	3.66	0.38	4.55	0.29	0.72	0.01	0.062	η ²

*p<.05, **p<.01, ***p<.001.
Source: Author.

than students without specific learning disabilities. On neuroticism, students with specific learning disabilities scored significantly higher than students without specific learning disabilities.

Interaction between personality traits in boys and girls with and without specific learning disabilities

To test the fourth hypothesis, this study analyzed

differences in personality traits between students with and without specific learning disabilities by gender. Only two measures-neuroticism and agreeableness-showed statistically significant interaction (Table 4). The information in Table 4 and Figures 4 and 5 shows significant interaction for neuroticism and agreeableness. Similar to the findings for the third hypothesis, on average, students (boys and girls) with specific learning disabilities scored significantly higher on neuroticism than

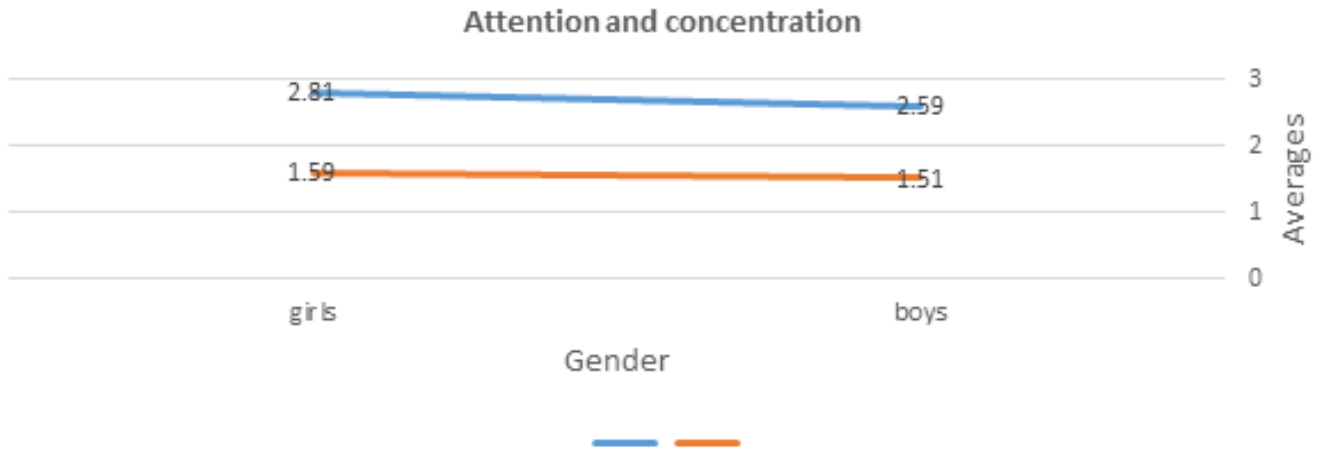


Figure 2. Average attention and concentration by gender (N=80).
Source: Author.

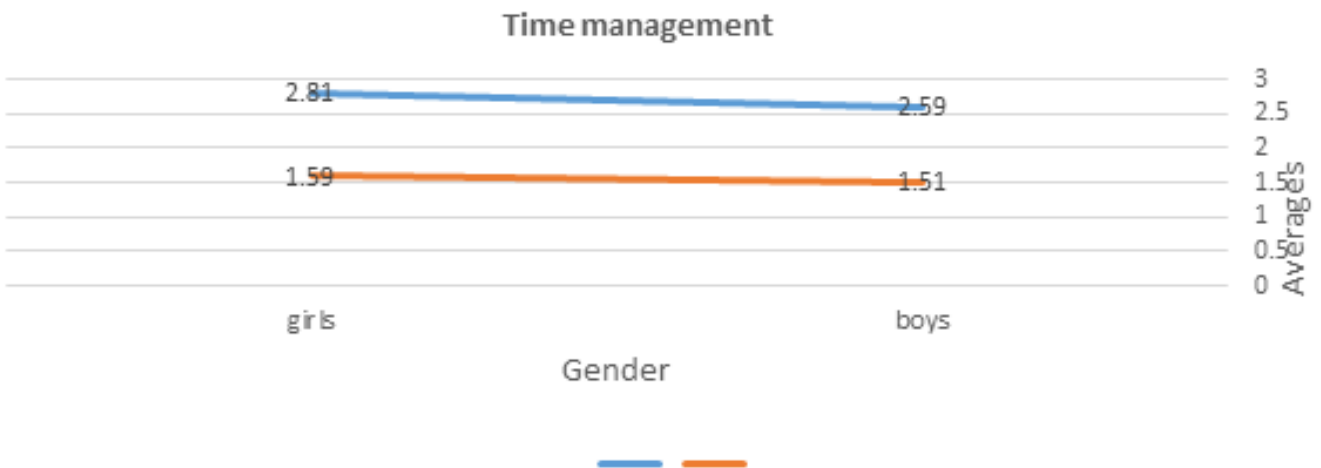


Figure 3. Average time-management by gender (N=80).
Source: Author.

Table 3. Average, standard deviation, and t-test for executive functions in students with and without specific learning disabilities (N=80).

Variable	Group type	Mean	SD	Total
Extroversion	With specific learning disabilities	3.28	0.19	-23.68**
	Without specific learning disabilities	4.41	0.22	
Neuroticism	With specific learning disabilities	2.69	0.22	23.90**
	Without specific learning disabilities	1.54	0.19	
Personality traits Agreeableness	With specific learning disabilities	3.18	0.22	-24.07**
	Without specific learning disabilities	4.33	0.20	
Conscientiousness	With specific learning disabilities	3.20	0.21	-23.34**
	Without specific learning disabilities	4.29	0.20	
Openness	With specific learning disabilities	3.50	0.12	-29.22**
	Without specific learning disabilities	4.53	0.18	

*p<.05, **p<.01, ***p<.001.
Source: Author.

Table 4. Average measures of personality traits, standard deviation, and two-way ANOVA by research group and gender (N=80).

Variable	Factors of personality traits	With specific learning disabilities		Without specific learning disabilities		Group $F(1, 76)$	Gender (F)	Interaction	
		M	SD	M	SD				
Neuroticism	Boys	2.59	0.21	1.51	0.18	653.78**	11.59**	2.33**	F
	Girls	2.81	0.18	1.59	0.21				0.89
Agreeableness	Boys	3.22	0.20	4.34	0.20	570.70**	0.967**	0.613**	F
	Girls	3.14	0.24	4.33	0.21				0.88

* $p < .05$, ** $p < .01$, *** $p < .001$.
Source: Author

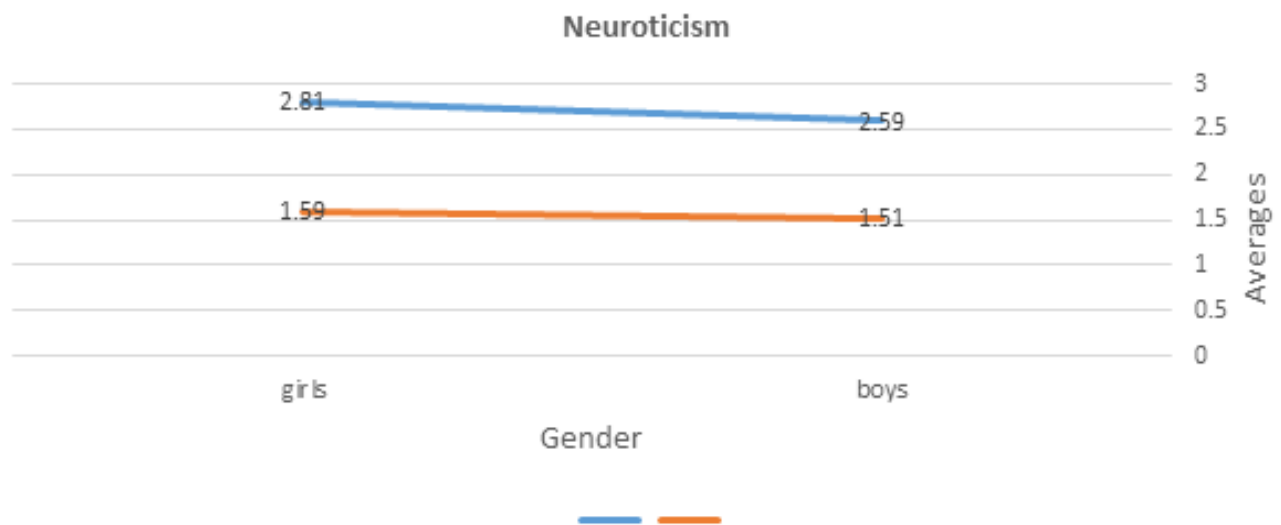


Figure 4. Average neuroticism by gender (N=80).
Source: Author.

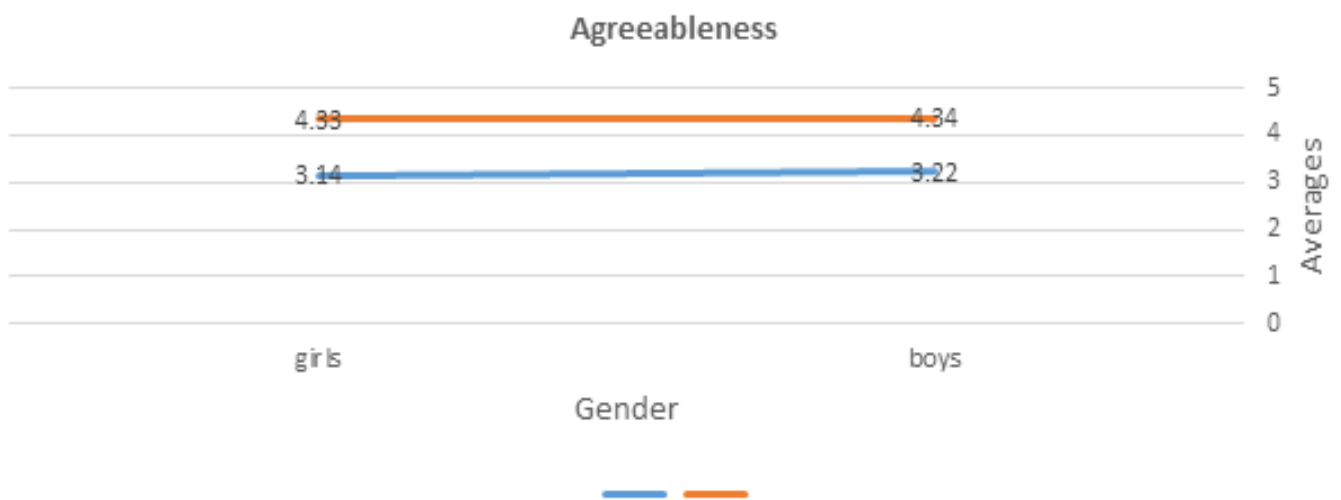


Figure 5. Average agreeableness by gender (N=80).
Source: Author.

Table 5. Correlation between executive functions and personality traits (N=80).

Variable	With a specific learning disability (n=40), Without specific learning disability (n=40)				
	Extroversion	Neuroticism	Agreeableness	Conscientiousness	openness
Response delay	-0.153*	-0.057*	0.063	-0.003	0.145
	-0.018	-0.276	-0.129	0.238	0.182
Emotional control	0.013*	0.280	-0.067	-0.054	0.281
	-0.169	-0.088	-0.258	-0.024	0.057
Initiate a task	0.142	-0.133	0.088	-0.039	-0.331*
	0.280	-0.024	0.305	0.094	-0.027
Organization	-0.143	0.015	-0.142	-0.187	-0.052
	-0.083	-0.469**	0.56	-0.029	0.249
Meta - cognition	-0.201	0.160	0.187	-0.334*	-0.129
	0.255	-0.004	0.239	0.011	0.016
Goal-directed perseverance	0.068	0.327*	-0.456**	0.090	0.022
	-0.051	-0.212	-0.129	0.030	0.260
Overall index	0.138	0.048*	0.053	-0.213	-0.034
	0.261	-0.318	0.122	-0.081	0.235

*p<.05, **p<.01, ***p<.001. Note: In the table cells, the section above the diagonal refers to students with specific learning disabilities and the section below the diagonal refers to students without specific learning disabilities.

Source: Author

students without specific learning disabilities. On agreeableness, on average, boys and girls without specific learning disabilities scored significantly higher than boys and girls with specific learning disabilities. Also, girls with specific learning disabilities scored higher on neuroticism and lower on agreeableness than boys with specific learning disabilities.

Association between executive functions and personality traits

To test the fifth hypothesis regarding significant correlations between executive functions and personality traits Pearson correlations were calculated. Table 5 shows correlations between executive functions and personality traits in the two groups. Table 5 shows significant associations between response inhibition and extraversion and neuroticism, between emotional control and extraversion, between task initiation and openness, between organization and neuroticism, between meta-cognition and conscientiousness, between goal-directed persistence and neuroticism and agreeableness, and between the overall index (average of all factors) and neuroticism.

DISCUSSION

This study aimed to test associations between executive functions, gender, and personality traits in students with and without specific learning disabilities. According to the first hypothesis, students with specific learning disabilities were expected to have weaker executive functions

compared with students without specific learning disabilities. In this study, the students with specific learning disabilities scored markedly and significantly lower than students without specific learning disabilities on most executive function measures. The literature suggests that individuals with impaired executive functions have difficulty planning, organizing, and managing their time and space. They often present weak working memory, which is an important tool in guiding a person's actions and in making plans (Bishara and Kaplan, 2016; NJCLD, 2005). These functions include self-regulation, working memory, flexibility, planning, sustained attention, and ability to grasp abstract ideas. These processes are impaired more often in people diagnosed with ADHD and hyperactivity, autism spectrum disorders, dyslexia and dyscalculia, as well as in people with depression, anxiety, and sleep disorders (Best et al., 2009; Monetten et al., 2011; Serfaty, 2016). As students with specific learning disabilities have difficulty completing tasks that rely on executive functions, they are unable to achieve the required level of knowledge and skills for their age, specifically language and auditory skills, time management, flexibility of thinking, control, and selection of appropriate sensual information (Tannock, 2013). The possible conclusion is that, in some students, in the context of executive function, learning disabilities may present as other psychopathologies. This is an important factor to consider when adapting instruction methods for these students and when setting academic expectations.

On the other hand, students with specific learning disabilities scored significantly higher than students without specific learning disabilities on emotional control.

Possibly, the specific learning disability gives diagnosed students better control of their emotions compared with their peers without specific learning disabilities (Davidson et al., 2006). This study's findings support existing research and offer new information regarding emotional control in which, surprisingly, students with specific learning disabilities scored higher than students without specific learning disabilities. Students with specific learning disabilities are shown to have relatively lower levels of executive functions, and this underscores the importance of helping these students develop their executive function related skills, as they are already struggling with many other learning-related difficulties. The second hypothesis proposed a significant interaction between executive function and gender in students with and without specific learning disabilities. The study's findings showed significant interaction on two measures (attention and concentration and time management): Students without specific learning disabilities reported better attention and concentration than students with specific learning disabilities, and boys without specific learning disabilities reported better attention and concentration than girls without specific learning disabilities. Looking at boys with specific learning disabilities, the reverse is seen—girls with specific learning disabilities have better attention and concentration than boys with specific learning disabilities. Time management in boys without specific learning disabilities was better than in boys with specific learning disabilities and girls without specific learning disabilities reported better time management than boys without learning disabilities. However, boys with learning disabilities were better at time management than girls with learning disabilities.

In general, students without specific learning disabilities reported better attention and concentration than students with specific learning disabilities, and boys without specific learning disabilities reported better attention and concentration than girls without specific learning disabilities. Looking at boys with specific learning disabilities, the reverse is seen—girls with specific learning disabilities had better attention and concentration than boys with specific learning disabilities. Time management in boys without specific learning disabilities was better than in boys with specific learning disabilities and girls without specific learning disabilities reported better time management than boys without specific learning disabilities. However, boys with specific learning disabilities were better at time management than girls with specific learning disabilities.

An earlier study that examined differences between boys and girls with specific learning disabilities in executive functions reported mixed findings regarding different measures. It seems that boys and girls are born with identical intellectual potential, and gaps develop as a result of the societal-cultural effects of education, preconceptions, expectations, and messages conveyed

by parents and educators (Oplatka and Atia, 2007). This affects the findings of the present study as the differences found between boys and girls can be ascribed to their social-cultural background.

When creating intervention programs such as a program for improving executive functions, it is also worth considering designing a gender-specific program in which some of the sessions will be gender-separate allowing girls with learning specific disabilities to receive interventions emphasizing time management, and boys with specific learning disabilities to concentrate on improving attention and concentration. According to the third hypothesis, students with specific learning disabilities were expected to have lower personality trait scores compared with students without specific learning disabilities. The present study shows that students with specific learning disabilities scored significantly lower than students without specific learning disabilities on extraversion, agreeableness, conscientiousness, and openness and scored significantly higher on neuroticism. A possible explanation for these differences is that a child's specific learning disability makes them feel more stressed, neurotic, and restless than their peers without learning disabilities. In their 2016 study, Brown and Cinamon note that many parents of adolescents with learning disabilities make decisions for their children who are at school, particularly in academic matters. Consequently, these children may have fewer opportunities of setting goals, developing initiative, and planning activities. The researchers suggest this could explain why they found that adolescents with learning disabilities were less likely to develop extraversion, openness, and conscientiousness. The same explanation may apply to the findings in the present study, and the validity of this proposition may be examined in future studies by cross-referencing the data with information from the parents. The fourth hypothesis proposed a significant interaction between personality traits and gender in students with and without specific learning disabilities. Our results show significant differences between genders on neuroticism and agreeableness only. For neuroticism, students with specific learning disabilities were generally more neurotic than their peers without specific learning disabilities, and girls with specific learning disabilities were significantly more neurotic than boys with specific learning disabilities. No gender difference was seen in the children without specific learning disabilities. As proposed above, it is possible that the difficulties that students with specific learning disabilities experience make them more neurotic, i.e. they worry more, and are more anxious and depressed. Students without specific learning disabilities scored higher on agreeableness than students with specific learning disabilities and there was no gender difference. However, girls with specific learning disabilities showed lower agreeableness than boys with specific learning disabilities.

The literature paints a similar picture. Amitay and Gumpel (2014) studied boys and girls with learning disabilities in acute distress who had been placed in Youth Authority institutions for medium and long-term care and compared them with teens in the general educational system who had no learning disabilities. They found that the girls with learning disabilities showed more severe emotional-behavioral indices than girls without learning disabilities. They also found significant differences in personality and emotional indices between the boys with and without learning disabilities. The fifth hypothesis proposed an association between level of executive function and personality traits in the study populations. This study shows significant correlations between specific executive functions and personality traits (response inhibition correlated with extraversion and neuroticism, emotional control with extraversion, task initiation with openness, organization with neuroticism, meta-cognition with conscientiousness, goal-directed persistence with neuroticism and agreeableness, and the overall index with neuroticism). A recent study that looked at the associations between executive functions and personality traits in adolescents and young people with ADHD found that ADHD greatly affected adolescent behavior and actions, making them more industrious in their work. This signifies that hyperactivity and personality traits can be useful in improving academic and social functioning in this population. These findings accentuate the association between executive functions and personality traits (Krieger et al., 2020). As presented in the theoretical background, the Big Five personality traits, executive functions, and the symptoms of the disorder are linked in many ways. The present study proposes that the explanation offered by Krieger et al. (2020) applies to students with learning disabilities too, who share some characteristics with students diagnosed with ADHD. Furthermore, the present findings are in line with evidence presented in studies from the past decade regarding the interactions between two fundamental structures: personality and cognition (such as, Curtis et al., 2015; Rammstedt et al., 2018; (Nikolašević et al., 2021), and expand our understanding of these in terms of students with learning disabilities. There is some overlap in conceptual characteristics between executive function as a cognitive measure and several personality traits, and both use similar terms to define strategies. Thus, personality traits and executive functions both play a role in daily functioning mechanisms, (Nikolašević et al., 2022) and the present findings illuminate the relationship between these variables in a particularly important and interesting population whose proportion of the general population students is on the rise.

CONCLUSIONS AND PEDAGOGICAL IMPLICATIONS

The present study has both a theoretical contribution as

well as a practical one. On the theoretical level, this study contributes to existing knowledge of the links between executive functions, gender, and personality traits in students with and without specific learning disabilities. This will hopefully expand scientific dialog and research in the areas of executive functions and personality traits, and how they are associated with gender. In practice, this study provides a basis for encouraging teachers, students, and education professionals to use executive functions to help students with specific learning disabilities to learn. Intervention programs developed specifically for students with specific learning disabilities should focus on training students to use their executive functions to boost their abilities and improve achievements. As noted, this study's results indicate that students with specific learning disabilities scored very significantly lower than students without learning disabilities on most tested measures: response inhibition, working memory, task initiation, attention and concentration, planning or prioritizing, organization, time management, flexibility, meta-cognition, goal-directed persistence, and stress tolerance. Students with learning disabilities scored significantly lower than students without learning disabilities. Moreover, the measures which showed significant interaction were attention and concentration, and time management. In view of this, developing and providing interventions at school that focus on improving these specific executive functions, with an emphasis on time management may support the learning processes of students with specific learning disabilities. Schools could incorporate in their regular schedule sessions in which students are taught skills related to executive functions for example, how to approach a school assignment, specifically: what are the steps in the process, how to plan them, how to manage the time each part requires, how to cope with failure to meet the goals. Furthermore, and in keeping with the study findings, these interventions should be gender-specific; some sessions will deliver time management skills to girls only while boys receive interventions that focus on increasing attention and concentration. Additionally, in-school professional training for teachers should address means of improving executive functions in students with specific learning disabilities and describe the important role that executive functions have in improving learning and teaching processes. Moreover, if we are able to identify the parameters associated with the behavioral pathways of using executive functions specifically to manage anxiety we may learn more about students who are at risk of developing behavior problems. In view of this, if lower achievements can be linked to weaker executive functions, the latter can serve as a beacon for identifying students at risk of developing behavioral problems associated with one or more specific executive functions. There is a need to develop executive function skills during learning, to help students improve their planning, flexible thinking, and working memory.

Study limitations and suggested future research

This study examined the associations between executive functions, gender, and personality in students with and without specific learning disabilities. It would be interesting to explore the pattern of links between these variables and other executive functions, such as control center, meta-cognitive knowledge, self-efficacy, and others. A possible limitation of this study is the use of a single self-reported instrument to assess executive functions. Traditionally, executive functions have been assessed using standard psychometric evaluations conducted in controlled environments, or using research questionnaires. Although neuropsychological indices are good indicators of cognitive components and basic performance, they generally fail to predict performance of complex real-world tasks and functioning. Consequently, evaluating executive functions using objective instruments such as the Executive Function Performance Test (EFPT) which evaluates performance of daily functions (Baum et al., 2008) may provide valuable information on subject of this research. This study principally applied quantitative methods. Future research should incorporate qualitative methods, such as interviews with students and their teachers, to provide a broader perspective and validate the present study's findings regarding the link between executive functions, gender, and personality traits in students with and without specific learning disabilities.

Moreover, as studies point to development of executive functions and personality traits being age dependent, future research can benefit from longitudinal studies that follow changes in executive functions and the way these changes are linked to personality traits and gender differences. It is also advisable to design intervention programs specifically for students with specific learning disabilities that focus on teaching executive function skills and on development of personality traits in ways that will help raise motivation and achievements.

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CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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