Cognitive dysfunction in children presented with behavioral disorders

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Background
Executive function impairments have been proposed to be implicated in a wide range of childhood neuropsychiatric disorders.
Objectives
The primary aim of this study is to directly examine the similarities and differences in executive functioning among attention deficit hyperactivity disorder (ADHD), disruptive behavior disorder (DBD), and pediatric bipolar disorder (BD) and to determine whether a distinct cognitive profile exists for each.
Patients and methods
A sample of 92 children were selected from the psychiatric outpatient clinic of Mansoura University Hospitals, who were diagnosed according to diagnostic and statistical manual 4th ed. text revision as having one of the following childhood psychiatric disorders: ADHD, DBD, or BD. They were subjected to seven executive function tasks (adopted from Van der Sluis S *et al.*, 2007) to assess specifically shifting, inhibition, and updating. Cases were compared with a control group of 45 children with minor dermatological problems and free psychiatric history. They were with the same age range, sex percentage and educational and cultural background of patients' sample.
Results
Children with BD (manic episode), specifically, have significant deficits in the shifting ability. Meanwhile, children with ADHD show significant impairment in updating function. However, impairment in inhibition was detected in ADHD, DBD, and BD.
Conclusion
The differences in executive functions may be used to establish a specific cognitive profile for different disorders that provides a more objective means of differential diagnosis among them when they are not reliably distinguished by clinical diagnostic methods. Moreover, these could propose a cognitive dimension for such disorders.

Keywords:
attention deficit hyperactivity disorder, bipolar disorder, disruptive behavior disorder, executive functions

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Introduction

Impairment in executive functions (EF) has been consistently linked to criminality, delinquency, physical aggression, conduct disorder, psychopathy, and antisocial personality disorder [1]. These impairments have also been implicated in a range of neuropsychiatric and medical disorders, including schizophrenia, major depression, alcoholism, structural brain disease, diabetes mellitus, and normal aging [2]. EF impairments are not unique to specific childhood psychiatric disorders and have been linked to a range of clinical disorders, including attention deficit hyperactivity disorder (ADHD), substance-use disorders, autism spectrum disorders, schizophrenia, and bipolar disorder (BD) [3,4]. Impairment in the neuropsychological processes of executive functioning (EF), which includes the cognitive functions necessary for self-regulation and the regulation of socially appropriate behavior, has received considerable research attention. In this context, EF impairment has been established, impairing the ability to anticipate behavioral consequences, to assess punishment and reward, and impairing abilities to generate socially appropriate behavior in challenging contexts [5,6]. EF is an umbrella term encompassing a diverse range of cognitive processes and behavioral competencies to facilitate the initiation, planning, regulation, sequencing, and achievement of complex goal-oriented behavior and thought [2]. No overarching or widely accepted conceptual framework of EF has been developed and there continues to be disagreement about the processes thought to be involved in EF [2,7,8]. Within this profusion of terms, three EFs are generally acknowledged as important because they are supposedly implicated in the performance of most executive tasks and are relatively well defined: shifting, inhibition, and updating [8–10]. Shifting, attention switching, or cognitive flexibility refers to the ability to switch rapidly back and forth between multiple tasks, mental sets, and

operations [8,11]. It has been estimated that this ability emerges in children between the ages of 3 and 5 years when using simple switching tasks. As the task rules increase in complexity, however, the child will show more errors in flexibility [12]. This ability improves considerably between the ages of 7 and 9 years and continues to improve until adolescence [13]. Inhibition is defined by Morris and Jones [14] as the ability to suppress dominant, automatic, or prepotent responses in favor of a more goal-appropriate one. Failure to inhibit in children might result in behaviors such as responding before the task is understood, answering before sufficient information is available, and allowing attention to be captured by irrelevant stimuli, that is, distractibility or failing to correct obviously inappropriate responses [15]. Studies found that the greatest period of development inhibition occurred between the ages of 6 and 8 years, as cited by Passler *et al.* [16]. They further suggested that by age 10 the child's ability to inhibit attention to irrelevant stimuli, as well as to avoid preservative errors, was complete with mastery of these skills evident at the age of 12 years. However, younger children had more variability in their responding rates and showed slower response times overall than did either older children or adults. Miyake *et al.* [8] mentioned that updating refers to the updating and monitoring of representations held in working memory. These processes involve the monitoring and coding of incoming information that is relevant to the task at hand, followed by the revision of item held in working memory and a replacement of old irrelevant information with new relevant information. Updating thus concerns the dynamic, goal-directed manipulation of memory content. Hughes and Graham [17] have identified several difficulties in the accurate assessment of executive functions in children, the most important of which is the child's limited language ability. When task instructions are complex, verbal comprehension in the child is taxed engaging nonexecutive skills.

In pediatric populations, there is considerable overlap between some psychiatric disorders such as ADHD, disruptive behavior disorder (DBD), and BD as there are shared symptoms such as inappropriate actions and verbal responses in social situations, lack of inhibition, and distractibility [18]. Behavioral disinhibition could be considered as a marker of motivational or emotional dysregulation that might predispose a child to develop one of several dysregulatory disorders such as ADHD, DBD, or BD [19]. However, there is limited research on the relation between impairment in EF and behavioral problems in children, despite the shared developmental timetable [20] and despite the increasing evidence for the underlying neural mechanisms in common [21]. Accordingly, this study hypothesizes the role of executive functions as a core process in such disorders with behavioral disinhibition. The aim of this study is to examine three facets of executive functions (shifting, inhibition, and updating) in children diagnosed as having one of the following disorders: ADHD, DBD, and BD. These disorders have behavioral disinhibition in common that may interfere with the cognitive task performance. This might further help the diagnostic accuracy by uncovering the similarities and differences in executive functions and might help to compare the cognitive profiles among these disorders.

Patients and methods

The study was conducted at the outpatient clinic (OPC) of Psychiatry Department, Mansoura University Hospitals. The OPC presents its services to several governorates, mainly ElD akahlia, Demietta, Portsaid, and their surrounding countryside. The study was conducted during the period from March 2009 to August 2010. This is a case–control study in which 92 children fulfilled the inclusion and exclusion criteria during the period of the study. Children included in this study were of both sexes, aged from 6 to 12 years with an intelligence quotient (IQ) equal to or more than 80, with attendance of at least one parent, and diagnosed as having one of the following childhood psychiatric disorders: ADHD, DBD, and BD. Children with an IQ below 80, with general medical condition, organic mental disorders, or epilepsy, under medical or psychiatric treatment, with comorbidity of the different disorders, and/or those who refused to join the study (child or parental causes) were excluded from this study. Exclusion criteria such as IQ being below 80 was considered given the complex nature of higher order processing of executive function that is markedly reliant on other nonexecutive processes such as language, calculation, or visuospatial processing.

A control group of 45 children was recruited randomly from the OPC of the Dermatology Department of the Mansoura University Hospitals (Egypt). They had the following criteria: complaint of minor dermatological problems with free psychiatric history, matched with cases for age, sex, education, and cultural background, and not receiving centrally acting medical agents, for example, antihistamines, which may interfere with the psychiatric assessment.

Parental consent was obtained for 137 children (92 cases, 45 controls) to participate in this study. All children were subjected to an extensive clinical history and physical and psychiatric semistructured interview guided by the Child Mental Status Examination [22]. The latter is a set of observations that provide a detailed description of the child's behavior during the diagnostic interview. The interview is used to collect basic information about the personal, physical, and psychiatric histories, complaints, mental status evaluation, and investigations if needed. In addition, they were subjected to physical and neurological examination to exclude any general medical condition, which may interfere with the performance of the child during assessment of executive functions. Those diagnosed as having one of the following pure childhood psychiatric disorders were selected. These disorders include ADHD, DBD (conduct disorder and oppositional defiant disorder), and BD. Diagnoses were confirmed by at least two senior staff according to the diagnostic and statistical manual 4th ed. text revision criteria [23]. Data were collected by two independent psychiatrists with at

least a Master's degree and a minimum of 5 years of training in the Children and Adolescent Unit of the Psychiatric Department at the Mansoura University Hospitals.

Neuropsychological assessment was made using the following tools: Wechsler Intelligence Scale for Children [24], Arabic Version [25], designed for application on children from ages of 5–15 years, was used to assess the IQ of the children. It consists of 12 items, six for the verbal scale and the other six for the performance scale. These are used for the calculation of verbal IQ, performance IQ, and total IQ. Assessment of executive functions was made using a battery of seven tasks adopted for children to assess shifting, inhibition, and updating as the main components of executive functions. These tasks were obtained by interpersonal communication with Van der Sluis *et al.* [26]. Three measures of inhibition were administered namely quantity inhibition task, object inhibition task, and numerical size inhibition task. For quantity inhibition, children were presented with a set of similar digits; they had to name the number of stimuli within the set, for example, if the set '444' was presented, the correct answer was '3'. In object inhibition, children were instructed to name the smaller, less obtrusive object, that is, to ignore the larger, prepotent figure in favor of the smaller, less noticeable one. In numerical size inhibition, the children had to name the numerically largest digit of a pair, which was always the physically smallest, that is, they had to ignore the larger, more prepotent digit in favor of the smaller one. Furthermore, three measures of shifting were administered namely object shifting, symbol shifting, and place shifting. For objects shifting, depending on the color of the stimulus, children were to name either the object (when blue) or the digit (when yellow). For symbol shifting, depending on the color of the stimulus, children were required to name the letter (when blue) or the digit (when yellow). For place shifting, a letter and a digit were presented in pairs in one of the corners of a square. Children were to name the letter when the pair was printed in one of the top corners, and the digit when the pair was printed in one of the bottom corners. Meanwhile, one measure of updating was administered namely to keep track in which the children were instructed to name all pictures in the series and to keep track of the target categories. At the end of a series, they were asked to name the last picture that they had seen of each of the target categories. Scores of all these tasks are proportionate to the correct answers (1 for correct or 0 for wrong item's response). Inhibition and shifting task scores measure from 0–40 for each task. Updating task scores measure from 0–28.

Translation and back translation of executive function tasks and validity were performed through the cooperation with the Department of Educational Psychology, Faculty of Education, Mansoura University. Reliability was examined by the test–retest method with Cronbach alpha coefficient (0.87) through the cooperation with the Department of Community, Faculty of Medicine, Mansoura University. This study is now in process for publication. Arabic Version Wechsler Intelligence Scale for Children [24] was applied by a professional psychologist with a minimum of 5 years experience. Assessment of executive functions was made by psychiatrist with a Master's degree with more than 5 years of training in the Children and Adolescent Unit of the Psychiatric Department at the Mansoura University Hospitals. This was preceded after supervised evaluation of a prestudy training.

The statistics of data was calculated using excel program and Statistical Package for Social Science program version 10 (SPSS Inc., Chicago, Illinois, USA). To test the normality of data distribution, the Kolmogrov–Smirnov test was conducted. The data description was carried out in the form of frequency and proportion for qualitative data and in the form of mean and (± standard deviation) for quantitative data. The analysis of the data was performed to test statistically significant difference between groups. The χ^2-test was used for qualitative data. For quantitative data, the Student's *t*-test was used to compare between two groups. The one-way analysis of variance test compares more than two groups, followed by the post-hoc least significant difference test for intragroup comparisons. Correlation coefficiency was calculated to detect association between variables. Significance levels are reached when *P* value is less than or equal to 0.05 at a confidence interval of 95%.

Results

The mean age in the patient group was 9.1 ± 2 years, the majority were boys (60; 65.2%), and 70 patients were from urban area (76.1%). Meanwhile, among the control group the mean age was 9.1 ± 1.8 years with the majority being boys (25; 55.6%) and 35 were from urban area (77.8%). Table 1 shows that the highest mean of age is present in patients with BD than other disorders with statistical difference. Furthermore, sex difference is present in ADHD as more boys (80%) were found to have the disorder. In Table 2, significant difference in IQ between cases (88.16) and control (95.37) was found. In addition, the lowest mean of scores of IQ is present in ADHD inattentive type in comparison with the other disorders ($P = 0.026$). In Table 3, the comparison between cases and the control groups across the selected executive functions (shifting, inhibition, and updating) represents significant differences ($P < 0.001$) in all measures of executive functions. Table 4 shows that shifting function (total) has the highest mean of scores in conduct disorder (27.72), followed by ADHD hyperactive, oppositional defiant, ADHD inattentive, and ADHD combined, respectively. Then, the lowest mean of scores was bipolar (14.159) with statistically significant difference ($P < 0.001$). Table 5 shows that the highest mean of scores in the total inhibition function was present in ADHD inattentive (35.95), then in oppositional defiant, ADHD hyperactive, conduct disorder, bipolar, and finally ADHD combined (27.18). With regard to updating function in the different disorders, the lowest mean of scores is present in ADHD inattentive type (13.57) followed by ADHD hyperactive and ADHD combined (15.86). Higher scores with slight differences are present in

Table 1 Sociodemographic distribution of the patients in different disorders

			Sex		Residence	
Patients	*N* (%)	Age (years)	Male	Female	Urban	Rural
ADHD inattentive	14 (15.21)	8.17 ± 1.8	9 (64.3%)	5 (35.7%)	10 (71.4%)	4 (28.6%)
ADHD hyperactive	15 (16.30)	8.9 ± 2.07	12 (80%)	3 (20%)	13 (86.7%)	2 (13.3%)
ADHD combined	15 (16.30)	8.2 ± 1.4	12 (80%)	3 (20%)	12 (80%)	3 (20%)
Conduct disorders	24 (26.8)	9.9 ± 1.8	16 (66.7%)	8 (33.3%)	17 (70.8%)	7 (29.2%)
Oppositional defiant	13 (14.13)	8.1 ± 1.9	6 (46.2%)	7 (53.84%)	11 (84.6%)	2 (15.4%)
Bipolar disorders	11 (11.95)	11.1 ± 0.7	5 (45.5%)	6 (54.5%)	7 (63.6%)	4 (36.4%)
Significance		$F(6.63)$; $P<0.001$	$\chi^2(6.89)$; $P=0.229$		$\chi^2(3.03)$; $P=0.694$	

ADHD, attention deficit hyperactivity disorder.

bipolar, oppositional defiant, and conduct disorder, respectively (Table 6).

Discussion

Impairment of EF generally does not present in isolation, but is a component of a larger constellation of psychological, emotional, and behavioral problems, including physical and mental health issues, substance use, and poor academic functioning [27]. Research that assists in identifying or supporting a particular executive process as underlying the behaviors of psychiatric disorders in children may help our understanding of these disorders [28]. In this study, it is suggested that finding out relationships between the behavioral symptoms detected in children and executive functions may later on help clinicians with improved diagnoses and particularly with differential diagnoses and with the designing and implementation of interventions.

Sociodemographic data of the studied groups show that the highest age mean was detected in BD; this is similar to Birmaher *et al.* [29]. More boys were identified as having ADHD. This sex difference is consistent with epidemiological studies of ADHD [30]. Moreover, IQ level showed significant difference between cases and control and between the different disorders. ADHD inattentive type has the lowest mean of IQ scores than did other groups. This is similar to the results of Nigg [31] and Mahone *et al.* [32]. This could be to the psychopathological effect of the disorders.

Assessment of shifting

This study's results show that children with ADHD do not have a specific deficit in shifting with no variations among ADHD subtypes compared with other groups. These results were similar to that of Nigg *et al.* [33] and Alloway *et al.* [34]. In contrast, Tripp *et al.* [35] and Willcutt *et al.* [3] found considerable deficit in shifting among ADHD children. In these findings, there is a deficit in the shifting ability (symbol, object, and place) among the BD group. In agreement with this study, other studies [36–38] showed a significant difference in shifting from the control group.

Table 2 Intelligence quotient level of the studied groups

Groups	IQ	Significance
Cases	88.16 ± 4.73	t (−8.52); $P<0.001$
Control	95.37 ± 4.48	
ADHD inattentive	84.85 ± 1.95	F (2.68); $P=0.026$
ADHD hyperactive	89.86 ± 6.27	
ADHD combined	86.73 ± 2.96	
Conduct disorders	88.62 ± 5.63	
Oppositional defiant	89.76 ± 4.65	
Bipolar disorders	89.09 ± 2.16	

ADHD, attention deficit hyperactivity disorder; IQ, intelligence quotient.

Assessment of inhibition

These results revealed the presence of greater difficulty with inhibition measures in ADHD combined type in comparison with other ADHD subtypes. These results are similar to those of other studies [39–41]. In contrast, Willcutt *et al.* [3] found no differences between subtypes of ADHD. Furthermore, it is found that there is similarity between ADHD combined and BD in inhibition measures. This is consistent with the study of Passarotti *et al.* [42], which directly compared inhibition in each of these disorders. The finding in this study might add to the interpenetration and to the overlap of the concepts of disinhibition. Hence, it could be suggested that both ADHD combined and BD have add-on effects of two types of inhibitory dysfunction. Behavioral disinhibition, as a novelty seeking and approach of unfamiliar stimuli and the impairment in executive inhibition, as a defect in the process of suppression of a response for goal direct behavior, might be implicated in the impairment of EF.

Assessment of updating

This study shows a greater deficit in updating in ADHD inattentive type. This confirms the results of Nigg *et al.* [39], Chhabildas *et al.* [43], Sergeant *et al.* [44], and Happé *et al.* [45]. Meanwhile, Willcutt *et al.* [3] found no impairment in working memory among ADHD subtypes. However, according to the results of this study, it appears that updating may differentiate between ADHD and BD as it is more impaired in ADHD. These results are similar to those of Nigg *et al.* [39], Barkley *et al.* [46], Dickstein *et al.* [47]. Accordingly, the updating task is not secondary to the behavioral disinhibition. Furthermore, it could be in favor of the working memory as a core or primary deficit in ADHD that results in difficulty in paying attention.

Executive functions in disruptive behavior disorders

In these results, no deficit in EF could be considered to be specific to the pure DBD. Clark *et al.* [48] and Oosterlaan *et al.* [49] concluded that impairment in EF

Table 3 Comparison between cases and control groups across executive functions

Executive function tasks	Cases ($N=92$) (mean ± SD)	Control ($N=45$) (mean ± SD)	Significance
Updating task	16.86 ± 2.79	22.75 ± 1.46	t (−13.25); $P<0.001$
Symbol shifting task	26.63 ± 6.64	34.91 ± 1.76	t (−8.20); $P<0.001$
Object shifting task	26.44 ± 6.79	34.8 ± 1.96	t (−8.06); $P<0.001$
Place shifting task	26.04 ± 6.97	34.55 ± 1.92	t (−8.02); $P<0.001$
Shifting (total)	23.99 ± 5.09	31.75 ± 1.61	t (−9.95); $P<0.001$
Quantity inhibition task	31.14 ± 4.93	37.71 ± 1.76	t (−8.64); $P<0.001$
Object inhibition task	30.38 ± 5.12	37.46 ± 1.79	t (−8.99); $P<0.001$
Numerical size inhibition task	31.57 ± 5.08	38.31 ± 1.85	t (−8.60); $P<0.001$
Inhibition (total)	31.03 ± 4.75	37.82 ± 1.69	t (−9.28); $P<0.001$

SD, standard deviation.

Table 4 Assessment of shifting in different disorders[a]

		Symbol shifting task	Object shifting task	Place shifting task	Shifting (total)
Disorders	N	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
ADHD inattentive	14	28.92 ± 3.95	26 ± 3.16	24.42 ± 3.41	23.23 ± 1.76
ADHD hyperactive	15	27.80 ± 5.68	29.86 ± 2.09	29.86 ± 2.58	25.80 ± 2.35
ADHD combined	15	24.93 ± 5.18	25.80 ± 5.25	24.33 ± 4.22	22.73 ± 3.39
Conduct	24	30.45 ± 3.65	30.70 ± 4.51	30.95 ± 4.72	27.72 ± 3.66
Oppositional defiant	13	28.30 ± 5.42	27.61 ± 5.62	28.15 ± 4.94	25.63 ± 4.52
Bipolar	11	14.09 ± 2.70	12.54 ± 1.29	12 ± 1.41	14.15 ± 1.21
Significance		F(21.96); $P<0.001$	F(32.94); $P<0.001$	F(40.44); $P<0.001$	F(30.68); $P<0.001$

ADHD, attention deficit hyperactivity disorder; SD, standard deviation.
[a]Scoring of shifting tasks = 0–40.

Table 5 Assessment of inhibition in different disorders[a]

		Quantity inhibition task	Object inhibition task	Numerical size inhibition task	Inhibition (Total)
Disorders	N	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
ADHD inattentive	14	36.21 ± 1.25	34.78 ± 1.36	36.85 ± 1.95	35.95 ± 1.06
ADHD hyperactive	15	33.86 ± 1.84	31.33 ± 3.79	33.33 ± 3.71	32.84 ± 2.71
ADHD combined	15	28.00 ± 6.05	26.06 ± 5.96	26.0 ± 6.02	26.68 ± 5.53
Conduct	24	29.41 ± 4.85	30.41 ± 4.72	31.50 ± 3.84	30.44 ± 4.23
Oppositional defiant	13	32.76 ± 2.12	32.92 ± 3.09	33.30 ± 2.68	33.0 ± 2.53
Bipolar	11	27.09 ± 3.64	26.27 ± 4.51	28.18 ± 3.18	27.18 ± 3.60
Significance		F(11.88) $P<0.001$	F(9.21) $P<0.001$	F(14.37) $P<0.001$	F(13.16) $P<0.001$

ADHD, attention deficit hyperactivity disorder; SD, standard deviation.
[a]Scoring of inhibition tasks = 0–40.

Table 6 Assessment of updating in different disorders

		Updating
Disorders	N	Mean ± SD
ADHD inattentive	14	13.57 ± 1.94
ADHD hyperactive	15	15.66 ± 1.91
ADHD combined	15	15.86 ± 1.88
Conduct	24	18.79 ± 2.60
Oppositional defiant	13	18.46 ± 2.40
Bipolar	11	18.00 ± 1.00
Significance		F(14.48); $P<0.001$

ADHD, attention deficit hyperactivity disorder; SD, standard deviation.

found in children with DBD was due to the presence of comorbid ADHD. The association between DBD and EF deficits did not remain significant, when the effect of ADHD was partialled out. However, other finding suggests that DBD could be associated with EF impairment after controlling for ADHD [46,48]. Hence, this association between DBD and EF should be questioned because of the finding suggesting that the association can be explained by comorbidity of these disorders with ADHD, which has been associated with EF impairments.

Conclusion

This study provides evidences that the primary deficit in BD is present in shifting ability, whereas updating function is specifically impaired in ADHD. However, the findings indicate that inhibition impairment is present in ADHD, DBD, and BD. In addition, differences in executive function performance are found among ADHD subtypes as deficits in inhibition are more specific to the ADHD combined type, whereas impairment in updating is more specific to the ADHD inattentive type. These differences may suppose a specific cognitive profile for each disorder that provides more objective means of differential diagnosis among these disorders when they are not reliably distinguished by clinical diagnostic methods.

Limitations of the study

This study is a preliminary examination of executive function profiles in different childhood psychiatric disorders. The first limitation is the wide age range (6 years to 12 years of age) that may result in systematic differences between children in different stages of development of EF. Second, the sample size was relatively small. The use of variable analysis to investigate processes involved in different disorders is better to be pursued with larger samples. Third, the available measures may not assess 'pure' EF tasks as they mostly measured more than one EF. Tapping pure EF is conceptually not feasible because almost every task requires an individual to keep rules in mind and thus addresses working memory next to the EF, which was aimed to be measured.

Recommendations

Further research could examine the interaction of age and development on executive functions in normal versus disordered children. Moreover, it is recommended to compare the inhibitory tasks of large samples of boys and girls separately to clarify the effect of sex differences on EF. This would be helpful in understanding better these developmental processes. Lastly, this study addressed the pure forms of the disorders. Hence, future studies considering the impact of comorbidity between the childhood disorders may enhance further understanding of the psychopathology involved.

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الملخص العربى

اختلال الوظائف المعرفية فى الاطفال فى وجود الاضطرابات السلوكية

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يفترض وجود خلل فى الوظائف التنفيذية فى معظم الأضطرابات النفسية فى الأطفال.

و تهدف هذه الدراسة لفحص أوجه التشابه والاختلاف فى الوظائف التنفيذية بين بعض الأضطرابات النفسية فى الأطفال وتحديدا فى اضطراب نقص الانتباه وفرط الحركة واضطراب السلوك المناوئ والاضطراب الوجدانى ثنائي القطب وذلك كمحاوله لتحديد ما إذا كان هناك منظور معرفى محدد لكل من تلك الضطرابات.

ولقد أخذت عينه من 92 طفلا من عيادة لأمراض النفسية بمستشفيات المنصوره الجامعيه حيث تم تشخيصهم بإحدى الاضطرابات السابقه طبقا للدليل التشخيصى والاحصائى الامريكى الرابع للاضطرابات النفسية. وقد تم تطبيق اختبارات الوظائف التنفيذية للأطفال (صوفى فان دير سلويس) حيث تم تحديد ثلاثة من هذه الوظائف التنفيذية (القدرة على التثبيط، القدرة على التحول، والقدرة على التتبع) لدراسة مدى اختلال هذه الوظائف. وتمت مقارنتهم بعينه ضابطه من 45 طفل.

وخلصت الدراسة الى أن الأطفال ذوى الاضطراب الوجدانى يعانون من خلل واضح فى القدرة على التحول و أن أطفال اضطراب فرط الحركة ونقص الانتباه يعانون من ضعف القدرة على التتبع. وأن القدرة على التثبيط بها اختلال فى جميع الأمراض المذكورة.