

Equivalence of Remote, Online Administration and Traditional, Face-to-Face Administration of Woodcock-Johnson IV Cognitive and Achievement Tests

A. Jordan Wright, Ph.D., ABAP

Abstract

Many children in need do not receive the mental health services they require. This is true with psychoeducational services in schools, where a shortage of school psychologists has been identified. An estimated 15% of all students struggle with attentional or learning difficulties that are unassessed and unaddressed, largely due to problems with access to psychoeducational evaluations. Remote, online psychoeducational evaluations have the potential to decrease this access problem by assisting school psychologists with their evaluation workload. The present study evaluated the equivalence of a remote, online administration procedure for the Woodcock-Johnson IV cognitive and achievement tests with traditional, in-person administration. Results revealed no significant differences between the scores on any index or individual test between the administration procedures. The remote, online procedure is a viable alternative for the traditional, in-person administration of the WJ IV, having the potential to improve psychoeducational evaluation access for many students across the country.

Introduction

There is a worldwide treatment gap for children and adolescents with mental health needs (Kieling et al., 2011; Patel, Kieling, Maulik, & Divan, 2013). Some have found that fewer than a quarter of all children with mental health disorders are appropriately identified as being in specific psychological need (Jensen et al., 2011). While in general mental health needs are high and largely unmet, about 8% of all U.S. public school students have been identified as having a learning disability (National Survey of Children's Health, 2012), with an additional 15% of all students struggling with learning and attention problems and needs that are unidentified, unaddressed, and unmet (Cortiella & Horowitz, 2014). While there are many barriers to children receiving assessment and treatment for mental health and learning needs, one important reason is problems with access to appropriate services. Rural areas often have fewer school psychologists available to provide services, and suburban and urban areas struggle to meet the demand for assessment and treatment services in schools in timely ways, if at all (Clopton & Knesting, 2006; Myers, Vander Stoep, Mccarty, Klein, Palmer, Geyer, & Melzer, 2010). Children of color may be especially vulnerable to not receiving adequate psychoeducational services (Morgan, Farkas, Hillemeier, & Maczuga, 2012; Morgan, Farkas, Hillemeier, Mattison, Maczuga, Li, & Cook, 2015), for multiple theorized reasons, including less general access to healthcare (Flores, 2010; Inkelas, Raghavan, Larson, Kuo, & Ortega, 2007) and fewer triggers for evaluations for children

in need in disadvantaged schools, among a greater number of underperforming students (Delpit, 1995; Hibel, Farkas, & Morgan, 2010). School psychologists in these schools simply cannot evaluate every student who needs an evaluation.

Nationally, there has been an identified shortage of school psychologists, with rural areas being particularly affected (Castillo, Curtis, & Tan, 2014; Fagan, 2004; Gadke, Valley-Gray, & Rossen, 2016). Nationally, school psychologists, who spend the overwhelming majority of their time doing psychoeducational testing and related services (Curtis, Chesno-Grier, Abshier, Sutton, & Hunley, 2002; Reschly, 2000), carry over twice the caseload recommended by the National Association of School Psychologists (2010). High caseloads have been linked not only to delay or shortage in actual psychoeducational services, but also to burnout and school psychologists leaving the field, reinforcing the shortage (Salyers, Bonfils, Luther, Firmin, White, Adams, & Rollins, 2017). There has been a specific call to make sure that, somehow, assessment services provided in schools continue to be comprehensive, widely available, and even more utilized, despite ongoing and likely future shortages of school psychologists providing them (Cummings, Harrison, Dawson, Short, Gorin, & Palomares, 2004).

Some have argued that, in general, internet-based testing is ideal, in part because of some advantages like precise recording of responses and reduced cost for materials, but largely because it has potential for much wider access to assessment services (Barak, 1999). In fact, online mental health services in general have been lauded for overcoming practical access constraints, such as distance from services and timing problems related to employment, child care, and health problems (Barak, 1999; Berends, Gardiner, Norman, Devaney, Ritter, & Clemons, 2004; Young, 2005). The ability for multiple providers to be involved in a single location at the same time (rather than, for example, a single school psychologist, who can only see one child at a time) also improves accessibility of online mental health services (Beattie, Cunningham, Jones, & Zelenko, 2006; Chester & Glass, 2006; Cunningham, Humphreys, & Koski-Jannes, 2000; Etter & Etter, 2006; Young, 2005). Specifically, internet-based and videoconferencing assessment services are used globally with children and youth (Boydell, Hodgins, Pignatiello, Teshima, Edwards, & Willis, 2014; Lingely-Pottie & McGrath, 2006; Reed, McLaughlin, & Milholland, 2000) to fill in gaps in access in areas with greater demand than local service providers are able to meet (Boydell, Hodgins, Pignatiello, Teshima, Edwards, & Willis, 2014; Cruz, Krupinski, Lopez, & Weinstein, 2005; Elford et al., 2000; Meyers, Valentine, & Melzer, 2007; 2008; Pesamaa et al., 2004; 2007).

Remote, online administration of cognitive and academic achievement tests has the potential to increase access to these services for many children and students (as well as adults). However, there are certainly methodological challenges for actual clinical work, and it must be explicitly determined whether an online, remote administration yields equivalent results as a traditional, in-person administration. With remote, online administration, the examinee sits in a secure location with a computer and a proctor overseeing and assisting in the process. The examiner sits at her or his own computer in a secure location. The stimulus materials are largely built into an online system (with the exception of manipulatives and response booklets), so that the examiner does not have to use traditional manuals or stimulus books. Two cameras allow the examiner to see the face and hands/workspace of the examinee, and the examinee can see the face of the examiner, in addition to stimulus materials, on the screen. Tests that require a response booklet are administered in the same way as the traditional, in-person administration, directly into the response booklet, which has a camera specifically trained on it so the examiner can see what is being written.

In theory, several factors could contribute to differences between traditional, in-person administration and online, remote administration of cognitive and achievement tests. From more obvious differences, such as experiencing and interacting with the stimuli differently in the two formats, to more subtle ones, such as influences of not having the examiner there in person, or of having a proctor overseeing the examinee for the duration of the test and interacting with both the examiner and the examinee, administering tests via an online platform introduces multiple potential factors that could affect examinee performance. Specific steps need to be taken in developing a remote, online protocol for administration of the tests, in order to minimize, as much as possible, the difference in experience between the online, remote administration and traditional, in-person administration. Some modifications to administration prompts, careful consideration of placement of stimulus material on the screen, and careful use of the proctor at specific moments in administration, for example, may need to be utilized. This new protocol needs to be standardized, manualized, and adhered to, just as examiners adhere to standardized administration procedures in the traditional test manual.

Present Study

The present study aims to evaluate the equivalence of two administration procedures of the Woodcock-Johnson IV (WJ IV) cognitive and achievement tests; the traditional, standardized, in-person administration and remote, online administration. The equivalence of the scatter of scores captured by remote, online administration and traditional, in-person administration is evaluated. The goal was to evaluate both cluster and individual test standard scores, to determine if the scores are interchangeable in the two formats, to determine if the current normative and psychometric information can be applied to both administration formats. It must be noted that this study evaluated a very specific set of protocols for delivering remote, online administration of the Woodcock-Johnson IV tests, as described in Wright (2016). The generalizability of any findings should be limited to trained test administrators who follow the specific protocol examined, including specific digital platform requirements, examiner training, and use of a trained in-person proctor.

Method

Equivalence Study Design. For the present study, a case control match design was utilized, in which examinees took the WJ IV tests (both cognitive and achievement) in only one format (traditional, in-person or remote, online). While a matched design requires a larger sample, it avoids testing effects of test-retest or alternate forms designs. That is, when an examinee answers either the same type of problem or the exact problem more than once, learning may have occurred (of the problem solving strategy, or the content) that can alter the performance the second time. The case control match design creates two groups that are matched on specific variables/characteristics (in this case age and gender), each group receiving only one format of test administration, as would be the case in clinical practice. Therefore, two groups equal in number, matched on age and gender, were created, with examinees randomly assigned to one of the two groups. The *Cognitive Abilities Test* (CogAT) was administered in the same way (traditional, standardized, in-person administration) to all participants as a manipulation check, to ensure equivalence of the two randomly assigned groups.

Participants. The sample consisted of 240 children, ages 5 to 16, who were recruited between January and May 2016 in multiple states across the country. Participants were recruited

from schools with demographic characteristics similar to a general school population and were not specifically screened for any specific disorders (intellectual, learning, or otherwise), in order to maintain generalizability to the general population. There were no participants with specific hearing, vision, or physical impairments in the present study. Case control matching (on age and gender) was used for the WJ IV equivalence study. Participants were randomly assigned to either remote, online administration or traditional, in-person administration of the WJ IV, with equal numbers in each cell by age and gender (see Table 1). All examinees were paid between \$25 and \$50 (depending on location) for their participation in the study.

Table 1 reports demographic characteristics of the sample. The subgroups taking the WJ IV with standard or remote administration were very similar. Overall, there was equal representation of males and females. Latino and Native American children were slightly overrepresented compared with the general population, while Black, White, and Asian children were slightly underrepresented compared with the general population.

Table 1

Demographic Characteristics of the WJ IV Sample

Demographic Characteristic		Administration Format			
		Traditional, In-Person		Remote, Online	
		Number of Cases			
		120		120	
		Male	Female	Male	Female
Age (years)	5-6	10	10	10	10
	7-8	10	10	10	10
	9-10	10	10	10	10
	11-12	10	10	10	10
	13-14	10	10	10	10
	15-16	10	10	10	10
		Mean	10.52		10.57
	SD	3.483		3.439	
Race/Ethnicity	Asian	4.1%		3.2%	
	Black	15.8%		4.1%	
	Latino	31%		20.5%	
	Native American	.8%		4.1%	
	White	48.3%		68%	
Parent Education	Less than HS graduate	5		7	
	HS graduate	16		12	
	College Experience	99		101	

Measures

Cognitive Abilities Test (CogAT). The CogAT (Lohman & Hagen, 2001) is a group-administered set of tests that measure cognitive ability in three broad domains, verbal, quantitative, and non-verbal functioning. Three subtests of the CogAT (subtests 7, 8, and 9) that constitute the non-verbal battery were utilized. The three subtests are Figure Classification,

Figure Analogies, and Figure Analysis. The non-verbal tests of the CogAT have exhibited good internal consistency and appear to measure what they purport to measure (DiPerna, 2005). These subtests were chosen as non-verbal intelligence serves as a generally acceptable proxy for general intelligence (Neisser et al., 1996).

Woodcock-Johnson IV Tests of Cognitive and Achievement (WJ IV). The WJ IV (Schrack, McGrew, & Mather, 2014) is an individually-administered battery of tests organized into cognitive and achievement domains, which assesses general cognitive ability and academic achievement in multiple academic domains, respectively. Both the WJ IV Cognitive and Achievement tests have shown strong reliability and validity in their traditional, standardized format (Reynolds & Niileksela, 2015; Villarreal, 2015), noted for their strong validity evidence base.

Procedure

Examiners were school and clinical psychologists qualified and experienced in administering the WJ IV and CogAT. After demonstrating competence in administering the WJ IV in the traditional, face-to-face format, all examiners received six hours of group training and two hours of individual training in administering the WJ IV via the prescribed remote, online procedure, and they conducted several practice administrations before the study began, as well as passed a practical demonstration/exam with the lead trainer. All examiners were paid for their training and participation in the study.

Proctors (in-person assistants used in the remote, online administration procedure) were recruited from different sources. Some were volunteers who wanted to learn more about the WJ IV, some were students who were getting contact hours with “clients,” and some were paid professionals (school psychologists). All proctors received 30 minutes of training directly before their first proctoring of the remote, online WJ IV.

As each participant was scheduled for testing, he/she was randomly assigned to either the traditional, in-person or the remote, online administration format, with the requirement that the cases within each age-by-gender “cell” would be divided equally between the formats. All administrations (in both formats) occurred within the child’s school, and all examiners administered cases using both formats.

Each examinee first took the nonverbal tests of the Cognitive Abilities Test (CogAT), Form 6, which yields a nonverbal ability score. Every examinee was administered the CogAT in the traditional, paper-and-pencil format. Then each examinee took the complete WJ IV, both cognitive and achievement tests, in standard test sequence, in the assigned format (remote, online or traditional, in-person).

Examiners’ scoring decisions were used in the present analysis for any test that required immediate scoring (to determine reaching basals and ceilings/discontinues, for example), in order to determine whether examiners’ decisions were affected by format. That is, any test that needed immediate scoring utilized immediate scoring, and each was checked afterward for accuracy by the project director, in order to determine if the administration format affected how accurate these scoring decisions were. All raw scores were entered into the WJ IV online scoring program, regardless of administration format, in the same manner.

Group equivalence was first explored by comparing the CogAT scores (all of which were collected by traditional administration of the CogAT) of the two different groups (online versus traditional administration of the WJ IV groups). Then, finally, all cluster and test standard/scaled

scores were compared between groups to determine whether there is an effect of format on scores.

Data Analysis Plan

For the purpose of this study, both significance tests (p values of t -tests) and Cohen's d were calculated to determine equivalence. The standards of $p \geq .05$ and $d < 0.2$ (in accordance with the recommendation of Cohen, 1988) were used as the standard for equivalence. That is, $p < .05$ and $d \geq 0.2$ would indicate significant difference, and thus not equivalence. Cohen's d is calculated as the difference between mean scores on the two different administration formats, divided by the pooled standard deviation of scores.

Results

Randomization Check. As seen in Tables 2 and 3, the CogAT nonverbal scores for each group (administered identically) did not exhibit significant differences at the $p < .05$ level or an effect size of grouping at the predetermined level above 0.2. Specifically, the difference in CogAT between groups emerged as $p = 0.226$, with an effect size of Cohen's $d = -0.159$. This suggests there was no significant difference between the two administration groups in terms of general nonverbal abilities, as a proxy for general ability.

Table 2

Descriptive Statistics for the CogAT and WJ IV Cluster and Test Scores by Administration Format

Test/Cluster	Traditional, In-Person Administration		Remote, Online Administration		Total Sample	
	Mean	SD	Mean	SD	Mean	SD
CogAT	90.09	16.392	92.63	15.513	91.34	15.983
WJ IV Cognitive						
General Intellectual Ability	98.07	16.551	97.12	14.961	97.59	15.750
Gf-Gc Composite	98.30	17.991	96.82	14.673	97.56	16.399
Comp-Knowledge	94.31	16.037	94.90	12.062	94.60	14.162
Fluid Reasoning	101.69	18.226	98.91	16.073	100.30	17.204
Short-Term Working Memory	100.13	14.493	99.10	16.121	99.61	15.305
Cognitive Efficiency	100.75	14.299	97.99	14.463	99.37	14.418
Oral Vocabulary	97.14	16.524	97.22	12.106	97.18	14.454
Number Series	102.19	17.237	100.69	15.115	101.44	16.194
Verbal Attention	100.43	14.721	102.22	14.993	101.32	14.854
Letter-Pattern Matching	101.10	15.297	99.44	14.496	100.27	14.894
Phonological Processing	93.85	15.783	93.20	14.972	93.52	15.354
Story Recall	95.44	13.849	92.62	15.218	94.03	14.588
Visualization	98.72	15.353	97.39	13.193	98.06	14.304
General Information	93.58	15.233	94.41	11.992	93.99	13.686
Concept Formation	100.41	18.304	97.39	16.488	98.90	17.453

Numbers Reversed	99.54	14.503	96.57	16.317	98.05	15.476
WJ IV Achievement						
Broad Reading	98.73	14.418	99.38	14.203	99.06	14.284
Broad Mathematics	98.17	15.338	100.08	13.096	99.13	14.259
Broad Writing	105.18	13.930	107.45	14.641	106.31	14.306
Letter-Word Identification	99.79	13.615	100.86	13.612	100.33	13.596
Applied Problems	101.45	18.786	103.08	15.027	102.26	16.995
Spelling	100.20	12.835	102.37	13.537	101.28	13.206
Passage Comprehension	95.14	13.939	95.13	12.975	95.13	13.438
Calculation	97.08	12.473	98.22	12.902	97.65	12.677
Writing Samples	111.22	16.715	112.38	16.692	111.80	16.679
Word Attack	102.18	17.575	101.40	15.616	101.79	16.594
Oral Reading	97.98	15.342	99.38	13.186	98.68	14.292
Sentence Reading Fluency	98.58	15.670	99.60	16.558	99.09	16.094
Math Facts Fluency	97.49	14.769	99.00	14.809	98.25	14.777
Sentence Writing Fluency	100.82	14.240	102.98	16.666	101.90	15.510
N	120		120		240	

Note. All scores are standard scores ($M = 100$, $SD = 15$).

WJ IV Equivalence. Table 2 reports the means and standard deviations of the WJ IV cluster and test scores for each format and for the sample as a whole. Given the close similarity of the demographic characteristics and the balancing by age and gender for the two groups, with random assignment, as well as the CogAT check of randomization, there would be no expectation of large or systematic differences in scores between the groups.

Table 3 shows for the WJ IV the t value associated with the format as a predictor, its related p value, and its effect size (Cohen's d). No cluster or test had either a significant (at the $p < .05$ level) difference between administrations or an effect size of administration format that exceeded the pre-established criterion of 0.20. Therefore, there does not seem to be a statistically significant effect of the online, remote administration format on examinees' scores.

Table 3

Significance and Effect Size of Remote, Online Format on the CogAT and the Cluster and Test Scores of the WJ IV

Test/Cluster	T	P	Effect Size
CogAT	-1.214	0.226	-0.159
General Intellectual Ability	.466	0.641	0.060
Gf-Gc Composite	.700	0.485	0.090
Comp-Knowledge	-.323	0.747	-0.042
Fluid Reasoning	1.255	0.211	0.162
Short-Term Working Memory	.516	0.606	0.067
Cognitive Efficiency	1.486	0.139	0.192
Oral Vocabulary	-.040	0.968	-0.006
Number Series	.717	0.474	0.093
Verbal Attention	-.934	0.351	-0.120

Letter-Pattern Matching	.862	0.390	0.111
Phonological Processing	.327	0.744	0.042
Story Recall	1.504	0.122	0.194
Visualization	.714	0.476	0.093
General Information	-.471	0.638	-0.061
Concept Formation	1.341	0.181	0.173
Numbers Reversed	1.493	0.137	0.192
Broad Reading	.352	0.725	-0.045
Broad Mathematics	-1.034	0.302	-0.134
Broad Writing	-1.233	0.219	-0.159
Letter-Word Identification	-.607	0.544	-0.079
Applied Problems	-.740	0.460	-0.096
Spelling	-1.272	0.204	-0.165
Passage Comprehension	.010	0.992	0.001
Calculation	-.695	0.488	-0.090
Writing Samples	-.537	0.592	-0.069
Word Attack	.365	0.715	0.047
Oral Reading	-.754	0.452	-0.098
Sentence Reading Fluency	-.489	0.626	-0.063
Math Facts Fluency	-.787	0.432	-0.102
Sentence Writing Fluency	-1.073	0.285	-0.139

Note. A positive effect size indicates higher scores with traditional, in-person administration.

Discussion

The present study aimed to evaluate the equivalence of an online, remote administration procedure to traditional, in-person administration of the Woodcock-Johnson IV cognitive ability and academic achievement tests. There were no exhibited method effects for the different modes of administration in this nonclinical, general school-based U.S. sample, the present study showing negligible effect sizes (below the 0.20 threshold) and no significant differences (at the $p < 0.05$ level) between administration modes. These findings suggest that the scores elicited by the two different administration methods are equivalent and interchangeable, and as such all the WJ IV normative and psychometric (reliability, validity, utility) research can be applied confidently to this specific online, remote administration procedure (which adhered to very specific protocols for digital specification, training for examiners and proctors, and modified standardized administration procedures) for the tests. More data should be collected to compare the two administration methods with specific clinical populations, to determine if the online, remote administration is equivalent with them, as well. For a general school population (much of the population referred for special education evaluations, for example), this remote, online procedure offers a viable alternative to traditional, in-person administration of the WJ IV cognitive and achievement tests.

Perhaps most importantly, the present findings have the potential to begin addressing the widespread problems with access that many school (and other) communities are facing, with greater demand and need for psychoeducational assessment than they are able to provide. Rural areas without (or with widely shared) school psychologists and other areas with more students in need of evaluation than the greatly overworked school psychologists are able to evaluate can

benefit from evaluators being contracted to conduct evaluations at a distance. School psychologists with heavy caseloads will not be nearly as limited by time constraints as before, as multiple students can be evaluated at a distance at the same time (as long as they have school space to conduct such assessments). There are of course logistical limitations, even for remote, online administrations, such as finding and adequately training proctors, evaluators being appropriately trained to adhere faithfully to the modified standardization procedures, and evaluators most often needing to be licensed in the state in which the students are being evaluated (perhaps one of the biggest current limitations). Further, remote administrators must have access to the administration materials (e.g., the online platform with the test built into it). However, even with these constraints, the shown equivalency of the remote, online administration to traditional, in-person administration of the Woodcock-Johnson tests has the potential to begin mitigating some of the strain on overworked school psychologists.

Limitations

The present study has several limitations. The most important limitation is the generalizability of the sample. Specifically, a general school sample was utilized, and while students were not pre-screened for learning, intellectual, or emotional difficulties, there were no participants with specific hearing, vision, or physical impairments. Also, while the WJ IV is fully normed on both child and adult populations, the present study only evaluated children between ages 5 and 16. As such, the equivalence of the online, remote administration format with traditional, in-person administration is limited in its evidence to general school evaluations (not excluding special education evaluations) for children between ages 5 and 16.

Further, the present study does not comment on the equivalence of all online, remote administrations of cognitive and achievement tests with their traditional, in-person analog. That is, the exhibited equivalence of this specific procedure for this specific test (the WJ IV) does not imply equivalence for another procedure used with the WJ IV, nor does it imply equivalence of online, remote administration of other tests. Ethical application of these findings requires examiners to adhere to the specific, manualized protocol for the remote, online administration of the WJ IV (as discussed in Wright, 2016).

Conclusion

Online, remote administration of psychoeducational batteries of tests has the potential to significantly increase access to learning, attentional, and special education evaluations to those who have some sort of barriers to access, such as rural schools without school psychologist resources and suburban and urban schools with demand greater than their local school psychologists can meet. Developing specific, structured protocols for administering tests in this way, as well as evaluating and exhibiting the equivalence between this method of administration and traditional, in-person methods, is a necessary step in the evolving use of online, remote administration protocols more widely. Students who need psychoeducational evaluations should have them, and in a timely fashion, and the WJ IV online, remote administration procedure can help achieve that goal.

About the Authors

- A. Jordan Wright, Degree** is a Clinical Assistant Professor of Counseling Psychology in the Steinhardt School of Culture, Education, and Human Development at New York

University. Correspondence can be sent to ajw11@nyu.edu; or mailed to Applied Psychology Department, Steinhardt School of Culture, Education, and Human Development, New York University, 246 Greene Street, 8th Floor, New York, NY 10003.

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