Attention, Attention Rating and Cognitive Assessment: A Review and a Study

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We begin with the suggestion that the definition of Attention Deficit Hyperactive Disorder (ADHD) still faces some challenges. Conceptually, inhibition of the Pavlovian kind preexisted the "behavioral inhibition" popular in the USA; the difference between them has to be understood in order to understand ADHD. The present project examines the relationship between a teacher rating scale for student attention and the Cognitive Assessment System's measure of Attention in contrast to Planning. The participants were 82 Grade 3 and Grade 4 children from the First Nations community (Cree). Students were administered the Planning and Attention tests of the Cognitive Assessment System (CAS), while teachers rated their own students by using the Attention Checklist (ACL). Correlations between the ACL and the CAS Attention and Planning scores were positive and significant. However, based on the ACL, groups of low- and high- attention participants were contrasted on Attention and Planning scores; tests showed significant differences between the low- and high- attention participants in the Attention score but not in Planning.

Introduction

According to the *Harvard Mental Health Letter*, a deficit in attention "is the most commonly diagnosed childhood psychiatric disorder in the form of attention deficit hyperactivity disorder (ADHD)" (2004, p. 4). Das and Papadopoulos (2003) mention that 15 % of children in North America may have some kind of attention problem that hinders their day-to-day functioning. Reliable measures of attention deficits per se, apart from hyperactivity and conduct disorders, are valuable in order to detect and treat early forms of attention disorders. These measures are valuable since it is believed that attention lies beneath all cognitive and intellectual functioning. The purpose of this study is to investigate

whether observed inattention in the classroom as rated by teachers corresponds with scores on the Attention Scale of the Cognitive Assessment System (CAS). We believe this is the first study to examine a sample of First Nations children that relates individual differences in attention, as rated by teachers, to cognitive tests.

The paper is a review and report of the study and its findings. Following a review of the concept of attention and attention deficit in order to place the study in perspective, we present a report of the study of attention in the classroom and tests of attention.

Attention is a mental process by which a person selectively registers some stimuli and ignores others. It is a cognitive activity as human beings interpret arousal in terms of their ideas and thoughts. Attention has at least two primary aspects: it can be focused and it is selective. In both focusing attention and selecting relevant information from irrelevant information, an individual must resist distraction. This process involves the orienting response, which was described by Pavlov as the "What is it?" response (Pavlov, 1928). Examples of the orienting response are when a student turns his/her head toward the teacher to listen carefully to what is being said, or when he/she gazes towards the blackboard. A student's posture quite often reveals whether or not he/she is attending. The role of the teacher is to present the lesson in such a way that it will attract the student's orienting response.

A brief note on Attention Deficit and Hyperactivity

Defining Attention Deficit Hyperactivity Disorder is by no means an easy task. Sometimes it is used as an umbrella term and refers to unspecified subtypes. The literature usually does not enable any distinction among them with regard to empirical findings (Nigg, 2001). Barkley (1997) reflects the generally accepted suggestion that, in the case of children with ADHD, behavioral inhibition appears to be the problem. The ADHD child's main problem is not inattention or poor attention; rather it is the failure to stop, look, listen, and feel. A low level of "behavioral inhibition" is to be blamed for ADHD syndrome. It is usually attributed to deficient executive processes (Hamlett, Pellegrini, &

Conners, 1987); inability to sustain an organized, planful approach while simultaneously attempting to avoid responding in an impulsive manner (Chelune, Ferguson, Koon, & Dickey, 1986; Reardon & Naglieri, 1992); impulsive responding or failure to think through a plan before responding (Aman, Roberts, & Pennington, 1998); deficiencies in automaticity of information processing, fewer self-corrections and employment of less efficient strategies (Shue & Douglas, 1992; Tannock, Purvis, & Schachar, 1993); or poorer self-regulation (Berman, Douglas, & Barr, 1999). This suggests that behavioral inhibition of children with ADHD, while explained as cognitive deficits, is a variant of the Planning process (Das, Naglieri, & Kirby, 1994). The European point of view of inhibition and attention deficit preexisted Barkley (1997). We consider this because it clarifies Barkley's concept (See Das & Papadopoulos, 2003, for an extended discussion). Gray, a student of Eysenck, succinctly represents an alternative view (Gray 1982, 1995). According to Gray, behavioral inhibition can be activated by three conditions, all of which are present in the classroom: punishment and reward in addition to novel stimuli that arouse the orienting response. The first two are associated with learning. The other, novelty, causes disinhibition. Both interrupt ongoing behavior. The outcome of both is one and the same: the child's behavior shows signs of arousal and distraction. As a result, goal behavior is blocked, attention is segmented, and the child may appear to be agitated and anxious. So what is an antidote to "behavioral inhibition?" The opposite of the behavioral inhibition system is the behavioral approach system. This system is activated by rewards and non-punishment. It enables children to pursue intentional and goal-directed behavior. The behavioral approach system, therefore, can guide us in constructing intervention programs based on rewards, reduction of anxiety, and distractions (Das & Papadopoulos, 2003). In summary, we agree with Nigg (2001) that conceptualizing ADHD still faces challenges.

Attention Rating Scale, PASS theory & CAS

The Attention Checklist (ACL; Das & Melnyk, 1989) is a rating scale to be filled in by teachers (see Appendix). It is specifically designed to

measure inattention of students as observed by the teacher in his/her classroom. The ACL contains 12 items (e.g. Does the child appear detached from class activities?) that can each be scored on a four-point scale ranging from "Not at all" (1) to "Very Much" (4). With these item scores, a total score can range between 12 and 48, where a higher score indicates better attention.

How does it relate to Conner's scale (Conners, 1969; Goyette, Conners, & Ulrich, 1990)? In a previous study, Das, Snyder, and Mishra (1992) compared the ACL to one of Conners' scales, CTRS-R (Goyette, Conners, & Ulrich, 1990), and established a close link between ACL and the Attentive-Passive subscale of CTRS-R; the correlation was 0.86. Subsequent factor analysis with varimax rotation yielded an Inattention-Passivity-ACL factor on which Inattention-Passivity and the ACL had loadings of 0.92 and 0.94, respectively. A negligible loading of 0.23 on the Hyperactive-Conduct Disorder factor established the ACL primarily as a measure of attention. The 12 items of ACL when factor analyzed have strongly loaded only on one factor (see Method section for further description of ACL).

Attention is one of the four cognitive processes in the Planning, Attention-Arousal, Simultaneous, and Successive (PASS) theory of intelligence, which can be described as a modern theory of ability within the information-processing framework (Das, 2003). All four cognitive processes are operationalized in the Das-Naglieri Cognitive Assessment System (CAS), which provides measures in each area of cognitive functioning (Naglieri & Das, 1997).

Several studies have been conducted in order to measure the validity of the CAS as an instrument to detect attention deficits. Reardon and Naglieri (1992) compared males diagnosed with Attention Deficit/Hyperactivity Disorder (ADHD) with males not diagnosed with ADHD. The researchers found significant differences between the two groups of males on measures of attention, planning, and successive processing, with "the greatest deficiency in attention" (p.158). Reardon and Naglieri suggested that the results could be explained by an inability to "attend to relevant stimulus information" and difficulty when

required to "formulate and monitor plans and strategies while inhibiting impulsive behavior" (p.151).

Das, Snyder, and Mishra (1992) examined the relationship between teacher rating scales for attention and performance on objective selective attention tasks (i.e., a paper-and-pencil version of Posner's task, a version of the Stroop task, and an auditory selective attention task). The researchers examined 49 regular Grade 3 and 4 school children and found a "significant association between attention ratings on the one hand and Stroop interference and commission errors in vigilance on the other" (p.37). These writers suggested, "the underlying common cognitive process was resistance to distraction" (p.37).

 Papadopoulos, Das, Kodero, and Solomons (2002) studied the predictive validity of Das's Attention Checklist (ACL) and examined 110 Grade 4 children in regular classrooms. These researchers identified two groups of students based on their score on the ACL. The 15 lowest and 15 highest scores were used to form a group of low-attention participants and a group of high-attention participants, respectively. In their scores on objective tests of attention, mostly from the Cognitive Assessment System, the high-attention participants outperformed the low-attention participants on an Expressive Attention Test (i.e., the Stroop task), Receptive Attention (i.e., Posner's physical and name-matching task), and a Visual Attention task (a slightly different version of the Number Detection task used in the CAS). Also, on an Auditory Attention task, the high-attention participants committed significantly fewer false detections, although no significant difference was found in omissions. The researchers concluded, "low-attention participants had difficulty sustaining attention, persisting with tasks until completion, and resisting distraction" (p.25).

The Present Study: Hypotheses

In the present study, two hypotheses are tested. First, it is expected that high-attention participants, as rated by the ACL, will perform significantly better than low-attention participants on attention measures

in the CAS. Second, in line with Barkley's (1997) distinction between ADD of the inattention (Gray, 1995) type (that is reflected in ACL ratings) and ADD of the hyperactive (Barkley, 1997) type, essentially characterized by an inability to inhibit an on-going or proponent behaviour (as discussed above), we should expect that Planning deficiency will have a weaker association with teacher's rating (ACL) than Attention deficit.

Method

Participants

The participants were 82 Grade 3 and Grade 4 children from a Middle School, in a First Nations Community located in central Alberta, Canada. The sample consisted of 45 girls and 37 boys, divided over three Grade 3 classes and three Grade 4 classes. The mean age for the total group was 9.5 years with a standard deviation of 11 months. There were no significant differences in age between the boys and girls.

Measures

Attention Checklist (ACL.) Various studies (Das et al., 1992; Das & Melnyk, 1989; Papadopoulos et al., 2002) have been conducted on the validity and reliability of the ACL. Results showed a high reliability (Cronbach's alpha ranging between 0.94 and 0.96). As mentioned before, in several studies (Papadopoulos et al., 2002) factor analysis has shown one single factor underlying the 12 items on the ACL (see Appendix for ACL items).

Cognitive Assessment System. Results of two scales from the Cognitive Assessment System (CAS) were used in this study: Planning and Attention. The Planning scale measures an individual's capacity "to develop a plan of action, evaluate the value of the method, monitor its effectiveness, revise or reject a previous plan as the task demands change, and control the impulse to act without careful consideration" (Naglieri, 1999, p.13). The Planning scale evaluates the use of strategies and consists of two subtests: Matching Numbers and Planned Codes.

The Attention scale consists of scales that "demand focused, selective, sustained, and effortful activity (Naglieri, 1999, p.15) and consists of two subtests, Number Detection and Expressive Attention.

Matching Numbers. The subtest Matching Numbers consists of three items of increasing difficulty. Each item contains eight rows and each row contains six numbers with -- depending on the item -- two, four or seven digits. Participants have to underline the two numbers that are similar in each row.

Planned Codes Planned Codes is a subtest that has two items. Each item consists of 56 boxes that are marked with a letter (A, B, C or D). The participants have to code the letters with a code system of Xs and Os (e.g., A=OX, B=XX) that appears at the top of each page. For each item there is a different set of codes and a different arrangement of response locations (Naglieri & Das, 1997, p.19).

Number Detection. The subtest Number Detection in the CAS consists of two items. Each item has fifteen rows of numbers and each row holds twelve numbers. Each row contains an unfixed number of targets and distracters. Targets consist of the numbers 123 or 123456 in a particular font. Distracters have either the same font but a different number, or a different font and the same number. Participants have to underline as many targets as possible in a 90-second time limit. The total score is based on the ratio of the accuracy score (number correct minus false detections) and time in seconds. Two other measures were obtained. The first measure was based on the ratio of the number of omissions of target stimuli and the number of attempted rows collapsed over the two items. The second measure was based on the number of false detections and the number of attempted rows collapsed over the two items. Participants were requested to stop when the time limit was over, even if they were working in the middle of a row. Omissions and false detections were counted until the last underlined number in a row.

Expressive Attention. The subtest Expressive Attention in the CAS is a version of the Stroop task. The subtest consists of three stimulus pages.

Each page contains eight rows, and each row has five stimuli. The first page requires the child to read 50 color words (i.e., red, green, blue, and yellow). The second page requires the child to name the color of colored rectangles using the same four colors used on page one. The third page again contains color words, but each word is printed in an ink color different from the color it names (i.e., the word red is printed in green ink). The participants had "to identify the color [of the] ink in which color words are printed rather than to read the words" (Naglieri & Das, 1997, p. 51). The total score was based on the number of correctly identified ink colors and the time in seconds. The number of errors and self-corrections in all rows on page three, the color-word interference, was obtained for additional measures. An "error" was defined as an omission or a false detection. A "self-correction" was defined as an initial error that was scored correctly after a spontaneous correction by the participant, without a prompt from the examiner.

Procedures

The CAS was administered to all participants in combination with six selected subtests from various reading achievement tests, although we are considering only the results of the Attention and Planning Scales that are relevant for the present paper. Testing occurred in an individual setting in approximately 1 hour and 20 minutes. Most children were tested in one session. Six different teachers rated their students on inattention twice, in December and in February. The scores on both ratings were averaged and used for further analysis. For 6 cases (out of 82), only one rating (in December) was available and used for analyses. From the distribution of teacher ratings on the ACL two subgroups were formed. The first group, the low-attention participants, formed the first quartile in the ACL distribution and consisted of 20 students. The second group, the high-attention participants, formed the fourth quartile in the ACL distribution and consisted of 19 students (see Table 2). The students making up the second and third quartile were excluded from further analysis in this study.

Table 1
Attention Checklist Sample Size, Means, Standard Deviations, and First and Fourth Quartile per Grade and Gender

Gender	N	ACL scores		Quartiles	
		M	SD	First	Fourth
F	45	38.59	6.58	35	43.75
M	37	33.16	7.87	26.5	39.25
Both	82	36.14	7.64	31.75	41.88
		ACL scores		Quartiles	
Grades	N	M	SD	First	Fourth
3	39	34.87	6.87	29.75	40.63
4	43	37.08	8.17	34.75	43.13

Results

Sample Characteristics

Attention Checklist A correlation between the December and February administrations was calculated to check the test-retest reliability of the ACL as a teacher-rating instrument in this sample. The correlation was $r = .85$, $p < .001$. The effects of gender and grade were also investigated. The mean ACL scores, standard deviations and quartiles are reported in Table 1. An independent t-test of the mean scores showed a significant gender effect, t (81) = 3.40, $p < .001$, and a non-significant grade effect. The results were consistent with those obtained by Papadopoulos, Das, Kodero, & Solomons (2002), who found that "girls were more attentive than boys as rated by teachers using the ACL" (p. 22).

Measures of Attention Product-moment correlations were computed between the ACL and the two scales in the CAS (sample size = 82). Significant positive correlations were found between ACL and scores for Planning, r = .31, d = .65; ACL and Attention, r = .29, d = .61; and within the Attention Scale, ACL and the subtest Number Detection, r = .34, d = .72. Subsequently, significant negative correlations were found

between the ACL and the Number of Omissions in Number Detection, r = -.27, d = .56; and between the ACL and Errors in Expressive Attention, r = -.37, d = .80. The negative direction is expected for omissions and error scores. All of the above correlations, in terms of Effect Size, may be categorized as moderate.

The magnitudes of these correlations are likely underestimates and could be higher if we argue that the range of scores is restricted as the means and standard deviations show: Planning *M* = 88.04 (*SD* = 11.21); Attention *M* = 93.95 (*SD* = 12.14). Nevertheless, the point we make is that these correlations between ACL ratings and specific components of tests in the Attention Scale are in many ways consistent with previously reported correlations (Papadopoulos et al., 2002).

Group Differences

A group of low-attention participants (the first quartile of the ACL distribution) and a group of high-attention participants (the fourth quartile of the ACL distribution) were formed (see Table 1), as mentioned earlier. The participants with a score below or at a rating of 31 (maximum 48) were included in the group of low-attention participants. Participants with a score at or above 42 (maximum 48) were included in the group of high-attention participants. As expected, the group of high-attention participants contained more girls than the group of low-attention participants. Some characteristics on the Attention Checklist of both groups of participants are shown in Table 2.

Table 2
Differences between high- and low-attention participants on the Attention Checklist

Group	N	Females	Males	M	SD
Low-attention Participants	20	8	12	25.03	4.45
High-attention Participants	19	17	3	44.7	1.77

Next, independent t-tests were conducted on the CAS and other objective measures of attention (see Table 3). Significant differences between low- and high-attention participants were found on the Attention Scale, *t* (37) = 2.46, *p* < .05, and not on Planning.

Table 3
Means, standard deviations, and t-tests on measures of Planning and Attention for the low-attention and high-attention participants

| | Attention Group | | | | | |
| | Low-attention | | High-attention | | | |
Measures	M	SD	M	SD	t	d
Planning	84.65	12.32	90.85	9.77	1.76	.57
Attention	90.84	10.19	98.65	9.61	2.46*	.81
Number Detection	7.80	3.09	9.9	2.99	2.19*	.72
False Detections	.45	.89	.2829	.7684	-.63	.21
Omissions	.89	.70	.65	.60	-1.12	.37
Expressive Attention	9.06	2.41	9.1	2.15	.06	.02
Errors	2.41	1.70	.95	1.13	-3.08**	1.01
Self Corrections	2.00	1.58	2.22	2.29	.33	.11

Note. * *p* < .05; ** *p* <0.01

This is consistent with previous research. Significant differences between low- and high-attention participants were also found in Number Detection, *t* (38) = 2.19, *p* < .05, where the high-attention participants outperformed the low-attention participants. The Effect Size statistic confirms this as well. Although the high-attention participants committed fewer false detections and omissions, the variance of the small number of false detections and omissions within the groups was too high and no significant difference could be found between the

groups. Unexpectedly, no difference was found between the high- and low-attention participants in this sample on the Expressive Attention interference score. But on another performance score, the number of errors, the high-attention participants committed significantly fewer errors than the low-attention participants: t (34) = 3.08, p < .05. The effect size statistic confirms the above. Thus, these group differences are in line with the correlations reported above.

Is the sample of Native children typically more inattentive as measured by ACL and by CAS compared to previously reported norms obtained from non-Native children in regular schools? We do not think so. On ACL, the Native children have a mean of 36.14, *SD* of 7.64. Comparable mean and *SD* reported on a similar age group of typical students are *M* = 35.40, *SD* = 8.52 (Papadopoulos et al., 2002). However, on the CAS, the Native children were lower.

Discussion

In this study, two hypotheses were tested. First, it was expected that the high-attention participants, as rated by the ACL, would perform significantly better than the low-attention participants on measures of attention on the CAS. The results confirmed that, for the First Nations children who participated in this study, there was a significant correlation between the ACL and the Attention scale on the CAS, as well as the subtest Number Detection. The exception was the interference score of the other Attention subtest: there was no significant correlation between the ACL and the interference score of the subtest Expressive Attention. This finding was unexpected since previous results (Das et al., 1992; Papadopoulos et al., 2002) showed that group differences on the ACL were reflected in the Color-Word Interference Score, on which high-attention participants outperformed low attention participants, and that "teacher ratings [reflected] behaviour that commonly [was] represented by the interference score" (Das et al., 1992, p.44). However, other attributes in the Expressive Attention task did show significant differences between the groups. The high-attention participants made significantly fewer errors on the Expressive Attention (Stroop Test) than the low-attention participants. Performance on Expressive Attention is

determined by time and number of errors. The result suggests that low-attention participants work as quickly as high-attention participants although they commit more errors.

Second, it was expected that the participants who had high ratings on the ACL would commit fewer omissions and fewer false detections on the Expressive Attention and Number Detection tasks on the CAS. Significant group differences did occur in Expressive Attention, where false detections and omissions were collapsed. Significant differences between low- and high-attention participants were also found in Number Detection score, which reflected both omissions and false detections. In the future, larger samples might demonstrate differences in inhibition of response as measured by false detections in a variety of Attention tasks that include auditory selective attention tests as in previous studies (Das, 2002; Papadopoulos et al., 2002) between the high- and low-attention participants. A more refined statistic, d prime, could be used to examine the contribution of false detection as a measure of "disinhibition," given a larger sample size and a greater number of test items.

Planning deficit was predicted to have a weaker association with teacher's rating (ACL) in comparison with poor performance on the Attention scale. This hypothesis has been essentially supported by our results. However, we should be aware of the lingering equivocality regarding a complete separation of the two categories, the Inattentive and the Hyperactive types, as presented in the introduction. Add to this the imperfect association between Planning in the CAS and "behavioral inhibition," conceptualized by Barkley. Planning, as a concept, subsumes much more than behavioral inhibition; right objectives and goals that guide cognitive components of Planful behavior such as right representation, anticipation, monitoring feedback and finally execution of the response (Das, Kar, & Parrila, 1996). Conceptually, then, inability to engage in behavioral inhibition is an important albeit small part of Planning. Assessment of comprehensive planning is a daunting task, and we do not pretend to have been entirely successful in doing this in CAS. Perhaps a rating scale for Planning, if constructed, should include the

above planning components and will be able to predict Planning performance in an improved Planning scale. Are the teachers rating the students inadvertently on general intelligence? That is, even if none of the 12 questions in ACL refer to generally intelligent behavior, is it possible to discount the main findings of the study on attention rating merely as a covert rating on general intelligence? We think one should not doubt that the teachers understood the purpose of the questionnaire given the preamble to the questionnaire that described what attention is. We will only say, "No, not likely," and cite one of the empirical results in our earlier paper on the present topic (Das et al., 1992).

As noted, on an Auditory Attention task, the high-attention participants committed significantly fewer false detections, although no significant difference was found in omissions. A general intelligence difference would not be specific enough to anticipate that. Additionally, consider if general intelligence differences can explain the result of the present study: Attention Rating had a stronger correlation with Attention than the Planning subtest of CAS.

The results clearly show that Native children were not unusually low in either Attention or Planning according to published norms (Naglieri & Das, 1997). Whether or not a subgroup of the present sample could be diagnosed as exhibiting ADHD was not within the constraints and capabilities of the present research design.

Overall, as in previous studies on non-Native children, both the Attention Checklist and the CAS Attention scale were found to be valuable instruments for measuring attention in First Nations children as they have been for typical school children in non-Native schools. Their use along with CAS Planning tests is recommended in investigations into attention disorders among both Native and non-Native children.

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Author Note

Appendix
Attention Checklist Items

	Not at all	Just a little	Pretty much	Very much
1. Does the child have a short attention span?				
2. Does the child appear detached from class activities?				
3. Does the child accurately heed directions?				
4. Does the child daydream in class?				
5. Does the child have trouble concentrating?				
6. Does the child stay with one activity long enough to complete it?				
7. Does the child work independently?				
8. Is the child easily distracted?				
9. Is the child able to concentrate on a task until completed?				
10. Does the child listen attentively?				
11. Does the child become easily engrossed in an activity?				
12. Does the child disregard some or all directions?				