TITLE: Validation of the Woodcock-Johnson IV test of Cognitive Abilities and the Automated

Neuropsychological Assessment Metrics in a tele-neuropsychology setting

PRINCIPAL INVESTIGATOR: Thomas D. Parsons, PhD

Co-INVESTIGATOR: Justin Asbee, PhD

REPORT DATE: July 1, 2022

TYPE OF REPORT: Final Report

PREPARED FOR: Woodcock Institute Grant Research Program

FINAL REPORT

What were the major goals for UNT's role in the project?

Proposed:
- Utilize video teleconferencing to administer select paper-and-pencil neuropsychological assessments (e.g., select subtests of the ANAM, WJ IV COG, etc).
- Aim is to acquire data from participants (N=30) on the implementation of remote ANAM and video teleconferencing WJ IV
- Develop a preliminary normative sample—assess the psychometric properties of the remote ANAM and WJ IV COG measures.
- To examine the construct validity of tests from both the WJ IV COG and the new downloadable version of the ANAM a Multitrait-Multimethod Matrix (MTMM) approach was being used.

What was accomplished under these goals?

Summary
- Completed all human subjects requirements and obtained IRB approval
- Trained psychometrists
- Refined protocol
- Performed quality assurance runs
- Recruited and ran participants
- Developed database and codebook
- Cleaned and analyzed data
- Prepared manuscripts for submission to academic journals and conferences
- Completed report

Major activities:
- Completed IRB
- ANAM software was purchased and installed on all appropriate lab computers
- Acquired WJ IV. While this involved working with the company vendor and completing forms, we were not able to purchase the battery due to delays and lack of responses to queries. Finally, we were able to borrow a WJ IV battery. While this caused serious delay, we were able to meet all deliverables.
- Students were hired and trained on human subjects research, ANAM, video teleconferencing, and WJ IV (selected subtests, database building and management
- Researchers attended extensive training from Vista Partners on the use of the ANAM platform. This also involved extensive efforts to secure server space for the participant data
- Researchers trained students on ANAM.
- Students were trained on specific subtests of WJ IV
- All software and hardware was set up and tested
- A paradigm for multimodal data collection was established

- Procedures for data collection and initial analysis were established and tested
- Recruitment materials were drafted and distributed.
- Participants were run through the protocol
- Data base was developed, data was cleaned, and analyses were run

Specific objectives:

- Prepare software and hardware for data collection, establish procedures for data collection and analysis, beginning recruitment efforts.

Significant results or key outcomes:

- Procedures were developed and tested; data collection has commenced.
- SONA participant portal has been populated with open scheduling with participant availability slots for most workday hours
- An in-depth manual outlining the procedures for this study was created, collated information from the WTAR, WJ IV and ANAM manuals
- Specific WJ IV subtests were decided upon: General Information (What), Numbers Reversed, Memory for Words, and Word Fluency
- Developed a codebook for all data obtained from WTAR, WJ IV, and ANAM, defining what each variable name represents
- Created more seamless record sheets for all WJ IV tests for easier and quicker testing of participants, for recording results simultaneously in Excel as they are being tested, and for ease of data access across researchers
- Scheduled virtual meetings with all researchers to ensure that administration of all testing was as consistent and similar to one another as possible, and to ensure that WTAR and WJ IV tests are administered properly as outlined in their respective manuals (i.e. reading one number per second out loud)
- Developed understanding of ANAM software and how to create a custom battery specific for this study, along with how to properly extract ANAM data for analyzation
- Thoroughly reviewed proper WJ IV test administration, its manuals, and trained other researchers on how to do the same
- Coordinated practice runs with willing participants to work out any problems encountered with test administration (i.e. format of record sheets, possible typos, or other hurdles hindering a seamless testing process)
- Each psychometrist was observed administering all aspects of the battery via video-teleconferencing
- Began running official participants in-lab and remote.
- Completed running official participants in-lab and remote.

What problems occurred.

There were a number of obstacles that we faced.

- Participant recruitment was unprecedentedly low. We are attributing this to the pandemic as we have seen a sharp decline in participant involvement in our studies as well as those of others (both at UNT and outside institutions)

   o The total number who completed the WTAR, WJIV, ANAM, or any combination of those tests was 49

- When a participant signed up through the SONA system, we would often find that they would be a no-show, or they would attend the virtual appointments but lack the proper technology (e.g., have a Mac instead of a PC, lack a mouse, etc).

   o **In the study, 26 people signed up for the study but did not show up to participate. An additional 13 participants did not have the needed technology to complete all parts of the study.**

- The above reflects a limitation of the computerized neuropsychological assessment (ANAM) because it does not support apple products (only PC).

- On some occasions, a participant would complete the first half of testing, but we would find out that they lacked a mouse, were on a Mac, or that their computer would not allow them to install the ANAM software. In these cases, we were unable to glean all desired data

   o **As mentioned above, 13 participants were not able to complete the ANAM portion of the study due to missing technology.**

- Hence, primary difficulties have arisen as some participants do not possess the required technology to participate in the study. The study requires, ideally, a wired mouse. Many potential candidates seem to possess a simple trackpad or a wireless mouse, which does not supply ANAM response data with the highest accuracy.

   o The study also requires that the downloadable ANAM software is run specifically on a Windows PC. Again, part of the student population possesses only Apple/Mac products, and therefore cannot participate in the study.

   o **Some participants (6) were run using a Bluetooth mouse or trackpad, despite the accuracy concerns, due to the low number of participants recruited overall.**

What was done to overcome above issues to accomplish the goals and objectives?

- In light of these technological issues, we offered an alternative approach to participating in the study by undergoing the neuropsychological tests in-lab on one of our computers. However, due to COVID-19 restrictions and the recent rise of cases, participants were likely less willing to participate in person. In addition to the in-person option, we doubled

efforts, trained additional psychometrists, and greatly expanded availability of study times for remote assessment.
- We heavily enhanced our recruitment efforts via fliers
- We adjusted the SONA availability to offer several more available study scheduling slots
- We trained additional psychometrists
- Collected study data.
- Processed all study data.
- Ran statistical analyses.
- Wrote manuscript detailing results.

What were the results of the study?

There were 49 participants total, 16 of which had full datasets using the correct mouse and six of which had full datasets with the incorrect mouse. The rest were missing one or more subtests. Those missing subtests had their data included for the subtests they did complete. Table 1 demonstrates recruitment and collection problems encountered. Table 2 offers demographics.

Table 1 *Data Collection Problems*

	Count
Connection issues during WJ	22
Participants impacted by connection issues	13
Did not complete ANAM total	26
No PC/No Admin access	12
Did not complete ANAM – download problems	3
No corded mouse – ANAM data not collected	1
Did not complete ANAM (reason not given)	5
Technical problem during ANAM – no ANAM data collected	1
Technical problem during ANAM – partial dataset	2
Repeated Practice data	2
No corded mouse – ANAM data was collection	6
Did not complete WJ	1

Note: Demographic information for participants is listed in Table 2. ANAM = Automated Neuropsychological Assessment Metrics. WJ = Woodcock Johnson IV

Table 2 *Demographics*

	% or *M(SD)*
Female	34.70
Age	22.66 (5.26)
Race	
Hispanic/Latino	20.40

White	20.40
Black/African American	10.20
Asian/Pacific Islander	4.10
WTAR-Predicted	107.65 (10.69)

Note. WTAR = Wechsler Test of Adult Reading

Tables 3-4 present means, standard deviations (*SDs*), number of participants to complete that subtest, minimum, and maximum scores for key variables related to each subtest. These data meet the goal of getting normative data information on the remote WJIV and ANAM.

Table 3 *Woodcock-Johnson Scores for Remote Assessment*

Score Type	M	SD	N	Minimum	Maximum
General Information (What) Number Correct	5.67	1.93	48	3	10
Percent Correct	56.67	19.29	48	30	100
Numbers Reversed					
Number Correct	10.23	5.49	48	1	22
Percent Correct	42.62	22.87	48	4.17	91.67
Memory for Words					
Number Correct	12.96	2.32	48	7	17
Percent Correct	64.79	11.59	48	35	85
Word Fluency /m/ Sound	13.44	6.21	48	0	30
Word Fluency /d/ Sound	13.60	5.52	48	0	28

Table 4 *ANAM Scores for Remote Assessment*

Score Type	M	SD	N	Minimum	Maximum
CDD					
Mean RT	1185.14	321.20	25	780.28	2214.74
Mean RT on Correct Trials	1148.58	308.12	25	761.74	2112.77
Percent Correct	88.39	17.10	25	41.67	100.00
Throughput	47.89	16.86	25	19.20	75.27
CDS					
Mean RT	1058.01	344.13	25	682.07	1926.60
Mean RT on Correct Trials	1052.96	345.02	25	678.04	1971.80
Percent Correct	93.00	7.21	25	76.39	98.61
Throughput	57.76	17.09	25	24.22	86.75

Score Type	M	SD	N	Minimum	Maximum
GNG					
Mean RT	342.67	61.05	24	227.80	491.79
Mean RT on Correct Trials	345.65	63.44	24	230.79	500.36
D'	3.56	1.71	24	0.57	6.00
Hits Count	91.54	10.58	24	50	96
Correct Rejection Count	16.38	5.12	24	2	23
Misses Count	3.13	9.73	24	0	46
False Alarm Count	6.92	3.91	24	1	14
M2S					
Mean RT	1502.03	528.24	25	874.90	3144.75
Mean RT on Correct Trials	1459.60	547.16	25	739.00	3144.75
Percent Correct	90.08	16.39	25	45.00	100.00
Throughput	39.84	14.55	25	14.86	65.15
MTH					
Mean RT	2660.71	953.76	25	526.40	5070.06
Mean RT on Correct Trials	2644.38	925.64	25	533.00	4969.38
Percent Correct	85.54	14.67	25	40.00	100.00
Throughput	21.95	8.51	25	7.01	45.59
PRO					
Mean RT	607.43	175.26	25	391.50	1131.25
Mean RT on Correct Trials	595.11	145.72	25	399.70	1065.32
Percent Correct	92.11	12.42	25	53.12	100.00
Throughput	98.53	27.94	25	33.15	143.68
SPD					
Mean RT	1632.19	525.00	23	451.47	2570.55
Mean RT on Correct Trials	1614.54	485.92	23	475.75	2570.55
Percent Correct	86.56	21.13	23	20.00	100.00
Throughput	34.77	14.73	23	4.25	83.94
SR2					
Mean RT	376.21	290.16	24	160.37	1446.92
Mean RT on Correct Trials	376.21	290.16	24	160.37	1446.92
Percent Correct	99.69	1.53	24	92.5	100
Throughput	199.98	70.10	24	26.58	374.13
Score Type	M	SD	N	Minimum	Maximum
SRT					

Mean RT	291.73	69.42	25	183.82	556.12
Mean RT on Correct Trials	291.73	69.42	25	183.82	556.12
Percent Correct	100.00	0.00	25	100	100
Throughput	214.83	43.59	25	107.89	326.41
ST6					
Mean RT	836.23	219.87	23	541.30	1417.31
Mean RT on Correct Trials	845.94	257.99	23	543.63	1600.60
Percent Correct	90.87	16.71	23	37.50	100.00
Throughput	69.85	25.39	23	4.97	105.46

Note. ANAM = Automated Neuropsychological Assessment Metrics. RT = Reaction Time. CDD = Code Substitution Delayed. CDS = Code Substitution. GNG = Go/No-Go. M2S = Matching to Sample. MTH = Mathematical Processing. PRO = Procedural Reaction Time. SPD = Spatial Processing – Simultaneous. SR2 = Simple Reaction Time 2. SRT = Simple Reaction Time. ST6 = Memory Search

Tables 5 shows the mood data for remote and in person data collection and compare the two. The percent of mood adjectives endorsed metric represents how strongly a participant aligns with adjectives related to the given mood, with higher percentages representing higher alignment with that mood.

Table 5 *Percent of Mood Adjectives Endorsed for Remote Assessment*

Emotion	*M*	*SD*	*N*	Minimum	Maximum
Anger	7.44	10.26	25	0.00	38.89
Anxiety	22.11	17.32	25	0.00	58.33
Depression	16.11	17.55	25	0.00	63.89
Fatigue	37.83	18.79	25	5.56	72.22
Happiness	54.50	20.26	25	13.89	97.22
Restlessness	20.78	18.99	25	0.00	63.89
Vigor	39.44	21.26	25	8.33	88.89

Table 6 shows the relationships between variables from the Woodcock Johnson subtests and the ANAM subtests. Results indicate convergent validity between tests (e.g., correlation between general information subtest and code substitution, code substitution delayed, go/no-go, matching to sample, mathematical processing, procedural reaction time, spatial processing – simultaneous, and memory search) and divergent validity between tests (e.g., no correlation between general information and simple reaction time or simple reaction time repeated).

Table 6 *Correlations for WJ and ANAM Number Correct*

Test	Variable	GI	NR	MFW	WFM	WFD	CDD	CDS	GNG	M2S	MTH	PRO	SPD	SR2	SRT
WJ	GI	-													
	NR	-.07	-												
	MFW	-.14	.42**	-											
	WFM	-.04	.16	.27	-										
	WFD	.19	-.05	.31*	.80**	-									
ANAM	CDD	.57**	.15	.03	.31	.45*	-								
	CDS	.60**	-.05	.04	-.22	-.04	.52**	-							
	GNG	.42*	-.23	-.18	.09	.26	.51**	.34**	-						
	M2S	.43*	.02	-.06	.33	.47*	.73**	.45**	.56**	-					
	MTH	.54**	.09	-.07	.48*	.47*	.61**	.19	.46**	.62**	-				
	PRO	.51*	-.20	-.02	-.05	.22	.52**	.59**	.48**	.58**	.32**	-			
	SPD	.62**	-.30	-.10	.07	.27	.43*	.45*	.45*	.34	.40	.65**	-		
	SR2	.154	-.42*	-.05	-.11	.10	.00	.20	.58**	.01	-.17	.34	.27	-	
	SRT	.120	-.42*	-.23	.20	.20	-.02	.02	.31**	-.02	.07	.02	.05	.58**	-
	ST6	.439*	.06	.00	.15	.42*	.86**	.55**	.59**	.88**	.60**	.78**	.34	.10	-.20

Note. ANAM = Automated Neuropsychological Assessment Metrics. WJ = Woodcock Johnson. GI = General Intelligence. NR = Numbers Reversed. MFW = Memory for Words. WFM = Word Fluency /m/ sound. WFD = Word Fluency /d/ sound. CDD = Code Substitution Delayed. CDS = Code Substitution. GNG = Go/No-Go. M2S = Matching to Sample. MTH = Mathematical Processing. PRO = Procedural Reaction Time. SPD = Spatial Processing – Simultaneous. SR2 = Simple Reaction Time 2. SRT = Simple Reaction Time. ST6 = Memory Search. * = $p < .05$. ** = $p < .01$

Summary and Conclusions

When comparing the two tests administered – the WJ IV COG and the ANAM – there is demonstrated convergent and divergent validity. This provides evidence that the remote versions of these assessments are measuring what they are intended to. These results support the hypotheses for this study.

Budget and Expenditures

We were originally awarded $15,000 for participant remuneration, personnel, and equipment and supplies. We requested and were granted budget revisions in Spring 2022.

Graduate student worker.

Trained and closely supervised by Dr. Parsons in the administration of this study. Specific tasks included test administration, data collation and data analyses, and paper writing.

Undergraduate student worker.

Trained and closely supervised by Dr. Parsons in the administration of this study. Specific tasks included test administration, data collation and data analyses, and paper writing.

Supplies:

Automated Neuropsychological Assessment Metrics (ANAM):

We used this computerized neuropsychological assessment software for remote assessment of cognition, mood, effort, and sleep quality. (Cost: $1900).

Future Directions and Dissemination of Results

These results are currently serving as preliminary data for a larger study that will compare in-person and result administrations of cognitive tests.