Do Executive Functions Differentiate Gifted Children, Children at Risk of LDs, and Average Children?

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Abstract

The Executive Functions (EFs) cognitive ability was studied with a group of gifted children (n=27), children at risk of learning disabilities (LDs) (n=27), and control/average children (n=27). These children were enrolled in Kindergarten 2 and had the mean age of 63 months . The main purpose of this study was to evaluate group differences on EFs measure. Secondly, this study aimed to investigate how EFs correlates to intellectual performance and age among all children who participated in this study. The three groups of this study were matched on grade, age, and father's level of education. The findings indicated that there are statistically significant differences among the three groups of this study in terms of their performances on DCCS Test (the study measure of EFs). These differences are in favor of gifted children then average children, and the worst performances were documented for children at risk of LDs. In addition, *both participants' age and intelligence were positively correlated with their performances on the study measure of EFs. Implications of the findings are also discussed.*

Keywords: *Executive Functions, Gifted children, children at risk of learning disabilities, Jordanian children, intelligence.*

Introduction

Early childhood is considered a critical period of growth and development for children. During this time, children's brains are continuing to develop and thus, intervention is likely to make the most impact (National Scientific Council on the Developing Child, 2004). Through early identification and intervention we can prevent, ameliorate, and lessen the impact of a number of developmental risk factors for young children (Guralnick, 1998) as well as accelerate growth in young children who are potentially gifted (Brighton, Moon, Jarvis, & Hockett, 2007). Not only are we able to improve children's developmental functioning, which results in improving school readiness; early intervention also helps families and caregivers increase their ability to support their child's development and is cost effective (Guralnick, 1997). In fact, when young children receive early intervention services, they are less likely to require special education services in the future (Hallahan, Kauffman, & Pullen, 2011).

Recurring themes and findings from the literature provide a strong rationale for an increased focus on the needs of young children who show signs of potential. Numerous authors underscore the importance of early educational intervention for gifted children, arguing that gifted education should follow the lead of special education in recognizing individualized needs as early as possible in order to provide responsive instructional environments to allow for potential to be actualized (Brighton, et al., 2007; Levine & Kitano, 1998; Porter, 2005). Some children develop observable gifts and talents in areas such as spoken language/linguistics, reading, and mathematics, distinguishing them from their same-age peers who follow a more common developmental trajectory. Evidence suggests that failure to recognize and nurture these early developed talents can result in negative emotional and social consequences such as masking behaviors, code-switching and possible long-term underachievement (Porter, 2005).

On the other hand, although learning disabilities are typically formally identified after children reach school age, there are usually many signs of developmental difficulties that can indicate the presence of a learning disability. During the preschool years, most children become more independent and begin to attend more to people outside of their own family. During this stage, most children develop a variety of gross motor skills, use more complex language to express themselves, understand the concept of make believe, interact with other children, and take turns during play. They also begin to learn letters, sounds, and concepts about print. Children who are struggling during this stage of development may speak later than other children, have speech articulation difficulties, experience slow vocabulary growth and difficulty finding the word they need to express an idea, experience difficulty rhyming, and have difficulty learning numbers, days of the week, the alphabet, shapes, and colors. Problems with fine motor skills, such as buttoning, zipping, keyboarding, controlling a pencil, and using scissors, may also appear. Socially, they may experience difficulty with routines or following directions, have difficulty empathizing with others, and experience exaggerated frustrations when they struggle with a task (Abu-Hamour, 2014; Mather & Goldstein, 2008).

Thus, it is a necessity to identify these children (gifted children or children at risk of learning disabilities) as early as possible by valid and reliable assessment tools, then provide them with appropriate interventions. Assessment is a systematic process of collecting data that can be used to make decisions about children (Reynolds, Livingston, & Willson, 2006; Salvia & Ysseldyke, 2009). We assess children to learn what we need to do to serve their needs. We also assess students to determine if what we are doing is effective. Therefore, screening tools in the early ages should accurately identify children at risk for failing to develop learning skills or those who will be gifted. Fortunately, several decades of research consistently point to strong relations between children with special needs (specifically, gifted children and children with learning disabilities) and other cognitive abilities such as executive functions ability (Salvia & Ysseldyke, 2009).

Executive Functions

Executive functions (EFs) refer to a set of cognitive processes that are important for behavioral and cognitive regulation. EFs components are defined differently, and usually include updating representations of the working memory, inhibiting responses, and shifting between tasks or mental sets (Perrotin, Tournelle, & Isingrini, 2008; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Updating requires actively manipulating relevant information, rather than passively storing information in working memory. Inhibition requires stopping a response that is relatively automatic. Shifting requires changes between mental tasks, although the specific operations that need to be switched back and forth are quite different across tasks. Researchers pay attention to EFs' neural mechanisms and their relationship with other cognitive constructs. EFs are the foundation of many high level cognitive functions, which include planning, decision making, meta-cognition, and strategies (Dawson & Guare, 2004; Garner, 2009). Studies from developmental psychology and cognitive neuroscience suggest that EFs can be elicited in children as young as at the age of five years if suitable tasks are used (Anderson, 1998).

Furthermore, EFs also play an important role in a child's cognitive functioning, behavior, emotional control and social interaction. Their role in school learning is widely recognized by literature (Anderson, 2002). EFs are necessary for successful learning and are related to two major categories of functions and capabilities. In the first category, there are functions that are related to the capability of planning and handling activities efficiently, either directly or not. The second category is about how easily a person puts into action an already formed or externally indicated action plan, ignoring alternative courses of action (which may seem easier); for example, intervening stimuli, desires and so on that are not related to the ongoing task (Denckla, 2007). Executive functions are those skills necessary for purposeful, goal-directed activity. Anderson, (2002), required for the successful achievement of complex, higher order cognitive goals, including planning future actions, keeping these plans in mind until executed, problem-solving, self-monitoring to check on progress, mental flexibility, and the ability to inhibit irrelevant actions. On the other hand, executive dysfunction refers to deficits in the ability to inhibit well-learned patterns of behavior and derive new ways of solving problems. Individuals become trapped in repetitive cycles of well-learned behavior (perseveration) and lack flexibility to accommodate and re-accommodate their behavior to novel situations. The direct implications of EFs on gifted children with high intellectual ability and children who are at risk of learning disabilities are discussed in the following sections.

EFs and Intellectual Ability

Mounting evidence suggests that high intellectual aptitude supports the demonstration of higher order cognitive skills in EFs such as reasoning and attention (Dawson, Soulieres, Gernsbacher, & Mottron, 2007; Kalbfleisch, Van Meter, & Zeffiro, 2007). Intelligence is not an academic skill but rather a broad construct that refers to the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly, and learn from experience (Gottfredson, 1997). Recent advances in current theory and research on the structure of human cognitive abilities have resulted in a new empirically derived model commonly referred to as the

Cattell-Horn-Carroll Theory (CHC theory) (McGrew, Laforte, & Schrank, 2014). Currently, most well-known intelligence tests (e.g., Woodcock-Johnson Cognitive and Achievement Tests—4th edition; Wechsler Intelligence Scale for Children—5th edition; Stanford-Binet Intelligence Scale—5th edition) work to be aligned with a stratified model of intellectual abilities defined and refined by Cattell, Horn, and Carroll. For example, the fundamental criteria for developing cognitive abilities in the Woodcock-Johnson Cognitive and Achievement Tests (WJ IV) were derived from the CHC theory of cognitive abilities as described in the WJ IV examiner's manual (Mather & Wendling, 2014). CHC Theory is a three-level model of human cognitive abilities that includes general intelligence (*g*), nine broad cognitive abilities, and more than 100 narrow cognitive abilities (McGrew, 2005). The broad CHC abilities measured by the WJ IV are: Long-Term Retrieval (*Glr*), Auditory Processing (*Ga*), Fluid Reasoning (*Gf*), Processing Speed (*Gs*), Short-Term Working Memory (*Gwm*), Visual-Spatial Thinking (*Gv*), Comprehension-Knowledge (*Gc*), Reading-Writing (*Grw*), and Quantitative Knowledge (*Gq*) (see Abu-Hamour, Mattar, & Al Hmouz, 2015 for review).

Intelligence is also not simply the straightforward amalgamation of discrete cognitive processes but rather different cognitive processes appear to be more strongly associated with general intelligence. For example, working memory involves holding information ‘‘*on-line*’’ in the short term memory and concurrently processing that information (Miyake, Friedman, Rettinger, Shah, & Hegarty, 2001). The relationship between performance on tasks of working memory and intelligence has been demonstrated to be in the range of 0.55 and above by several researchers (Ackerman, et al., 2001; Conway, Kane, & Engle, 2003).

It is generally agreed that intelligence is related to EFs (Friedman, et al., 2006). Specifically, numerous studies have found moderate to strong relations between intelligence and working memory updating ability (Ackerman, Beier, & Boyle, 2005; Engle, Tuholski, Laughlin, & Conway, 1999). The evidence comes from different subjects, tasks and research approaches. With respect to inhibition, Salthouse, Atkinson, and Berish (2003) found that inhibition was strongly correlated with intelligence in aging adults. Dempster (1991) stated that "*intelligence cannot be understood without reference to inhibitory processes*". As for shifting, there have been mixed results from literature, perhaps depending on the participants and tasks. While Salthouse et al. (1998) found a high correlation between shifting tasks and intelligence, other studies have found either little relation (Rockstroh & Schweizer, 2001), or a weak correlation between them (Miyake, et al., 2001). Recently, Floyd, Bergeron, Hamilton, and Parra (2010) conducted a study that examined relationships among cognitive abilities as measured by the WJ-III Tests of Cognitive Abilities (WJ-III COG; Woodcock, McGrew, & Mather, 2001) and executive functions as measured by the Delis–Kaplan Executive Function System (DKEFS; Delis, Kaplan, & Kramer, 2001). Their study sample consisted of an independent general education sample of 100 children and adolescents. Floyd and colleagues conducted both an exploratory factor analysis and a confirmatory factor analysis on 25 tests of the WJ-III COG and the DKEFS. Results of these extensive analyses indicated that all 25 sub-test scores measure a general construct, and 24 of the 25 sub-tests measure at least one of the five broad CHC theory factors. However, the research on the relationship of IQ to performance on executive function tests is still sparse and further investigation is needed in this area (e.g., investigating the relationship of EFs and general intellectual ability among preschoolers). In this aspect, researchers showed that performance on executive function tasks or demonstration of executive function behaviors develops with age (see Zelazo, 2006, for review).

EFs and Learning Disabilities (LDs)

Although LDs are typically formally identified after children reach school age, there are usually many signs of developmental difficulties that can indicate the presence of a learning disability. During the preschool years, most children become more independent and begin to attend more to people outside of their own family. During this stage, most children develop a variety of gross motor skills, use more complex language to express themselves, understand the concept of make believe, interact with other children, and take turns during play. They also begin to learn letters, sounds, and concepts about print.

Children who are struggling during this stage of development may speak later than other children, have speech articulation difficulties, experience slow vocabulary growth and difficulty finding the word they need to express an idea, experience difficulty rhyming, and have difficulty learning numbers, days of the week, the alphabet, shapes, and colors. Problems with fine motor skills, such as buttoning, zipping, keyboarding, controlling a pencil, and using scissors, may also appear. Socially, they may experience difficulty with routines or following directions, have difficulty empathizing with others, and experience exaggerated frustrations when they struggle with a task. Furthermore, students with learning disabilities in elementary school may experience difficulties such as struggling to learn connections between letters and sounds, confusing basic words, making frequent reading and spelling errors, struggling with basic computation, being slow to acquire and retain new facts and learn new skills, over relying on memorization, and having poor physical coordination (Abu-Hamour, 2014).

Recent research has shown that learning difficulties and behavioral problems are both associated with deficits in executive function (Mazzocco & Kover, 2007; Powell & Voeller, 2004). For example, deficits in inhibition, working memory and cognitive flexibility have been strongly associated with mathematical difficulties in children with a normal IQ (Bull & Scerif 2001). Difficulties in reading and writing skills have been related to working memory and inhibitory control deficits (Altemeier, Jones, Abbott, & Berninger, 2006; Rucklidge & Tannock, 2002). Executive dysfunction has also been demonstrated in a range of behavioral problems. Barkley (1997) for example, has proposed that attention deficit/hyperactivity disorder arises from a deficit in inhibition, that in turn results in secondary EF deficits, such as impaired working memory.

Significance, Context, and Purposes of the Study

School systems now are playing more of a role in assessment and intervention with preschool children, partly in response to legislation requiring educational services for very young children with handicaps (e.g., '*Law on the Rights for Persons with Disabilities'* for the year of 2007 in Jordan, and Public Law 99-457 in U.S) and partly in response to the notion that early intervention can facilitate appropriate development. There are two major reasons to assess young children with preschool tests such as EF test: (1) to identify gifted children or students at risk of learning disabilities and (2) to ascertain the readiness of non-disabled children to enter school. EF tests are typically administered either before entering school or during kindergarten and are used to predict initial school success, and to identify youngsters who may not be ready to participate in a regular school experience.

It is a myth that gifted students will make it without positive and supportive interventions from school and family. Although gifted students may achieve in school, schools are failing these students, as well as society and schools themselves, when they do not provide gifted students the opportunities to achieve their full potential as early as possible. The evidence in Jordan indicates that schools are not responding fully to the educational and learning needs suggested by the defining characteristics of giftedness (Abu-Hamour & Al-Hmouz, 2014). The early identification of these students should be the first step to help these students because there is always risks associated with not identifying young children's giftedness.

Researchers have drawn attention to the emotional and social consequences for highly gifted young students when their talents go unrecognized and undervalued in the preschool and early school years (Neihart, Reis, Robinson, & Moon, 2002). Gross' (1999) longitudinal research suggests that as early as the first few months of preschool, children later identified as highly gifted might often begin to mask their abilities in an effort to fit in with peers and meet teacher expectations. These children might select picture books in the classroom even though they are reading text-laden books at home, or they might develop different "*codes*" for speaking at home and school in order to mask their linguistic sophistication (e.g., code switching). Highly gifted youngsters are sensitive to early messages that their attempts to express boredom, point out multiple approaches to a problem, or use sophisticated humor are likely to be perceived as disruptive or disrespectful behaviors by teachers, rather than as markers of high ability. Since they are likely to engage in social comparisons earlier than their age peers, young gifted children are vulnerable to feelings of isolation and difference when their abilities are not recognized and valued at school. In preschool and primary grades, gifted children often become frustrated when they are unable to find peers who share their interests or understand their advanced sense of humor (Robinson, 1993).

Similarly, the condition of LDs are universal problem that occurs in all languages, cultures, and nations in the world. Accumulating research shows that in all cultures there are children who seem to have normal intelligence but have severe difficulty in learning oral language, acquiring reading or writing skills, or doing mathematics. The problem appears in children learning an alphabet-based system of written language, such as Arabic (Abu-Hamour & Al-Hmouz, 2014; Abu-Hamour, Al-Hmouz, & Kenana, 2013), and with children learning a logographic (pictorial) system of written language, such as Chinese or Japanese (Tsuge, 2001). However, very little current research has examined the use of new tests (e.g., EF) to identify students with LDs in Jordan and Arab world. As discussed previously, early identification of problems leads to greater odds of successful intervention efforts. Early identification refers to both identifying problems when children are young, as well as identifying early signs of problematic behaviors. Several researchers indicated that early signs of potential learning problems can be reliably detected (e.g., Fletcher & Vaughn, 2009). In addition, researchers had shown that the sooner LDs is detected and intervention is begun, the better the chance to avoid school failure and to improve chances for success in life (Mather & Goldstein, 2008).

Unfortunately, the trend in Jordan and other Arab countries has been reluctance to screen for early signs for students with special needs (gifted students or students at risk of LDs) in very young children. Consistently, researchers in Jordan have stated in numerous reports and articles that the Jordanian educational system is in need of valid assessment tools to identify students with special needs and provide them with an appropriate intervention (Abu-Hamour & Al Hmouz, 2014; Abu-Hamour & Mattar, 2013). EF tests that have been used in English speaking countries effectively, should be investigated for Arabic speaking countries. To the best of the author's knowledge, no studies had investigated the use of EF test in Arabic language previously. The present study was conducted to add to the limited literature targeting EF ability in children with special needs (gifted children or children at risk of learning disabilities) at preschool age.

The main purpose of this study was to evaluate group differences on EFs measure in gifted children, children at risk of LD, and control group. Secondly, this study aimed to investigate how EFs correlates to intellectual performance and age among all children who participated in this study.

Method

Participants

The total sample included 81 children ranging in age from 4.7 to 5.9 years who placed in KG 2. There were three groups of children identified for the purpose of this study; gifted children (n=27), children at risk of LDs (n=27), and control/average children (n=27). Participants were recruited from two private schools in the central region of Jordan. Gifted children were qualified for this group if they met all of the following criteria: (a) classroom teacher's nomination; (b) Woodcock-Johnson Arabic Tests full scale IQ (FSIQ) of 116 or above; and (c) native speakers of Arabic, no noted emotional/behavioral disorder, no noted attention disorders, and no sensory impairments. Children at risk of LDs were qualified for this group if they met all of the following criteria: (a) classroom teacher's nomination; (b) Woodcock-Johnson Arabic Tests full scale IQ (FSIQ) of 85-115; and (C) had at least five frequent symptoms of the 10 Building Blocks Questionnaire; (d) native speakers of Arabic and no sensory impairments. Average children were qualified for this group if they met all of the following criteria: (a) classroom teacher's nomination; (b) Woodcock-Johnson Arabic Tests full scale IQ (FSIQ) of 85-115; and (c) native speakers of Arabic, no noted emotional/behavioral disorder, no noted attention disorders, and no sensory impairments.

There were 48 males and 33 females in the sample. Within the gifted group there were 15 males and 12 females; for the LDs group there were 19 males and 8 females; and for the control group there were 14 males and 13 females. The three groups of this study were matched on grade, age, and father’s level of education. The mean age in months for children at risk of LDs was 63.85 (*SD* = 2.46), for the gifted children was 63.74 (*SD* = 3.40), and for the control group was 63.59 (*SD* = 2.29). The mean for the three groups is not exactly the same due to how the groups were matched. However, there were no difference in mean age in months among the three groups of this study, F (2, 78) = .06, p = .942. Socioeconomic status was based upon the father's highest level of education. For each group, 11 had 1–3 years of college, and 16 had a Bachelors degree or higher.

Instruments

Inclusionary Instruments

Woodcock-Johnson Arabic Cognitive Tests (WJ IV). The Woodcock-Johnson Arabic Cognitive Tests (WJ IV) were used to assess the general intelligence of the participants (WJ IV; Abu-Hamour, Mattar, & Al-Hmouz, 2016; Schrank, McGrew & Mather, 2014). The WJ Arabic Tests are based on the Jordanian local norms that have been established in Jordan for individuals ranging in age from 4 years to 22 years. The WJ Arabic Tests are a comprehensive, norm-referenced, individually administered assessment of cognitive abilities and achievement. In general, the internal consistency reliability estimates for all WJ Arabic measures are uniformly high, most often with magnitudes in the .80s and .90s for individual tests, and in the .90s for clusters (Abu-Hamour, et al., 2015). The WJ Arabic battery is a perfect tool to identify the cognitive abilities or the general intelligence among preschool children since it relies on assessing multiple criteria of Cognitive abilities by using Cattell-Horn-Carroll theory of cognitive abilities (CHC theory). To achieve the Broad Cognitive Abilities Score/Full Scale IQ Score, the following WJ Arabic Tests were administered: Verbal Comprehension, Reasoning, Orthographic Matching, Verbal Attention, Visualization, Phonological Processing, and Long-Term Retrieval (see Abu-Hamour, et al., 2016 for detailed description of these tests).

Building Blocks Questionnaire. The Building Blocks Questionnaire (BBQ) (Mather & Goldstein, 2008) was adapted with permission from English language to Arabic language for the purpose of identifying students at risk of LDs in this study. The BBQ is designed to help educators to identify a student's with LDs and to provide an overview of school-related skills and behaviors. This questionnaire has two sections: Part 1 provides 10 questions, one question for each of the 10 building blocks, which are intended to provide a general overview of a student's strengths and weaknesses. The responses for these questions were: Rarely, Sometimes, or Frequently. Once the examiner/teacher have completed part 1, for each of the questions that they have answered frequently or sometime, they would proceed to part 2 of the questionnaire and complete the additional 10 items corresponding to that Building Block (BB). Part 2 provides an additional 10 items for each block in order to provide more in-depth information about the specifics of the behavior. The 10 BB are: attention and self-regulation (e.g., "*Does the student appear inattentive or impulsive?");* emotions *(e.g., "Does the student appear to be sad?"); behavior (e.g., "Does the student have trouble following school rules?*"); self-esteem (e.g., "*Does the student appear to have a low opinion of him- or herself?");* phonological processing *(e.g., "Does the student have difficulty hearing or applying letter sounds when speaking, reading, or spelling?");* orthographical processing (e.g.," *Does the student have trouble reading or spelling words with irregular elements?");* motor processing (e.g., *"Does the student have difficulty forming letters or writing legibly?");* thinking with language *(e.g., "Does the student have trouble using or understanding oral language?*"); thinking with images (e.g., "*Does the student have difficulty creating mental pictures?"*); and thinking with strategies (e.g., "*Does the student have trouble forming or following a plan?"*). For the present study, the internal consistency of the Arabic BBQ (obtained using Cronbach's alpha) was .91. In terms of social validity, teachers reported that the instructions for the BBQ were easy to understand and that they did not find completing the questionnaire difficult. A more detailed description of the BBQ items are provided in Abu-Hamour (2014), and Mather and Goldstein (2008).

Study Measure

The dimensional change card sort (DCCS). The dimensional change card sort (DCCS) Test is an easily administered and widely used measure of executive function that is suitable for use with children in a preschool age (see Zelazo, 2006 for more details). In the standard version pre-switch phase (6 test trials) of this test, which is usually used with healthy children between the ages of three and five years, children are shown two target cards (e.g., a blue rabbit and a red boat) and asked to sort a series of bivalent test cards (e.g., red rabbits and blue boats) according to one dimension (e.g., color). During a post-switch phase (6 test trials), they are told to sort the same types of test cards according to the other dimension (e.g., shape). Children who pass the pre-switch phase and the post-switch phase of the standard version of the DCCS may proceed immediately to the border version of the test (12 test trials). The border version consists of 12 trials. On each trial, the examiner repeat the rules (*"If there's a border, play the color game. If there's no border, play the shape game").* Performance on the DCCS Test is scored as the number correct out of 24 (see Figure 1). The administration of DCCS Test was around 10 minutes per student, and the examiner respond to children in a neutral, non-evaluative, non-corrective fashion. Several studies indicated that performance on the DCCS provides an index of the development of executive function, and it is a valid and reliable screening measure of early identification of gifted students and students at risk of LDs (Floyd et al., 2010; Zelazo, 2006; see Zelazo, 2012 for video presentation of DCCS Test, https://www.youtube.com/watch?v=Fv5DDyqGGAM).

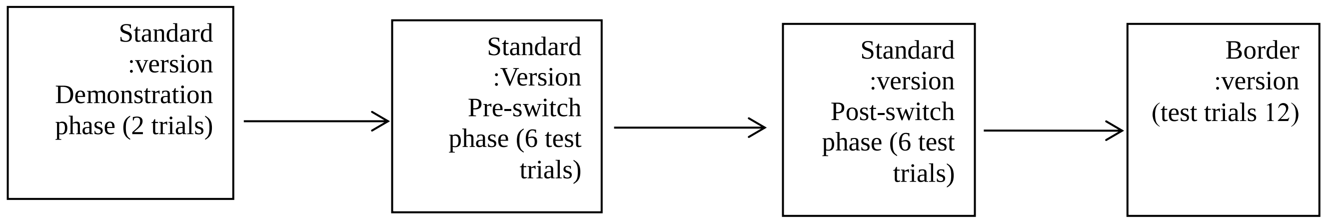

Figure 1: Summary of the phases involved in the standard and border versions of the DCCS (see text for details). Children who pass the post-switch phase may proceed to the border version.

Procedures and Data Analyses

The researchers used appropriate translation procedures (Brislin, 1986) to facilitate the use of DCCS Test in Arabic language. First, two native speakers of Arabic, who were also fluent in English, independently translated the DCCS into Arabic. Second, a back translation of the Arabic version into English was conducted by an English teacher who is fluent in both English and Arabic languages. Third, all translators reached an agreement on the forward-backward translations. Fourth, the DCCS was reviewed by five experts in the field of special education and educational psychology who made comments on clarity and content that were incorporated in the final version of the instrument. Finally, a small-scale pilot study (*n*=15) was conducted prior to the main study and only minor amendments to wording were required.

Selected schools were approached by the authors to coordinate the study work with the principals and teachers. The participants were assessed in the first semester of the 2015 academic year. The data was collected by the two authors of this study. During the data collection, the authors had daily updates and discussions to address the crucial points in the tests' administration and provide feedback. The actual administration time of the DCCS test was around 10 minutes per student.

To ensure consistency of DCCS testing administration on the children, the researchers read from scripts and used timers. The fidelity of testing administration was tested by using a detailed checklist to ensure each DCCS test was administered as it was intended and described in the testing protocol (Zelazo, 2006). Procedural reliability was obtained during 100% of testing sessions with an average reliability of 100 percent. The researchers scored each DCCS test and entered the data into an excel sheet. The first author checked randomly 30% of the scoring sheets. The average inter-rater reliability of scoring fidelity data was 100%. In terms of data entry reliability, all of the excel data (100%) were checked against the paper scores and all discrepancies were resolved by examining the original protocols. The Statistical Package for the Social Sciences (SPSS), version 17.0, was used to analyze the data. First, data was analyzed using descriptive statistics and visual figures. Second, to explore differences among the three groups of this study, one-way independent Analysis of Variance (ANOVA) was performed. Then, Pearson moment correlations were conducted to determine the relationship among the study variables.

Results

Preliminary Data Analysis

First of all, to improve the shape of the distributions, the responses of outliers whose scores were ±2 standard deviation or more from the group mean were replaced by a value equal to the next highest non-outlier-score plus 1 unit of measurement (Tabachnick & Fidell, 2001). Table 1 presents the descriptive analyses included calculating the means and standard deviations among gifted children, children at risk of LDs, average children and the integrated group of children according to all study variables. This descriptive information was helpful in understanding the data and making initial inferences on the differences among all groups of this study.

Table 1. Means and standard deviations of the study variables

Measure/Variable	Gifted Children (n=27)		Children at risk of LDs (n=27)		Control (n=27)		Total (n=81)
	Mean	SD	Mean	SD	Mean	SD	Mean
Age	63.74	3.40	63.85	2.46	63.59	2.29	63.73
DCCS	19.52	4.40	10.78	3.80	15.19	3.43	15.16
WJ IQ	118.63	2.18	99.81	4.27	100.15	6.03	106.20

Note. LDs = learning disabilities, DCCS = The dimensional change card sort Test, WJ IQ = Woodcock-Johnson Arabic Cognitive Tests-full scale intelligence score.

Descriptive statistics also allowed providing visual graphs that facilitated more convenient presentation of the data. Figure 2 displays the average performance of the DCCS Test among the three groups of this study. In general, the preliminary results indicate differences among all groups performances. A closer inspection of the data analyses that addressed study's. questions is followed

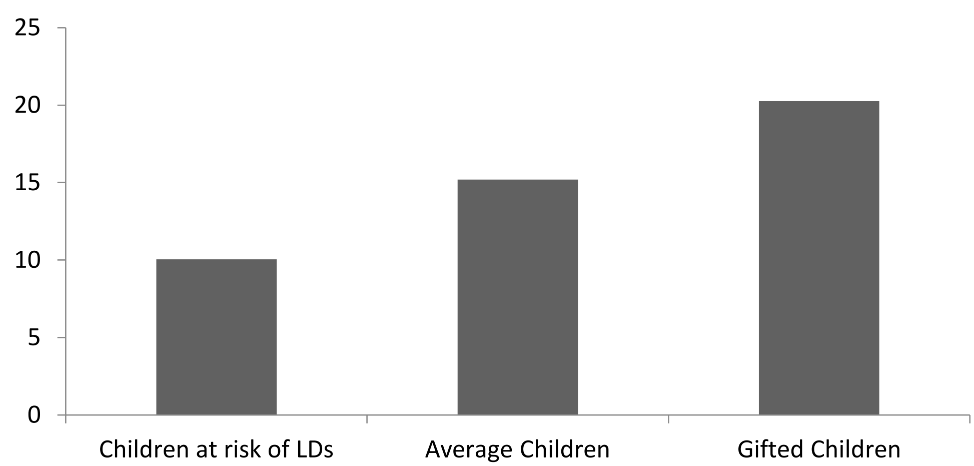

Figure 2. Graphic display of the mean performance on DCCS measure for the three groups of this study

The Average DCCS Test Differences among the Three Groups of This Study

To explore EFs differences among the three groups of this study, one-way independent Analysis of Variance (ANOVA) was performed. All assumptions of performing ANOVA were examined. No violations of normality and homogeneity of variance were detected. The variances were equal for all three groups, $F(2, 78) = .273$, $p = .762$. There were significant differences among the three groups of this study in terms of their performances on DCCS, $F(2, 78) = 68.07$, $p<.001$, $\omega = .79$. These differences are in favor of gifted children then average children, and the worst performances were documented for children at risk of LDs.

The Relationship between the Children's Age and their Performance on DCCS Test

To meet the assumptions of executing Pearson correlation and to increase the statistical power, the three groups of this study were integrated into one group, then age variable was correlated with EFs variable as measured by the DCCS Test. The result indicated that DCCS and age were significantly and largely correlated $r\ (80) = .68^{**}$, $p < 0.01$

The Relationship between the Children's IQ and their Performance on DCCS Test

Similar to the previous analysis, to meet the assumptions of executing Pearson correlation and to increase the statistical power, the three groups of this study were integrated into one group, then IQ variable as measured by WJ Arabic Test was correlated with EFs variable as measured by the DCCS Test. The result indicated that DCCS and IQ were significantly and moderately correlated $r\ (80) = .44^{**}$, $p < 0.01$.

Discussion

The primary purpose of this study was to broaden the knowledge base regarding the applicability of EFs Arabic assessment among preschool children. EFs Test are typically administered either before entering school or during kindergarten and are used to predict initial school success, and to identify youngsters who may not be ready to participate in a regular school experience. More specifically, the purpose of this study was to evaluate group differences on EF measure in gifted children, children at risk of LDs, and control group. In addition, this study aimed to investigate how EFs correlates to intellectual performance and age of children. The most important results of this study are discussed in the following sections.

Results indicated that there are statistically significant differences among gifted children, children, children at risk of LDs, and average children in terms of their performances on DCCS Test (the study measure of EFs). These differences are in favor of gifted children then average children, and the worst performances was documented for children at risk of LDs. The distinguished performance of gifted children in EFs measure assures the fact that EFs also play an important role in a child's cognitive functioning, behavior, facilitate his/her excellent performances on different cognitive tasks, and can be used to differentiate children according to their abilities. This finding is in line with several researchers' recommendations who suggested that EFs measure may be used with confidence for early identification of gifted children (e.g., Anderson, 2002; Brighton, et al., 2007; Porter, 2005). On the other hand, children at risk of LDs did not present adequate performance when compared with the other two groups of this study. This result is consistent with previous western countries findings that had shown that learning difficulties and behavioral problems are both associated with deficits in EFs (e.g., Mazzocco & Kover 2007; Powell & Voeller 2004). This finding may be explained by the fact that children at risk of LDs must have at least five frequent symptoms of the 10 Building Blocks Questionnaire to be included in this study. Particularly, most children of LDs group in this study had ADHD. The high rates of co-morbidity between LDs and ADHD are well-documented in research (Hallahan, et al., 2011; Mather & Goldstein, 2008). Thus, it is expected that the condition of ADHD may cause secondary EFs deficits among children at risk of LDs because of the combined problems on several cognitive and behavioral aspects (e.g., deficits in inhibition and attention, impaired working memory). Since significant differences were found among the three groups of this study in their performances on the EFs measure, it may be suggested that DCCS Test can be used as a universal screening tool to find gifted children or children at risk of LDs as early as possible.

Significant and large correlation was found between the study measure of EF and age of participants in months. In other words, the study measure of EFs distinguished participants from different ages in months. Older participants perform better on EFs tasks than younger ones. This finding supports the hypothesis about the relationship between the DCCS Test scores and the participants' chronological age. In this aspect, researchers showed that performance on EFs tasks or demonstration of EFs behaviors develops with age (see Zelazo 2006, for review). In addition, this finding suggests that DCCS Test is a suitable measure for young children. Studies from developmental psychology and cognitive neuroscience suggest that EFs can be elicited in children as young as at the age of 5 years if suitable tasks are used (Anderson, 1998).

Significant and moderate correlation was found between the study measure of EFs and the participants' IQ as measured by WJ Arabic Test. This finding was expected since EFs are the foundation of many high level cognitive functions, which include planning, decision making, meta-cognition, and strategies (Dawson & Guare, 2004; Garner, 2009). This finding is consistent with emerging evidence that points to the significant relationship between intelligence and EFs because high intellectual aptitude supports the demonstration of higher order cognitive skills in EFs such as reasoning and attention (e.g., Dawson et al. 2007). Furthermore, it is worth documented that DCCS Test and WJ Arabic Tests share two common cognitive factors (specifically, working memory and processing speed) that might contribute significantly along the attention to achieve this positive significant correlation. However, some of these studies documented higher correlations than this study. This may be explained by the differences between this study and other studies in terms of the participants age, number, and selection procedures.

Limitations, Future Research, and Implications

In this study, the researchers attempted to offer an effective tool that may serve as a quick and valid screening procedure to identify gifted children or children at risk of LDs. As indicated previously, the Jordanian and other Arabic educational systems are in need of valid assessment tools to identify children with special needs and provide them with an appropriate intervention. The DCCS Test proposed here should fill this gap and help teachers to identify children who might need further help to success in schools. Future research that will investigate the DCCS Test across different ages or grades is warranted. Gender differences should be investigated in future research as well. This study was intended to be preliminary, providing a framework for future research. Including a larger representative sample for the sake of building Jordanian national norms/benchmarks can be the next step in this line of research.

The promising result of this study suggests that DCCS Test may be used as a screening tool for early identification of gifted children or children at risk of LDs. Teachers in the Arab world should consider other valid and reliable assessment tools such as DCCS Test for use in both general and special education systems. The results of the current study offer an established methodology for evaluating EFs performance that includes ease of development and administration, low cost, and short administration times.

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