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Running head: HIGH FUNCTIONING ADULT ADHD

“Ecological” and highly demanding executive tasks detect real life deficits
in high functioning adult ADHD patients

Abstract

Objective: Many adult ADHD patients with a convincing history of real life executive deficits perform entirely within normal limits or with minimally impaired performance in classical executive tests. We assessed a group of high cognitive functioning adult ADHD patients on “ecological” and “highly demanding” executive tasks.

Method: 117 adult ADHD patients were classified as showing either a high (Hi-ADHD) or a low (Lo-ADHD) functioning neuropsychological profile based on standard assessment. Their performance was compared to healthy controls ($n = 21$) on an “ecological” task of executive function (the Hotel Task) and computerized tasks of high cognitive demand.

Results: Lo-ADHD significantly differed from controls on multiple standard neuropsychological variables, as well as on the experimental tasks. Hi-ADHD and healthy controls did not differ significantly on any of the standard neuropsychological variables, but a significant difference was found between the groups on measures of the experimental tasks.

Conclusions: Real life executive dysfunction of patients with ADHD who perform within normal range on standard assessment can be detected with the use of more “ecological” and highly demanding tasks.

Introduction

Since its earliest description by Still back in 1902 (Still, 1902), Attention Deficit/Hyperactivity Disorder (ADHD) was considered a childhood-specific disorder, thought to disappear or diminish toward adolescence (Hill & Schoener, 1996). However, ADHD is now recognized as a disorder that persists into adolescence and further into adulthood in 40 to 70% of all cases (August, Braswell, & Thuras, 1998; Mannuzza et al., 1991; Weiss, Hechtman, Milroy, & Perlman, 1985; Weiss, Hechtman, Perlman, Hopkins, & Wener, 1979), affecting personal, social, academic, and professional development. In fact, ADHD-prevalence studies indicate that about 4% of the adult population suffers from this disorder (Faraone, Sergeant, Gillberg, & Biederman, 2003; Heiligenstein, Conyers, Berns, & Miller, 1998; K. Murphy & Barkley, 1996).

While the expression of ADHD in adults resembles the set of symptoms identified earlier in childhood, clinical signs are influenced by the changes that occur as patients grow older. In accordance, several studies have shown that toward adolescence and adulthood, hyperactivity and impulsivity symptoms tend to diminish, while symptoms of inattention persist (Hart, Lahey, Loeber, Applegate, & Frick, 1995; Millstein, Wilens, Biederman, & Spencer, 1997).

Besides the impaired performance on tests of attention (Biederman et al 2000) and inhibition (Barkley, 1997), executive functions seem to be the most severely impaired cognitive domain in adult ADHD patients, affecting planning, self-monitoring, working memory, flexibility, and set shifting, among others. The dysexecutive profile of ADHD patients is qualitatively, though not always quantitatively, similar to the pattern observed in adults with frontal lobe damage (D. E. Johnson et al., 2001; Shue & Douglas, 1992)

While the 4th Edition of the Diagnostic and Statistical Manual of Mental Disorders; (DSM-IV, 2000) proposes three possible types of ADHD – predominantly inattentive type,

predominantly hyperactive-impulsive type, and a combined type – recent studies have found little to no differences between ADHD adult subtypes in terms of their performance on neuropsychological tests (Schweitzer, Hanford, & Medoff, 2006; Tucha et al., 2008; Tucha, Mecklinger, et al., 2006; Tucha, Walitza, et al., 2006). Adult patients who fulfill DSM-IV criteria for ADHD but perform normally on neuropsychological tests are not unusual in clinical practise. For example, it is not uncommon for some successful professionals to consult at a memory clinic reporting difficulties in “memory”, especially with increase of daily life stress and more resposanibilities or just because her/his kid was diagnosed with ADHD and, althought she/he compesated it for many years, the symptoms are similar to those of the kid. Many such patients fulfill criteria for ADHD, though were not diagnosed during their childhood, and perform within-normal upon neuropsychological assessment. Moreover, althought executive functions seem to be primarily impaired in ADHD, real-life difficulties experienced by patients may go undetected.using standard executive tests. This may be due to the fact that in classical tests of executive function, the examiner provides the structure, organization, guidance, plan and monitoring necessary for optimal performance, soon becoming the patient’s own executive system (Gioia & Isquith, 2004) and thus lowering the sensitivity of these tests to detect executive dysfunction (Gregory et al., 2002). In order to overcome this, our group has recently demonstrated (Torralva, Roca, Gleichgerrcht, Bekinschtein, & Manes, 2009) the usefulness of incorporating executive tests that are more “ecological” in nature, for they resemble real-life demands more closely, in evaluating executive functioning in patients with frontal deficits.

With this growing need for tests that resemble real life scenarios’ cognitive demands, the present study examined the neuropsychological performance of ADHD patients and healthy controls on both a standard neuropsychological battery and “ecological” and highly demanding

executive tasks. Patients were classified as either showing a high or low functioning profile based on their standard neuropsychological examination.

Methods

Participants

ADHD patients were evaluated during admission interviews to the specialized clinic of adult ADHD at INECO where they underwent a detailed examination that include neuropsychiatric assessment, neurological examination and neuropsychological evaluation. Questionnaires were incorporated in the regular neuropsychiatric examination. Relatives or significant others were usually integrated in the assessment interviews, during which they completed the informant-based version of questionnaires. ADHD diagnosis based on the DSM-IV criteria was made by two experts (AL and FM). All participants were assessed before initiating treatment with specific drugs for ADHD. Patients ($n = 117$) fulfilled DSM-IV criteria for ADHD and were examined to rule out other possible comorbid psychiatric or neurological disorders (exclusion criteria). Healthy controls (CTR, $n = 21$) were recruited from a larger pool of volunteers who had neither a history of abuse of recreational drugs nor a family history of neurodegenerative or psychiatric disorders. All participants gave their informed consent prior to inclusion in the study.

Materials & Procedure

The study was approved by the ethics committee at the Institute of Cognitive Neurology in accordance with international principles for human medical research. Patients initially

completed a series of psychiatric and behavioral questionnaires in order to establish a profile of clinical symptoms, including the Barkley Scale (Barkley, 1997) for inattention and hyperactive profiles, and the Beck Depression Inventory II (Beck, Steer, Ball, & Ranieri, 1996) to control for mood disturbances. The neuropsychological examination included a standard battery and a series of experimental tests included in this study to detect executive dysfunctions in a more “ecological” or “highly cognitive demanding” way.

Standard Neuropsychological Battery. Participants completed a thorough neuropsychological battery assessing (1) *estimated premorbid IQ* with the Word Accentuation Test – Buenos Aires (WAT-BA; Burin, Jorge, Arizaga, & Paulsen, 2000); (2) *general cognitive status* with the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) and the Addenbrooke’s Cognitive Examination (ACE; Mathuranath, Nestor, Berrios, Rakowicz, & Hodges, 2000); (3) *verbal memory* through the Rey auditory verbal learning test (RAVLT; Rey, 1941) and the logical memory subtest of the WMS-R (Wechsler, 1997), and *non-verbal memory* with the Rey Complex Figure test (Rey, 1941); (4) *attention* with the forward digits span task of the Wechsler Memory Scale – Revised (WMS-R; Wechsler, 1997) and the Trail Making Test Part A (TMT-A; Partington & Leiter, 1949); (5) *language* with the Abbreviated version of the Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1983) for naming, the Token Test (Spreeen & Benton, 1977) for comprehension, and the semantic fluency task (Lezak, Howieson, & Loring, 2004) for fluency; (6) *executive function* using the backward digits span test (Wechsler, 1997), part B of the Trail Making Test (TMT-B; Partington & Leiter, 1949), the letters and numbers ordering test (Wechsler, 1981), the phonological fluency task (Lezak et al., 2004), and the modified version of the Wisconsin Card Sorting Test (WCST; Nelson, 1976).

Experimental Executive Tasks. The experimental tasks used in this study included: the Hotel task (adaptation from Manly, Hawkins, Evans, Woldt, & Robertson, 2002), as well as the inhibitory control (Go-No Go) and the working memory subtests of the Test of Attentional Performance (TAP; Zimmermann & Fimm, 1994). The latter is a computerized battery of tests aimed at detecting attention and working memory deficits using highly demanding tasks. Scoring of both TAP subtests included the percentage of correct responses as well as commission (incorrect responses) and omission (ignored responses) errors. The Hotel task has been recently described for the first time as an assessment tool, rather than as a sole rehabilitation tool (Manly et al., 2002) by our group (Torralva et al., 2009). The task comprises recreated the scenario of a job interview at a hotel. The examiner instructs the participant as follows: “In this task you are asked to imagine that you are working in a hotel. Your manager is keen for you to try each of these five everyday activities during the next 15 minutes so that you can get a ‘feel’ for the tasks—and make an informed estimate of how long each task would take to complete. Your main goal is to attempt to do each of these five tasks over the next 15 min. There are five main tasks to do. Each of the tasks may take longer than 15 min to complete on its own, so there is no way that you will be able to complete all of them. The most important thing is to try and do a little of each task—spending as much time on each as possible within the total time available.” The stimuli needed for each task are distributed on a table. A written summary of the task is placed on top of the stimuli in order to reduce working memory loading. Tasks included arranging individual bills by guest name, grouping coins according to their country of origin, looking up commercial telephone numbers in the local yellow pages, sorting conference name tags alphabetically, and proofreading a hotel leaflet for typos. Scoring of the Hotel Task included the number of main

tasks attempted (out of 5), the number of tasks correctly executed (out of 5), and deviation from optimal time allocation (in seconds).

Statistical Analysis

Participants in the ADHD group were classified as showing either a high functioning (Hi-ADHD) or a low functioning (Lo-ADHD) neuropsychological profile. Patients were examined individually and categorized according to a strict set of criteria. Initially, patients whose performance on any of the standardized tests included in the neuropsychological battery – the logical memory WMS-R (immediate and delayed scores), the RAVLT (immediate, delayed, distractor list, and recognition scores), the Rey Figure (immediate and delayed scores), the semantic and phonological fluency tasks, or the TMT-A and TMT-B – was 1.5 or more standard deviation units below the normalized scores were immediately assigned to the Lo-ADHD group. From the remaining ADHD patients, the following conditions were used as inclusion criteria for the Lo-ADHD group: (1) Boston Naming Test score of 17 (out of 20) points or lower; (2) Token Test score of 29 (out of 32) points or lower; (3) five or fewer digits achieved on the forward digit span task; (4) four or fewer digits achieved on the backward digit span task; (5) four or fewer categories achieved on the WCST.

Neuropsychological performance was compared between Hi-ADHD, Lo-ADHD, and CTR groups using one-way ANOVA followed by Tukey's HSD *post hoc* comparisons when appropriate. When analyzing categorical variables (e.g. gender, Figure Rey recognition), the Freeman-Halton extension of the Fisher exact probability test for 2×3 contingency tables was used.

Results

Classification of ADHD patients

Under the previously described criteria, 34 (29.1%) patients were categorized as Hi-ADHD and 83 (70.9%) patients were categorized as Lo-ADHD, setting a Lo- to Hi-ADHD ratio of 2.44.

Neuropsychological Profile

Table 1 summarizes general demographic information and neuropsychological test results for all three groups. Patients were successfully matched for age ($F_{2,135} = 0.85, p = .43$) and gender ($\chi^2 = 2.1, df = 2, p = .35$). While years of education significantly differed between the groups ($F_{2,135} = 7.82, p < .05$), particularly between controls and Lo-ADHD ($p < .001$) and Hi-ADHD ($p < .01$), premorbid intellectual performance was similar ($F_{2,135} = 0.87, p = .45$).

The groups performed similarly on general cognitive status screening tests. On memory tasks, a significant difference was observed for the immediate ($F_{2,135} = 9.42, p < .001$) and recall ($F_{2,135} = 8.57, p < .01$) scores of the WMS-R logical memory test and the immediate score of the RAVLT ($F_{2,135} = 10.6, p < .001$). *Post hoc* comparisons showed a similar pattern for all variables: Lo-ADHD patients differed significantly from both Hi-ADHD and CTR, while these two groups showed a similar performance (corresponding p values shown on Table 1). Performance on classical executive tests were significantly different on the TMT-B ($F_{2,135} = 9.74, p < .001$) and the Letters & Numbers test ($F_{2,135} = 7.45, p < .05$). Again, Lo-ADHD differed significantly from CTR and Hi-ADHD, while the latter did not show significant differences between themselves (corresponding p values shown on Table 1). No other significant differences were found between the groups on other standard neuropsychological battery tests.

Experimental Tasks Performance

Time deviation on the Hotel Task was similar across the groups ($F_{2,135} = 0.81, p = .45$), but the number of tasks attempted ($F_{2,135} = 5.36, p < .01$) and the number of tasks completed correctly ($F_{2,135} = 7.01, p = .001$) was significantly different between the groups. More specifically, CTR attempted a significantly higher number of tasks than Hi-ADHD ($p < .01$) and Lo-ADHD ($p < .01$). CTR also correctly executed a significantly higher number of tasks than Hi-ADHD ($p = .001$) and Lo-ADHD ($p < .001$). Hi- and Lo-ADHD did not differ significantly on any of the Hotel Task scores (Figure 1).

Performance on the inhibitory control subtest of the TAP did not differ significantly between the groups for the number of correct responses ($F_{2,135} = 1.21, p = .33$), omitted trials ($F_{2,135} = 0.65, p = .52$), or commission errors ($F_{2,135} = 0.76, p = .47$). On the working memory test, however, the groups differed significantly on the three same variables (correct responses: $F_{2,135} = 5.9, p < .01$; omission errors: $F_{2,135} = 3.38, p = .037$; commission errors: $F_{2,135} = 3.9, p = .022$). *Post hoc* comparisons showed that CTR differed significantly from both Hi-ADHD and Lo-ADHD ($p < .01$ for all cases), while the patient subgroups did not differ between themselves (Figure 2).

Discussion

The present study demonstrated that adult ADHD patients who showed within-normal performance on standard neuropsychological assessment that include classical executive tasks performed similarly to individuals with frontal lobe damage in ecological and highly demanding executive tasks. We divided ADHD patients based on their cognitive performance as presenting either a high functioning (Hi-ADHD) or a low functioning (Lo-ADHD) cognitive profile. To our knowledge, this strategy has not been used in ADHD research before. Measures of the standard

neuropsychological battery differed significantly between Lo-ADHD and healthy controls, but not between the latter and Hi-ADHD patients. However, when ADHD patients were compared with healthy controls on “ecological” or “highly demanding” executive tasks, significant differences were consistently found, irrespective of whether they had shown within-normal (Hi-ADHD) or decreased (Lo-ADHD) neuropsychological functioning.

The neuropsychological profile of Lo-ADHD was characteristic, with significant differences found in comparison to controls on the immediate and recalls scores of the logical memory, the immediate score of the RAVLT, and two classical executive tasks (TMT-B and Letters & Numbers). In fact, the immediate scores of both verbal memory tasks could be reinterpreted as measures of attention in memory acquisition, suggesting affection of memory, attention, and executive function. These findings are similar to those of previous studies in adult ADHD patients reporting performance deficits on certain measures of logical memory and RAVLT (Oncü & Olmez, 2004; Pollak, Kahana-Vax, & Hoofien, 2008), as well as executive dysfunction as measured by classical tests (Rodriguez-Jimenez et al., n.d.; Schweitzer et al., 2006; T. Shallice et al., 2002). Interestingly, the same variables differed significantly between both ADHD groups, supporting the idea of a high functioning group that performs at control level.

The rationale behind the inclusion of the experimental tasks chosen for this study was two-fold. On the one hand, the design of “ecological” tasks that mimic real-life scenarios has been of increasing interest in the field of neuropsychology over the past decades (Gioia & Isquith, 2004; Manly et al., 2002; Shallice & Burgess, 1991; Torralva et al., 2009). Such tasks are thought to minimize the executive aid of the examiner during cognitive assessment, which could potentially compensate the patient’s own dysexecutive functioning, and overrate scoring

on classical tests. Moreover, by resembling everyday scenarios, subtle dysexecutive signs become more apparent. The Hotel Task included in our battery was introduced originally by Manly et al. (2002) for the rehabilitation of patients with traumatic brain injury who seemed to experience difficulties in everyday functioning. Recently, our group (Torralva et al., 2009) demonstrated the usefulness of this task, among other tasks of “ecological” validity, for the detection of executive deficits in patients with frontal deficits that scored above the cut-off score of a general cognitive screening test. Similarly, ADHD patients in the present study who showed within-normal performance on every variable of the standard neuropsychological battery (Hi-ADHD) showed significant differences from controls on the experimental task aimed at evaluating real-life executive functioning. This is an important issue because other recent studies (Saboya, Coutinho, Segenreich, Ayrao, & Mattos, 2009) also failed to show executive deficits in a group of adult ADHD denoting low sensitivity of the standard executive tests to discriminate between controls and ADHD patients.

On the other hand, the inclusion of computerized tests that measured inhibitory control and working memory was thought as a way to assess two aspects of executive functioning using highly demanding cognitive tasks. Again, patients in the Hi-ADHD group were outperformed by controls on the working memory computerized task. Previous studies have also found working memory deficits in ADHD patients on other computerized tasks (Assef, Capovilla, & Capovilla, 2007; Messina, Tiedemann, de Andrade, & Primi, 2006). Moreover, some studies have shown that training working memory with computerized software stimulation programs improves executive performance (Klingberg et al., 2005; Klingberg, Forssberg, & Westerberg, 2002). While lack of inhibitory control is a main deficit reported in children with ADHD (for review, see Kenemans et al., 2005), the lack of significant differences between the groups on the

computerized inhibitory control task found in the present study is consistent with previous studies using digitalized assessment tools to assess adults with ADHD on this domain. For instance, Nigg et al. (2002) showed that while adult ADHD patients showed persistent motor inhibition deficits, as measured by an antissacade task, performance on a negative priming task was normal. Findings in this regard, however, are both scarce and contradictory, as some other authors have actually reported both motor inhibition (Armstrong & Munoz, 2003) and cognitive inhibition (Biederman, Mick, & Faraone, 2000; Murphy, 2002) deficits in adult ADHD patients. The differences between results most probably stem from inconsistent approaches in methodology (e.g. time frames for priming tasks, varying algorithms in stop signal tasks, etc.).

Limitations

There a number of shortcomings to the present study that must be acknowledged. First, it could be argued that the differences found in education levels between both ADHD groups and healthy controls pose a limitation to the generalizability of our results. However, it must be taken into account that premorbid IQ, as measured by the WAT-BA, did not differ significantly between the groups, making differences in performance across cognitive domains less critically dependent on any potential differences in intellectual functioning. Moreover, one must consider that by comparing ADHD patients' performance with a control group of such high education levels ($Mean = 16.3, SD = 2.7$), the lack of significant differences between Hi-ADHD patients and controls is actually indicative of genuine high functioning ADHD patients, as it may be associated with high functioning profiles in real life (e.g. completing a degree, being able to hold a career over time, etc.). Future studies will have to address this issue further in order to determine the way in which everyday life success in ADHD patients is reflected through neuropsychological performance, especially on these more “ecological” and highly demanding

cognitive tasks. Future studies should also tackle the other major limitation to our study which is the relatively low number of control subjects. It will be important to identify subgroups within larger control populations to allow for comparisons based not only on categorical variables such as diagnosis (i.e. ADHD vs control) but also based on neuropsychological performance (e.g. spared vs. impaired executive profile besides diagnosis) or the presence or absence of specific ADHD symptoms in patients and controls even when not fulfilling DSM-IV criteria for ADHD.

Conclusions

The findings of the present study have several important clinical implications. First, showing a group of adult ADHD patients as being “high functioning” based on normal performance on all variables of a standard neuropsychological battery is a novel concept that is worthy of further exploration. Second, our results highlight the importance of introducing novel tasks that mimic real-life scenarios and tasks that are designed to be highly challenging as a way to detect subtle, yet impairing, executive deficits that occur in everyday settings. This is especially important, as it also provides an objective tool for specialists to design specific treatment methods for helping patients achieve better functioning levels in their everyday life. Third, the findings of our study open a new line of research aimed at furthering our understanding of symptoms and clinical features of ADHD patients in adulthood. Future studies should attempt to understand how executive deficits may be apparently compensated as patients grow older, and yet be impairing enough to not allow for proper functioning. More studies are also needed to address the question on what behavioral aspects of ADHD patients (e.g., impulsivity, apathy, etc.) may explain the difference between high- and low-functioning individuals with this disorder.

In conclusion, we have showed a group of adult patients diagnosed with ADHD who, while performing normally on all tasks of a comprehensive standard cognitive battery, still show executive deficits when assessed with real-life and highly demanding tasks that have been previously shown to be sensitive to frontal lobe dysfunction. Ecological and highly demanding executive tasks may eventually be developed into a diagnostically useful clinical tests in adult ADHD that perform normally in the standard neuropsychological evaluation.

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Table 1

Demographic information and neuropsychological background tests for Hi-ADHD, Lo-ADHD, and control groups.

Values are shown as Mean (SD) and statistical comparison test results are shown on the right columns.

		Hi-ADHD (n = 34)	Lo-ADHD (n = 83)	CTR (n = 21)	Hi-ADHD vs. CTR	Lo-ADHD vs. CTR	Hi-ADHD vs. Lo-ADHD
	Age (years)	35.5 (15.1)	32.4 (15.6)	30.4 (10.1)	n.s.	n.s.	n.s.
<i>Demographics</i>	Gender (M : F)	18 : 16	54 : 29	11 : 10	n.s.	n.s.	n.s.
	Education (years)	13.8 (3.0)	13.5 (3.0)	16.3 (2.7)	< .01	< .001	n.s.
<i>General</i>	WAT-BA	34.6 (7.3)	34.5 (6.3)	37.7 (3.2)	n.s.	n.s.	n.s.
<i>Cognitive</i>	MMSE	29.6 (0.5)	29.2 (1.1)	29.5 (0.9)	n.s.	n.s.	n.s.
<i>Status</i>	ACE	92.2 (2.6)	91.9 (3.8)	95.1 (3.0)	n.s.	n.s.	n.s.
	Logical Memory						
	Immediate	28.6 (6.6)	23.6 (7.2)	29.1 (5.1)	n.s.	< .001	< .001
	Recall	24.1 (6.6)	18.8 (7.9)	25.4 (20.2)	n.s.	< .001	< .001
	Recognition	17.0 (2.0)	16.7 (3.0)	17.7 (1.9)	n.s.	n.s.	n.s.
	RAVLT						
	Immediate	49.2 (10.1)	44.2 (9.3)	54.9 (6.1)	n.s.	< .001	< .01
<i>Memory</i>	Delayed	9.5 (3.1)	9.0 (5.6)	9.9 (3.7)	n.s.	n.s.	n.s.
	Recognition	13.0 (2.0)	12.7 (2.5)	14.1 (1.2)	n.s.	n.s.	n.s.
	Rey Figure						
	Immediate	35.2 (2.5)	35.1 (2.0)	35.8 (0.6)	n.s.	n.s.	n.s.
	Delayed	20.8 (5.2)	20.8 (6.8)	21.3 (6.4)	n.s.	n.s.	n.s.
	Recognition	67.8%	59.6%	70.1%	n.s.	n.s.	n.s.
<i>Attention</i>	Digits Forward	7.4 (2.7)	7.1 (2.2)	8.0 (2.3)	n.s.	n.s.	n.s.
	TMT-A	30.4 (13.9)	33.2 (13.5)	28.4 (7.7)	n.s.	n.s.	n.s.
	Boston Naming Test	19.7 (0.5)	19.3 (1.5)	19.9 (0.6)	n.s.	n.s.	n.s.
<i>Language</i>	Token Test	30.8 (2.2)	30.1 (2.7)	31.0 (2.3)	n.s.	n.s.	n.s.
	Semantic Fluency	22.0 (4.1)	19.7 (5.2)	24.9 (1.3)	n.s.	n.s.	n.s.
	Digits backwards	4.7 (1.3)	4.1 (1.3)	5.4 (1.9)	n.s.	n.s.	n.s.
	TMT-B	67.1 (36.4)	86.5 (29.8)	61.4 (17.8)	n.s.	< .001	< .001
<i>Executive</i>	Letters & Numbers	10.2 (2.5)	8.5 (1.9)	11.8 (2.7)	n.s.	< .01	< .01
<i>Functions</i>	Phonological Fluency	16.5 (5.8)	15.2 (4.1)	17.8 (4.2)	n.s.	n.s.	n.s.
	WCST	5.9 (0.3)	5.6 (1.0)	5.9 (0.5)	n.s.	n.s.	n.s.

Figures

Figure 1. Mean (+ S.E.M.) number of tasks attempted and performed correctly, as well as time deviation on the Hotel Task. A significant difference was found between controls and Hi-ADHD, and Lo-ADHD on both measurements of task achievement (asterisks).

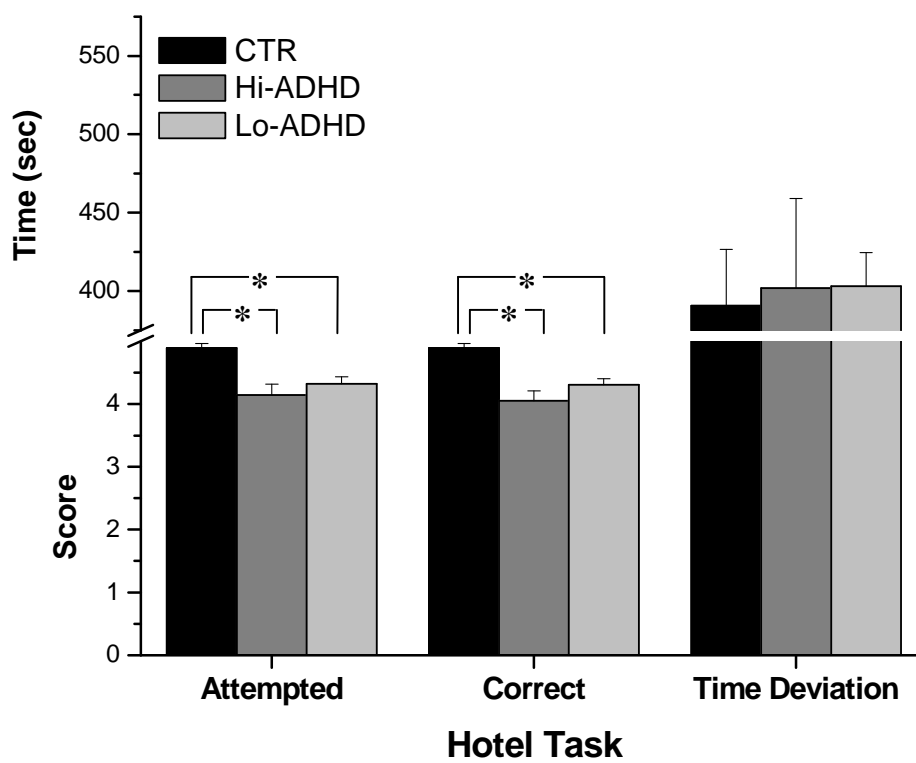


Figure 2. Mean (\pm S.E.M.) percentage of correct, omitted, and incorrect responses on the inhibitory control and working memory computerized subtests of the Test of Attentional Performance battery. The groups differed significantly on the three measures of performance on the working memory subtest (asterisks).

