

Inattention, Passivity and Reading Ability in Attention-Deficit Hyperactivity Disorder in a Greek Community Sample

Helen Lazaratou^{1*}, Maria Vlassopoulos¹, Zacharias Kalogerakis¹, George Zeliou¹, Dimitris Anagnostopoulos¹ and Georges Dellatolas²

¹Child and Adolescent Psychiatric Unit, Community Mental Health Center, 1st Psychiatric Department, Medical School, University of Athens, Greece

²Inserm and Laboratory of Psychology and Cognitive Neuroscience, CNRS UMR8189, Université Paris Descartes, France

Abstract

Background: Studies on Attention-Deficit Hyperactivity Disorder (ADHD) show high comorbidity with learning disorders. This study examines the relationships between inattention, hyperactivity and reading performance in a non-referred sample of second grade schoolchildren in an Athenian borough.

Methods: 201 pupils attending second grade in public schools were assessed for reading ability. The reading test was appropriate for second grade pupils according to the Greek curriculum. Teachers completed the Connors Rating Scale (CTRS) and the Achenbach's Teacher's Report Form (TRF).

Results: Attention/learning difficulties reported by the teacher were negatively associated with reading skills, but hyperactivity and other behaviour problems were not. Furthermore, in linear regression partialling out attention/learning difficulties, teachers' reports of hyperactivity or externalizing difficulties was positively associated with reading skills. Girls showed better reading skills and less hyperactivity than boys. Moreover, passivity was found to be a compounding factor in reading difficulties.

Conclusion: Among the three subtypes of ADHD according to DSM-IV, the predominantly inattentive has more possibilities to contribute to reading difficulties, and even more so if it is combined with a child's passivity.

Keywords: Attention-deficit hyperactivity disorder; Inattention; Reading ability

Introduction

Attention-Deficit Hyperactivity Disorder (ADHD) is a highly prevalent and complex neurodevelopmental condition characterized by persistent inattention and/or hyperactivity-impulsivity. Numerous genetic, neurochemical, neuroimaging and neuropsychological studies suggest that ADHD is related to deficits in key brain regions subserving attention and executive functions [1]. ADHD has a genetic and biochemical basis, but environmental factors, prenatal, perinatal, and postnatal in origin, might also be implicated in its etiology [2-5].

Children in community samples, who show symptoms of inattention, hyperactivity and impulsivity, with or without formal diagnosis of ADHD, show also poor academic and educational outcomes [6]. In particular, a strong association of Reading Difficulties (RD) with ADHD has been repeatedly reported [7,8]. A genetic aetiology, which is partly shared, may be responsible for this comorbidity, as supported by behavioural and genetic studies, in both clinical and community samples [9-13]. Environmental factors were also reported to contribute to the link between RD and inattention [14]. It is suggested by Roy and Rutter [15], that reading performance may also be associated with institutional upbringing. Consequently, the environmental influence of being raised 'in care' might have an impact on reading performance either directly or indirectly owing to the increased levels of inattention which accompany institutional upbringing.

Other studies suggest common cognitive components in RD and ADHD, such as deficits in language impairment [16], processing speed [17], phonological processing [18], or time perception and psychoacoustic tasks [19,20].

There are some differences concerning gender and reading difficulties or ADHD. Girls showed better reading skills than boys. In fact the epidemiology of ADHD and RD show higher percentages of boys referred for mental health services than girls [21-23]. This is further corroborated by the finding that men and women differ in areas of the brain that are activated during phonologic processing, which may lead to girls being better able to compensate for a reading deficit

compared to boys [24]. However, other studies [25,26] maintain that the clinical correlates of ADHD are not influenced by gender. According to them, gender differences reported in subjects from clinical settings may be due to referral biases.

A commonly used rating scale to screen for ADHD and monitor treatment in children is the Connors Rating Scale [27-29]. The Connors is specifically linked to the DSM-IV criteria for ADHD, oppositional defiant disorder, and conduct disorder. Another commonly used scale is the Achenbach Child Behavior Checklist (CBCL), Parent and Teacher Report Form (TRF), designed to stratify "externalising behaviors" such as hyperactivity and aggression, and "internalising behaviors" related to anxiety and mood concerns [30,31].

Factor analytic studies of parent and teacher symptom ratings have fairly consistently identified two broad distinguishable behavioural dimensions that best characterize ADHD: inattention and hyperactivity-impulsivity.

Data from two longitudinal studies in Australia and New Zealand, where separate measures of inattention and hyperactivity were considered, showed that earlier levels of inattention, but not overactive behaviors, significantly predicted later levels of school difficulties [32]. This stronger association of learning difficulties with inattention than

***Corresponding author:** Helen Lazaratou, Assoc. Professor in Child Psychiatry Child and Adolescent Psychiatric Unit, Community Mental Health Center, 1st Psychiatric Department, Medical School, University of Athens, 14 Delou Street, Kessariani, 16121, Athens, Greece, Tel: 0030-210-7640111/0030-210-7644705; Fax: 0030-210-7662829; E-mail: elazar@med.uoa.gr

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with hyperactivity has been repeatedly reported [33-35] and recent studies confirm that inattentive behaviours are associated with RD, in particular to reading fluency and comprehension [36-38]. The impact of inattention may have repercussions from school entry and appears to be a predictor of later reading ability [39,40].

The aim of the present study is to study the relationships between tested reading ability and hyperactivity, inattention, in a non-referred sample of second grade public school children in Greece. Specifically, given the stronger phenotypic and genetic association of reading with inattentive rather than hyperactive-impulsive symptoms, we hypothesized that the relationship with reading difficulties in our non-referred sample would be stronger for inattentiveness than for hyperactivity-impulsivity.

Methods

Design

This study was conducted by a Community Mental Health Centre (CMHC) in Athens, Greece. The sample was elicited through stratified sampling: (i) all of the schools in the CMHC's catchment participated; (ii) 100% of the schools' pupils who were attending second grade during the period from 01/09/2006 to 15/06/2007, and who were aged between 7 years to 8 years (84 to 96 months), were potential participants; (iii) a random selection of 55% of the above pupils participated in the study. There was a 6% parental refusal rate. Consequently the sample thus consisted of 201 children, 92 boys (45.8%) and 109 girls (54.2%).

Study instruments

(a) **Teacher's Report Form (TRF):** This is a teacher-rated behavioural inventory with a 3-point scale, yielding the same T-scores as the parents' CBCL [31]. It has been translated into Greek and standardized on the Greek population [41]. For the purposes of this study, only the Internalizing and Externalizing scales are analysed.

(b) **Conners-28 item questionnaire:** This questionnaire assesses behavioural difficulties which are rated by the teacher on a 4-point scale, "not at all", "just a little", "pretty much", and "very much present", coded 0, 1, 2 and 3 respectively. It is designed for ADHD screening of children aged from 4 to 17 years [27-28]. The instrument has been standardized on the Greek population [42]. In the present study, a detailed analysis of the relationship between the Conner's items and reading skills is proposed.

(c) **Reading ability test:** This test is comprised of a text based on the Aesopian myth of "The Wise Frog" which is relevant to the skills, taught knowledge and interests of 7-8 years old Greek children. The test has the following characteristics: (i) it is comprised of 95 words (letters' size 16) similar to the letters of the Language Official Handbook (Year 1, Year 2), accompanied by a pleasant illustration; (ii) the text level corresponds to that of the Official Handbook of Greek Elementary School, Grade 1 and 2 [43]. The test was administered at the schools by six teachers, who were specifically trained for the task. Their assessments were evaluated during a pilot study and no statistically significant "teacher" effect was found [44]. Reading ability was scored for: (i) Time (in seconds), from the initial uttered syllable until the reading task was completed; (ii) Accuracy: number of errors (stress errors, deletions, substitutions, additions, reversals, reiterations of letters, syllables and words, punctuation deletions and skipping rows of text); (iii) Comprehension: 8 specific questions on text comprehension were administered orally and the number of correct answers was noted. Some examples of comprehension questions were: 'Where did the frogs live?' and 'Why did the frogs have to leave the lake?' The test

was administered individually. The test's duration was approximately 10 minutes.

Procedure

All members of the research team and all teachers involved participated in a meeting before testing commenced. The aim of the meeting was to exchange information about the study's objectives and the specific procedures to be used. Teachers were given the Conners-28 questionnaire and the Teachers' Report Form, which they were requested to complete for all the pupils in their class.

Statistical analysis

Statistical analysis focused on the relations between the Conners-28 teacher questionnaire and reading scores. On the item level, correlations with reading scores using Spearman's rho were examined, and linear regressions with forward selection were performed, to detect the items explaining the best variance of the reading scores. After a Principal Component Analysis of the Conner's, the associations of the 4 retained factors (hyperactivity, social relations, attention/concentration, and sensitivity) with reading scores were examined using Spearman's rho and regressions with forward selection. In addition the impact of Internalizing and Externalizing scores on reading skills, after control of the Conner's "attention" factor, were examined. Given the number of subjects (n=201) correlations were significant at $p < 0.05$ if $> \text{abs}(0.16)$; they were considered as strong if $> \text{abs}(0.40)$, moderate if $> \text{abs}(0.30)$, and low otherwise.

Statistical analyses were performed using SPSS software package version 20.

Results

201 children performed the reading tasks. Their ages were between 84-96 months ($M=89.4$, $SD=3.2$). The teacher-rated TRF and Conner's were completed for 87% (n=175) of the children. Reading scores were not significantly different according to the presence/absence of missing data for TRF.

Reading task

Reading time varied from 42 to 414 sec, with a mean of 99.0 sec ($SD=47.8$). Regarding accuracy, the number of errors was from 0 to 54, with a mean of 9.7 ($SD=8.8$). The Comprehension score was from 0 to 23 with a mean of 16.2 ($SD=4.8$). A strong correlation was found between reading time and reading accuracy ($r=.60$, $n=201$, $p<.001$) and a lower, yet significant, correlation between comprehension and the other two factors, reading time ($r=-.24$, $n=201$, $p<.001$) and accuracy ($r=-.30$, $n=201$, $p<.001$). Girls performed better on reading time ($t=2.03$, $df=199$, $p=.04$) and reading accuracy ($t=2.37$, $df=199$, $p=.02$).

Conners-28 questionnaire and reading skills

Table 1 shows the Spearman correlation coefficients of each item with reading time, reading errors and comprehension. These coefficients are expected to be positive for reading time (more reading time in the case of positive answers) and for reading errors (more errors in the case of positive answers), but negative for comprehension (lower comprehension in the case of positive answers). "Difficulty in learning" was the item which was most strongly correlated with the reading scores, followed by "distractibility or attention span problem", "fails to finish things that he starts" and "childish and immature". All the other items were either not related or only partially and weakly related to the three reading scores. In some cases (e.g., "demands must be met immediately"), the sign of the correlation coefficients was opposite to the one expected.

	Reading Time	Reading errors	Comprehension
1. Restless in the « squirmy » sense	.11	.14	-.01
2. Makes inappropriate noises when he shouldn't	.04	.11	.02
3. Demands must be met immediately	-.13	-.04	.05
4. Acts « smart » (impudent or sassy)	-.04	.01	.02
5. Temper outbursts and unpredictable behaviour	.15	.07	.03
6. Overly sensitive to criticism	-.03	.02	-.10
7. Distractibility or attention span a problem	.30***	.36***	-.17*
8. Disturbs other children	.06	.09	.05
9. Daydreams	.03	.06	-.06
10. Pouts and sulks	.10	.11	-.17*
11. Mood changes quickly and drastically	.08	.05	-.03
12. Quarrelsome	.14	.15	-.04
13. Submissive attitude toward authority	-.03	.11	-.14
14. Restless, always up and on the go	.09	.07	.05
15. Excitable, impulsive	.07	.18*	-.04
16. Excessive demands for teacher's attention	-.06	-.02	.09
17. Appears to be unaccepted by the group	.18*	.23**	-.15
18. Appears to be easily led by other children	.16*	.20**	-.08
19. No sense of fair play	.09	.16*	-.04
20. Appears to lack leadership	.001	.11	-.06
21. Fails to finish things that he starts	.31***	.37***	-.19**
22. Childish and immature	.22**	.34***	-.16*
23. Denies mistakes or blames others	.10	.15	-.08
24. Does not get along well with other children	.11	.11	-.16*
25. Uncooperative with classmates	.09	.09	-.20**
26. Easily frustrated in efforts	.14	.18*	-.26***
27. Uncooperative with teacher	.13	.11	-.20**
28. Difficulty in learning	.47***	.52***	-.30***

Note. *p < .05; ** p < .01; *** p < .001.

Table 1: Spearman correlation coefficients of the Conner's items with reading scores.

Table 2 shows the results of regression models with a forward selection of the items, and $p < .05$ for an item to enter. For each reading score two forward selections were performed, with and without the “difficulty in learning” item, which was always the first selected. Selected items had either a positive or a negative coefficient. “Distractibility or attention span problem” and “uncooperative with teacher” were associated with slower reading; however, “demands must be met immediately” was associated with faster reading. For reading errors, “distractibility or attention span problem”, “fails to finish things that he starts” and “submissive attitude towards authority” were related to more errors; but “demands must be met immediately” “daydreams” and “easily frustrated in efforts” were related to less errors. Excessive demands for teacher's attention was linked to better comprehension; and “fails to finish things that he starts” and “easily frustrated in efforts” were associated with poorer comprehension. Note, however, that Conner's items explain only a small percentage of the variance of reading comprehension (15% with the “difficulty in learning item” and 11% without this item).

Table 3 shows the results of Principal Component Analyses of the 28 questions of the questionnaire. Items 6 (“Overly sensitive to criticism”), 13 (“Submissive attitude toward authority”), 20 (“Appears to lack leadership”), and 28 (“Difficulty in learning”) were poorly related to the total score (Table 4), (F1 unrotated). The four factor structure was chosen as the most appropriate solution and accounted for 64% of the variance. In the four factor solution, items were retained if their loading on the factor was $>.50$ after varimax rotation.

New variables were then generated, one for each factor, summing up the teacher's answers (i.e. 0, 1, 2, or 3 for “never”, “rarely”, “sometimes”, and “very often” respectively) to the corresponding items. The names of these four new variables were chosen in accordance with the questions they were based on: hyperactivity (10 items), sociability (6 items), inattention (4 items), and “sensitivity” (6 items). Boys presented higher levels of Hyperactivity ($p < .001$) and Total problems ($p = .01$) than girls.

As Table 4 shows in relation to the 4 factors of the Conner's questionnaire, only the third, attention/concentration, was significantly related to the scores evaluating reading. Forward selection of the Conner's factors by regression models, with $p < .05$ for a factor to enter, showed that attention/concentration problems were always associated with lower reading scores, but hyperactivity was associated with faster reading and better comprehension (when attention/concentration was partialled out) (Table 5).

Reading Time				
	b	s(b)	p	R2 ^a
Regression with item 28				
3. Demands must be met immediately	-21.5	5.3	< .001	0.30
7. Distractibility or attention span a problem	12.0	4.5	.008	
27. Uncooperative with teacher	23.0	7.6	.003	
28. Difficulty in learning	13.8	4.7	.004	
Regression without item 28				
3. Demands must be met immediately	-25.1	5.3	< .001	0.26
7. Distractibility or attention span a problem	18.7	4.0	< .001	
27. Uncooperative with teacher	28.9	7.5	< .001	
Reading Errors				
Regression with item 28				
7. Distractibility or attention span a problem	2.9	0.8	< .001	0.35
10. Pouts and sulks	-2.7	0.9	.003	
13. Submissive attitude towards authority	1.4	0.6	.03	
27. Uncooperative with teacher	-2.8	1.4	.04	
28. Difficulty in learning	5.1	0.8	< .001	
Regression without item 28				
3. Demands must be met immediately	-2.1	1.0	.03	0.30
7. Distractibility or attention span a problem	4.2	0.9	< .001	
9. Daydreams	-1.8	0.9	.04	
13. Submissive attitude towards authority	1.8	0.7	.007	
21. Fails to finish things that he starts	4.0	1.0	< .001	
26. Easily frustrated in efforts	-2.6	1.1	.02	
Reading Comprehension				
Regression with item 28				
16. Excessive demands for teacher's attention	1.8	0.6	.003	0.15
24. Does not get along well with other children	-1.6	0.7	.04	
28. Difficulty in learning	-1.6	0.4	< .001	
Regression without item 28				
16. Excessive demands for teacher's attention	1.7	0.5	.001	0.11
21. Fails to finish things that he starts	-1.1	0.5	.03	
26. Easily frustrated in efforts	-1.5	0.6	.009	

^a Proportion of variance explained.

Table 2: Regressions of the reading scores on forward selected items of the Conner's questionnaire.

Item	F1*	Varimax rotation (4 factors solution)**			
		F1	F2	F3	F4
1. Restless in the « squirmy » sense	.77	.81			
2. Makes inappropriate noises when he shouldn't	.68	.77			
3. Demands must be met immediately	.69	.72			
4. Acts « smart » (impudent or sassy)	.64	.63			
5. Temper outbursts and unpredictable behavior	.73	.51			
6. Overly sensitive to criticism	.39				.73
7. Distractibility or attention span a problem	.75			.70	
8. Disturbs other children	.77	.80			
9. Daydreams	.53				.62
10. Pouts and sulks	.66				.63
11. Mood changes quickly and drastically	.71				.61
12. Quarrelsome	.75		.56		
13. Submissive attitude toward authority	.10				.61
14. Restless, always up and on the go	.64	.72			
15. Excitable, impulsive	.77	.77			
16. Excessive demands for teacher's attention	.73	.64			
17. Appears to be unaccepted by the group	.65		.83		
18. Appears to be easily led by other children	.71				
19. No sense of fair play	.57		.61		
20. Appears to lack leadership	.33				
21. Fails to finish things that he starts	.59			.77	
22. Childish and immature	.67			.62	
23. Denies mistakes or blames others	.74	.60			
24. Does not get along well with other children	.76		.83		
25. Uncooperative with classmates	.71		.79		
26. Easily frustrated in efforts	.62				
27. Uncooperative with teacher	.68		.58		
28. Difficulty in learning	.46			.83	

*F1: first factor before rotation

** The four factors after varimax rotation are: F1: hyperactivity; F2: sociability; F3: attention/concentration; F4: Sensitivity

Table 3: Principal-Components Structure for the Conner's Teacher Rating Scale.

Conners Factors	Reading		
	Time	Nb of errors	Comprehension
Hyperactivity	.10	.12	.06
Social Problems	.21	.12	-.12
Attention/concentration	.41*	.44*	-.26*
Sensitivity	.14	.08	-.12
Total	.23	.20	-.07

Note. *p < .05

Table 4: Spearman correlations coefficients of the Conner's factors with reading scores.

	b*	sd**	p	R2***
Reading Time				0.19
Hyperactivity	-1.76	0.72	.02	
Attention/concentration	7.99	1.27	< .001	
Reading Errors				0.24
Attention/concentration	1.77	0.25	< .001	
Sensitivity	-0.51	0.24	.04	
Reading Comprehension				0.13
Hyperactivity	0.26	0.07	< .001	
Attention/concentration	-0.65	0.13	< .001	

* estimator;

** standard deviation of the estimator

*** proportion of variance explained

Table 5: Regressions of the reading scores on forward selected Conner's factors.

TRF

Overall, correlations of the TRF externalizing or internalizing scales and reading scores were low ($r \leq .25$). As expected, the Conner's scale was strongly correlated with teachers' TRF (e.g., $r = .81$ between Conner's hyperactivity and externalising problems; $r = .77$ between Conner's sensitivity and internalizing problems).

TRF externalizing or internalizing scales did not have a significant impact on reading scores after partialling out Conner's attention/concentration, with one exception: TRF's externalizing problems were associated with less reading errors ($p = .002$), when the attention/concentration effect was controlled.

Discussion

The results of this study show that reading ability is better in girls than in boys, which is in accordance with the existing literature. In four different epidemiological studies reviewed by Rutter et al. [45], reading difficulties were more prevalent in boys than in girls.

Furthermore, our results show that boys were more hyperactive according to the teachers. In ADHD, the question of gender is a controversial issue. Where clinical settings are concerned, male predominance is evident. Boys with ADHD are more likely to exhibit externalizing behaviours, in particular rule-breaking, than girls are [46]. Girls with ADHD are less impaired than boys in most parameters. Their behaviour is less disruptive and they have fewer learning difficulties related to reading or mathematics [47,48].

The most important finding in this study is related to the relationship between "inattention" and "reading difficulties" in children who exhibit ADHD. It has already been shown that ADHD symptoms and reading significantly predict each other. Moreover it appears that ADHD symptoms are a significantly stronger predictor of reading than the other way around. Furthermore, the two conditions, ADHD and reading difficulties, are highly heritable and their association is possibly attributed to shared genetic factors [13,49]. It must be noted however that inattentiveness plays a more direct causal role in reading difficulties as the child grows older, as the cognitive demands of reading become more apparent [50].

In this study, the factor structure of the Conner's Questionnaire is similar to previous analyses [27-29,51] with a four factor structure as the most appropriate solution. As expected from previous studies, only one of the four released factors (i.e. Attention/Concentration) was correlated with reading abilities. "Difficulty in learning" has consistently been found to be one of the four items composing the "attention/concentration" factor: when teachers report attention difficulties in a pupil, they usually also note "learning difficulties" in the same pupil. This finding has been reported in Greece [42], in France [35] and elsewhere [29,51]. These same studies, as well as longitudinal investigations from Australia and New Zealand [32], show that hyperactivity alone is not related to academic and learning difficulties. Moreover, in many studies the stronger phenotypic and genetic association of reading with inattentive rather than with hyperactive-impulsive ADHD symptoms is stressed [13,36-38]. Nevertheless, a longitudinal twin study on the association between ADHD symptoms and reading [52] showed that inattentive and hyperactive - impulsive symptoms of ADHD both contributed to the prediction of reading, but inattentiveness was a significantly stronger predictor.

In our study we stress the key role of the "learning difficulties" item in the "inattention" factor of the Conner's: firstly, it suggests that reported inattention is a marker of learning difficulties rather than a marker

for specific attention problems, which could be objectively assessed by specific attention tests; secondly, it explains the "comorbidity" of ADHD with "learning difficulties", when an ADHD diagnosis relies greatly upon the Conner's. In other words, the "inattention" factor is a "learning difficulties" factor.

In the present study, the presence of some "externalizing problems", including hyperactivity, in children showing learning difficulties according to the teacher had a positive rather than a negative impact on reading skills. A possible interpretation of this unexpected finding is that when a child shows learning difficulties according to the teacher, passive behaviour (i.e. zero or close to zero in "externalizing problems") has a negative impact on his/her learning, as it exhibits lack of motivation, whereas on the contrary, the presence of some "externalising problems" may have a positive impact on learning. In a multivariate analysis of the Conner's Teacher Rating Scale with low-income preschool children, three factors were retained; conduct problems, hyperactivity, and passivity. "Difficulty in learning" loaded on the "passivity" factor [53]. Our findings are also in accordance with a study that examined the behaviours related to academic engagement exhibited by students with ADHD [54]. It indicates that classroom activities that require passive engagement, such as listening to lectures or silently reading a passage are particularly problematic for students with ADHD and have a negative effect on their school functioning.

Study Limitations

A limitation of the study is that the sample is not representative. It includes children from public schools from only one suburb of Athens which correspond to a middle socioeconomic status. Children from lower and upper socioeconomic classes are excluded from the study. Another limitation is related to the transversal nature of the study. Longitudinal studies are needed to examine the persistence or, on the contrary, the transitory character of the observed or reported difficulties in schoolchildren.

Conclusions

Among the three subtypes of ADHD according to DSM-IV, the predominantly inattentive has more possibilities of presenting reading difficulties, even more so if it is combined with a child's passivity. The implications of this finding are that in screening for learning difficulties, the factor of a child's passivity must be addressed. It appears that children benefit when their engagement in learning tasks and procedures is more active, and that this may particularly have a positive impact on children with inattention and potential learning difficulties.

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