WISC-IV GAI and CPI in Psychoeducational Assessment

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Abstract

The General Ability Index (GAI) and Cognitive Proficiency Index (CPI) are two index scores that can be calculated for the Wechsler Intelligence Scale for Children–Fourth Canadian Edition ((WISC-IV^{CDN}). The GAI comprises the verbal comprehension and perceptual reasoning subtests and reflects reasoning abilities. The CPI includes the working memory and processing-speed subtests that are more focused on the proficiency and efficiency of cognitive processing. This article presents GAI and CPI patterns observed in several small samples of referred children and includes three brief case examples of how the scores can provide another lens for analyzing children's abilities with the WISC-IV^{CDN}.

Résumé

L'indice d'aptitude général (IAG) et l'indice de compétence cognitive (ICC) sont deux types de calculs alternatifs au quotient intellectuel total (QIT) du WISC-IV^{CDN}). L'IAG se compose des sous-épreuves de la comprehension verbale et du raisonnement perceptif, et reflète les habiletés de raisonnement. L'ICC se compose des sous-épreuves de la mémoire temporaire de travail et de la vitesse de traitement de l'information. Cet indice reflète la compétence et l'efficacité du traitement cognitif et fournit un autre point de vue objectif pour analyser les capacités des enfants évaluées par le WISC-IV. Cet article présente des patrons du IAG et du ICC observés dans des petites populations cliniques et inclu trois brefs exemples, en format d'étude de

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cas, qui démontrent comment les scores de ceux-ci peuvent fournir une autre façon d'analyser les habiletés des enfants en se servant du WISC-IV^{CDN}.

Keywords

WISC-IV, Wechsler Intelligence Tests, General Ability Index, Cognitive Proficiency Index, index scores, clinical populations

The Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2003, 2004) is among the most widely used tests to assess the cognitive abilities of children aged 6 to 16 years. The four index scores consisting of Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI), and Processing Speed Index (PSI) along with the Full-Scale IQ (FSIQ) are recognized as the basis for clinical interpretation of the WISC-IV. The General Ability Index (GAI) and Cognitive Proficiency Index (CPI) are two further composite scores that may have potential clinical relevance in the assessment of and treatment planning for children referred for psychoeducational difficulties (Prifitera, Saklofske, & Weiss, 2008; Saklofske, Zhu, Coalson, Raiford, & Weiss, 2010). The GAI is a composite score derived from the VCI and the PRI subtests that reflects reasoning abilities. The CPI is comprised of the WMI and the PSI subtests and summarizes cognitive efficiency and proficiency. However, there is still a paucity of clinically relevant research regarding application of the GAI and CPI. This article provides a brief overview of the GAI and CPI followed by data and case studies derived from several samples of referred children who were administered the WISC-IV^{CDN}.

The GAI was first described for use with the Wechsler Intelligence Scale for Children-Third Edition (WISC-III; Wechsler, 1991) by Prifitera, Weiss, and Saklofske (1998), and then for the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III; Wechsler, 1997) by Tulsky, Saklofske, Wilkins, and Weiss (2001). The GAI is a broad measure of cognitive ability that correlates highly with the FSIQ but is less sensitive to the basic cognitive processes measured by the WMI and PSI (Raiford, Weiss, Rolfhus, & Coalson, 2005; Tulsky et al., 2001; Weiss, Saklofske, Coalson, & Raiford, 2010). The subtests from the VCI and PRI are most associated with both crystallized and fluid intelligence in contrast to the subtests from the WMI and PSI (Harrison, DeLisle, & Parker, 2008; Raiford et al., 2005). The GAI was originally developed for use in ability–achievement discrepancy analysis when assessing children for learning disorders (LDs; Prifitera et al., 1998). LDs may impact cognitive processing abilities that, in turn, can lower FSIQ and may reduce the amount of discrepancy between FSIQ and academic achievement, thereby limiting access of children with LDs to intervention services (Saklofske et al., 2005). Recent trends toward using the Wechsler tests in the service of diagnostic assessment does not negate the potential value of the GAI that can provide yet another lens for examining the cognitive competencies of children referred for LD and other psychoeducational assessment. The GAI calculated for the WISC-IV^{CDN} has excellent psychometric properties with reliability coefficients ranging from .94 to .97 in the Canadian normative sample (Saklofske et al., 2005).

Dumont and Willis (2001) earlier proposed a further composite score that was renamed the CPI (Weiss, Saklofske, Schwartz, Prifitera, & Courville, 2006) for use with the WISC-IV and more recently for the WAIS-IV (Wechsler, 2008) described by Weiss et al. (2010). The CPI is a measure of how efficiently one is able to process cognitive information and may be considered as an overall indication of neurological efficiency (Weiss & Gabel, 2006). Examining the CPI separately from the GAI may provide school and clinical psychologists with valuable information because efficient processing facilitates fluid reasoning by reducing the cognitive demands required when learning new material (Berninger, O'Donnell, & Holdnack, 2008; Johnson, Humphrey, Mellard, Woods, & Swanson, 2010; Weiss et al., 2006). Specifically, working memory facilitates reasoning and problem-solving abilities, allows for the integration of newly learned information with previously learned information, and helps an individual attend to what he or she is doing (Alloway, 2006; Swanson & Saez, 2003). Slow processing requires more mental effort, making tasks more time consuming and mentally exhausting, and therefore, more difficult (Weiss et al., 2010; Weiss, Saklofske, & Prifitera, 2005). Thus, both working memory and processing speed interact with other higher-order cognitive functions to influence everyday reasoning and learning (Fry & Hale, 2000; Weiss et al., 2010, 2005). The WISC-IV^{CDN} CPI also has excellent psychometric properties with reliability coefficients for the Canadian norming sample ranging from .92 to .94 (Saklofske et al., 2010).

Neither the GAI nor the CPI has been thoroughly researched in relation to assessing and diagnosing various childhood exceptionalities. Some studies suggest that the GAI is useful for understanding cognitive abilities in individuals with more neurocognitive-based disorders, such as LDs and attention-deficit hyperactivity disorder (ADHD), because it parcels out the influence of working memory and processing speed (Longman, 2004). Harrison and colleagues compared GAI and FSIQ scores in adults with neurocognitive disorders (e.g., LDs, ADHD, traumatic brain injury) to those with more psychologically based disorders (e.g., depression, anxiety). Individuals with neurocognitive disorders performed lower on the WMI and PSI in contrast to the GAI, which was always equal to or greater than the FSIQ. They concluded that, when used in an empirically supported manner, comparing the GAI to the FSIQ may provide further evidence that there is a neurologically based impairment in individuals that may be underlying an individual's underachievement (Harrison et al., 2008). These findings are consistent with other studies that found that processing deficits tend to pull down FSIQ scores in children and adults with LDs and ADHD (Calhoun & Mayes, 2005; Harrison et al., 2008; Schwean & McCrimmon, 2008; Weiss & Gable, 2008; Weiss et al., 2006).

The pattern of GAI and CPI scores has also been shown to change in relation to overall intellectual ability reflected by the FSIQ. In particular, research has suggested that intellectually gifted children tend to score higher on the subtests that make up the GAI and slightly lower on the subtests that comprise the CPI (Newman, Sparrow, & Pfeiffer, 2008; Saklofske et al., 2005; Wechsler, 2004). Children who are intellectually gifted may obtain lower CPI scores because they exert less effort on these more cognitively simple tasks (National Association for Gifted Children, 2008). In addition,

Table 1. Demographic Information by Diagnostic Group

		Sex		Age		Grade	
	N	Male (%)	Female (%)	*M*	*SD*	*M*	*SD*
ADHD-C	29	22 (75.9)	7 (24.1)	10.0	3.0	4.0	3.0
ADHD-I	22	14 (63.6)	8 (36.4)	9.00	2.68	4.0	2.34
LD	43	27 (62.8)	16 (37.2)	12.04	2.56	6.79	2.64
BIF	29	20 (66.7)	10 (33.3)	10.34	2.79	4.74	2.86
MMR	15	10 (66.7)	5 (33.3)	10.53	2.33	4.71	2.59
HIA	17	12 (70.6)	5 (29.4)	11.0	1.84	5.5	1.81

Note: ADHD-C = attention-deficit hyperactivity disorder, combined type; ADHD-I = attention-deficit hyperactivity disorder, predominantly inattentive type; LD = learning disorder; BIF = borderline intellectual functioning; MMR = mild mental retardation; HIA = high intellectual ability.

children with reflective cognitive styles or perfectionist tendencies may score lower on timed tasks, such as the subtests within the PSI (Newman et al., 2008). Conversely, children with lower intellectual abilities tend to show the opposite pattern (Wechsler, 2003).

The present study offers a preliminary examination of the WISC-IV^{CDN} GAI and the CPI in a clinic-referred sample of Canadian children. It was expected that children with ADHD and LDs would have GAI scores significantly greater than CPI scores because of the processing deficits commonly associated with these disorders. Second, it was also suggested that children with above-average intelligence would have GAI scores greater than CPI scores. Finally, it was hypothesized that those with below-average intelligence would have lower GAI than CPI scores due to greater deficits with reasoning than processing information. In addition, three case studies will be presented to illustrate how interpretation of the GAI and CPI can aid in developing intervention strategies in the classroom.

Method

Participants

Data were collected from two university-based psychoeducational clinics and a school board in western Canada. All children were referred for psychoeducational assessment, and the cases included here were those resulting in a diagnosis of LD, ADHD, combined type (ADHD-C); ADHD, predominantly inattentive type (ADHD-I); borderline intellectual functioning (BIF); and mild mental retardation (MMR) following criteria from the *Diagnostic and Statistical Manual of Mental Disorders*—4th edition, Text Revision (*DSM-IV-TR*; American Psychiatric Association, 2000). Children with FSIQ or GAI scores greater than or equal to 120 were classified as having higher

Table 2. WISC-IV^{CDN} GAI-CPI Difference for Children With Various Clinical Diagnoses

	N	FSIQ $\bar{X}$ (*SD*)	GAI $\bar{X}$ (*SD*)	CPI $\bar{X}$ (*SD*)	GAI-CPI	BR
ADHD-C	29	95.96 (12.07)	98.45 (12.10)	92.66 (12.80)	5.79	35.7
ADHD-I	22	95.15 (10.78)	97.73 (14.37)	88.77 (11.77)	8.96*	26.8
LD	43	90.73 (7.60)	94.91 (9.05)	87.09 (11.09)	7.82*	31.4
BIF	29	76.76 (3.64)	76.51 (5.86)	79.71 (7.29)	−3.20	45.5
MMR	15	64.21 (4.15)	60.67 (6.01)	70.07 (9.22)	−9.4*	26.5
HIA	17	122.47 (6.00)	127.29 (8.00)	111.29 (10.12)	16.00**	12.5

Note: ADHD-C = attention-deficit hyperactivity disorder, combined type; ADHD-I = attention-deficit hyperactivity disorder, predominantly inattentive type; LD = learning disorder; BIF = borderline intellectual functioning; MMR = mild mental retardation; HIA = high intellectual ability. FSIQ = full-scale IQ; GAI = General Ability Index; CPI = Cognitive Proficiency Index; BR = base rate; WISC-IV^{CDN} = Wechsler Intelligence Scale for Children- Fourth Canadian Edition.
*$p < .05$. **$p < .01$.

intellectual abilities. Descriptive information regarding sex, age, and grade for each of the diagnostic groups included in this study is presented in Table 1.

Procedure

The GAI and CPI standard scores were calculated for each participant based on the criteria and tables outlined by Saklofske et al. (2010, 2005) using WISC-IV^{CDN} norms. The mean difference between the GAI and the CPI was calculated for each clinical group and examined for statistical significance. Specifically, a difference of 7.42 is significant at the .15 level and a difference of 10.09 is significant at the .05 level (Saklofske et al., 2010). In addition, base rates were obtained from previously published tables (Saklofske et al., 2010) to determine how common the difference between the GAI and the CPI scores is in the general population.

Results

The mean and standard deviations for FSIQ, GAI, and CPI standard scores, as well as base rates for the difference between the GAI and the CPI for each of the clinical groups, are presented in Table 2.

Table 3. WISC-IV^{CDN} index scores for Jason

FSIQ	GAI	CPI	VCI	PRI	WMI	PSI
100	119	75	110	122	77	80

Note: FSIQ = full-scale IQ; GAI = General Ability Index; CPI = Cognitive Proficiency Index; VCI = Verbal Comprehension Index; PRI = Perceptual Reasoning Index; WMI = Working Memory Index; PSI = Processing Speed Index; WISC-IV^{CDN} = Wechsler Intelligence Scale for Children–Fourth Canadian Edition.

Discussion

The results from these samples of clinic-referred children are generally consistent with the GAI–CPI patterns found in previous research reported above. Children with LDs and higher intellectual abilities have GAI scores that tend to be higher than CPI scores. Differences were seen in children with ADHD-I but not those with ADHD-C. There was no statistically significant difference between GAI and CPI for children with BIF; however, the GAI was significantly less than the CPI for children with MMR. It should be noted that not all children with these clinical disorders will demonstrate the same pattern of scores. In addition, with the exception of the high-ability sample, the base-rate data do not show that the differences between GAI and CPI scores are especially uncommon. However, what is most important for school psychologists is to understand how these scores can be useful clinically. To follow are three brief cases studies indicating how psychologists might use the GAI and the CPI in understanding the cognitive abilities of referred children.

Case Study: Jason

Jason is a 7-year-old boy in Grade 3 who was referred for a psychoeducational assessment to determine whether he met criteria for a gifted education program as well as to examine his emotional functioning. It was determined that Jason was experiencing difficulty managing mood and emotions that would require further assessment. Jason was performing above grade level in reading and writing and at grade level in mathematics. However, he seldom completed math problems or other tasks under timed conditions. On the WISC-IV, Jason's pattern of scores suggested that his reasoning abilities were high while his cognitive efficiency was low (see Table 3).

It is likely that Jason's high abstract reasoning abilities are compensating for his poor cognitive efficiency, reflecting both low processing speed and working memory. Jason may encounter difficulties in the future as academic tasks become more demanding and on tasks with added time constraints. Recommendations surrounding Jason's weaknesses in cognitive efficiency include: provide more time to complete tests and assignments, emphasize the quality of his work over the quantity, use visual cues and mnemonic devices to facilitate memory and retrieval, teach visualization and rehearsing strategies, provide step-by-step instructions for complex tasks, and break down tasks so they can be completed in smaller parts. Finally, due to Jason's high reasoning

Table 4. WISC-IV^{CDN} Index Scores for Susie

FSIQ	GAI	CPI	VCI	PRI	WMI	PSI
81	72	95	75	78	94	97

Note: See note to Table 3 for acronyms and their expansions.

abilities it is important that he remain challenged in the classroom; therefore, he may benefit from enrichment activities, taking the above suggestions into consideration.

Case Study: Susie

Susie is a 10-year-old girl in Grade 4 who was referred for a psychoeducational assessment because of her underachievement across the academic curriculum. Her teachers noted that she has an understanding of basic concepts in most subject areas but that she has difficulty applying this knowledge. When tested, Susie did not seem to be performing significantly below her peers, but her teachers feel that she sometimes misses the concept or purpose of an assignment. On the WISC-IV^{CDN}, Susie's pattern of scores demonstrated that her reasoning abilities are in the borderline range, but her cognitive efficiency is average (see Table 4).

Although it may appear that Susie is following along and keeping up with the rest of the class, it is important for her teachers to recognize that her comprehension and application of both new and previously presented material may be impeded by difficulties she experiences with reasoning and problem solving. Recommendations for Susie include activate prior knowledge of a topic, regularly review what has been learned, keep language simple and to the point, provide definitions for all new terms and concepts before teaching, use demonstrations and modeling to teach concepts/procedures, and use assessment methods with reduced demand on verbal output (e.g., true/false, multiple choice, short answer). Whenever possible, problem-solving techniques should occur in the contexts in which they are most likely to be applied.

Case Study: John

John is a 12-year-old boy in Grade 6 who was referred for a psychoeducational assessment because of increasing concerns about his progress in the regular classroom. John's family had moved frequently when he was young, and his teachers often assumed that he would soon catch up to his peers academically. However, he has continued to struggle despite receiving additional instruction and support. On the WISC-IV, John's FSIQ is in the low-average range; however, there is a significant difference between his GAI and CPI. Specifically, his GAI is in the average range and his CPI is in the extremely low range (see Table 5).

Table 5. WISC-IV^{CDN} Index Scores for Jason

FSIQ	GAI	CPI	VCI	PRI	WMI	PSI
84	99	66	93	107	62	78

Note: See note to Table 3 for acronyms and their expansions.

Further achievement testing revealed that John is performing in the extremely low to borderline range in reading and writing. Given the results of the full assessment, John meets diagnostic criteria for a reading disorder and a disorder of written expression. Although underachievement may be due to insufficient instruction, the difference between the GAI and the CPI provides one further piece of evidence that there is an underlying processing problem that may be contributing to the difficulties he is experiencing in the classroom. Simply increasing the amount of instruction is not the best way to support him. Recommendations to support John in reading and writing include the following: provide a reader or scribe for tests and assignments, ensure that John has time to process the information before questioning him, cue him to the types of information he should be paying attention to while reading, increase his sight word vocabulary, and provide graphical organizers to aid him in his writing.

Conclusion

The GAI and the CPI can potentially provide an additional level of interpretation for the WISC-IV by allowing the clinician to examine reasoning abilities separately from processing abilities. Examination of these scores may further assist the clinician's understanding of a child's intellectual functioning and, in turn, add information relevant to providing the most appropriate supports. Specifically, comparing the GAI and the CPI to each other and, in turn, to other key achievement and memory data as part of the psychoeducational assessment process may yield additional insight into a student's cognitive strengths and weaknesses (Prifitera et al., 2008).

Whereas further empirical data and research are required to determine more specifically the clinical utility of the GAI and the CPI, there is at least some preliminary support for employing these composite scores in the diagnostic assessment process where the WISC-IV is administered to assess cognitive abilities. Whether a priori or a posteriori hypothesis testing is applied to understanding a child's psychological and educational needs, examining the GAI and the CPI at the very least has heuristic value. This article, together with the previously published tables and psychometric indices for the WISC-IV^{CDN} GAI (Saklofske et al. 2005) and CPI (Saklofske et al. 2010), will hopefully prove useful to practicing psychologists engaged in the complexities of psychoeducational assessment.

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