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Automatized Sequences as a Performance Validity Test? Difficult If You Have Never Learned Your ABCs

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Abstract

Accurate identification of symptom exaggeration is essential when determining whether or not data obtained in pediatric evaluations are valid or interpretable. Apart from using freestanding performance validity tests (PVTs), many researchers encourage use of embedded measures of test-related motivation, including the newly developed automatized sequences test (AST). Such embedded measures are based on identification of performance patterns that are implausible if the test taker is investing full effort; however, it is unclear whether or not persons with pre-existing cognitive difficulties such as specific learning disabilities (SLD) might be falsely accused of poor test motivation due to actual but impaired learning of basic sequences. This study examined the specificity of the AST by reviewing performance of 83 SLD adolescents. Anywhere from 22 to 41% of SLD adolescents investing good effort failed one or more of the tasks included in the AST, and those with lower intelligence scores had higher rates of failure. Clinicians should therefore be cautious if using this PVT with individuals who have a documented history of reading, learning, or intellectual problems.

Keywords Assessment · Effort testing · Performance validity · Embedded measures · Automatized sequences · Adolescents

It is now expected practice to include symptom and performance validity tests (SVTs and PVTs) when completing a neuropsychological assessment with adults (American Academy of Clinical Neuropsychology 2007; Bush et al. 2005). In an effort to ensure that the assessment is not too lengthy, clinicians may often employ performance validity measures embedded within the test battery rather than use multiple freestanding PVTs as a means of identifying low test-taking effort or non-credible symptoms (Babikian et al. 2006; Babikian and Boone 2007). Failure on at least two unrelated embedded effort tests within a test battery is said to offer acceptable discrimination between credible and non-credible performance (Boone 2009; Victor et al. 2009) while minimizing the false-positive rate.

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While the majority of neuropsychologists now typically include measures of effort and motivation in their adult assessments (Martin, Schroeder, and Odland 2015; Sharland and Gfeller 2007), it is only recently that clinicians have been urged to include such measures in assessment of children and adolescents (Green and Flaro 2003; Heilbronner, Sweet, Morgan, Larrabee, Millis et al. 2009; Salekin, Kubak, and Lee 2007). Indeed, despite past research showing that low effort or avoidance of disliked tasks could negatively influence children's performance on achievement tests and result in inaccurate diagnoses (e.g., Adelman et al. 1989), clinicians continued to believe that children were always fully engaged in psychological or neuropsychological assessment tasks (Kirkwood et al., 2011b; Salekin et al. 2007). Many recent studies have demonstrated, however, that children are indeed capable of feigning cognitive impairment during a neuropsychological evaluation (e.g., Flaro and Boone 2009; Kirkwood et al., 2011a; Kirkwood et al. 2010; McCaffrey and Lynch 2009) and that parental coaching or persuasion can also produce false or exaggerated symptoms in such assessments (e.g., Lu and Boone 2002). Given that clinicians are not able to accurately identify suboptimal effort using clinical judgment alone (Guilmette 2013), clinicians are now beginning to include PVTs in their evaluation of children and adolescents.

Very little research has been published regarding accurate identification of response bias in this age group (DeRight and Carone 2013). Further, existing research has typically examined performance on freestanding, as opposed to embedded, PVTs. Recently, Kaufman et al. (2014) developed an embedded performance validity test for use in pediatric populations, the automatized sequences test (AST). This test evaluates fluidity of recall of sequences such as the alphabet, number counting (forwards and backwards), the days of the week, and the months of the year. The authors assert that slow performance can help identify invalid response patterns. Indeed, in a sample of 439 pediatric clients referred for mild head injury evaluations, they found this test had sensitivity of about 50% and specificity above 90%. The authors did speculate, however, that classification statistics might be worse in more severely affected populations.

One group of children who have difficulty acquiring such automatized sequences are those with specific learning disabilities (SLD). Research has demonstrated that children with SLD are at higher risk for experiencing disabling accidents relative to the general population and, when injured, are more likely to suffer a permanent injury of some type (Sigmundsson 2005; Brook and Boaz 2006). Hence, children with such preexisting disorders may often be referred for neuropsychological assessment in litigious circumstances where secondary gain is inferred or expected. No research to date, however, has investigated how frequently children or adolescents with SLD produce extremely low scores on the AST, or if lower full-scale IQ affects performance on this embedded measure. Given that children with reading disabilities are said to have impairments in procedural learning (Nicolson and Fawcett 2007, 2011), do not develop normal levels of automaticity in lower-level retrieval processes (Wolf et al. 1986), have been shown to have deficits in rapid automatized naming speed (Wolf et al. 2000), and show a general implicit sequence learning deficit (Staels and Van den Broeck 2017), it stands to reason that individuals with such preexisting disabilities may normally produce scores on timed tests of automatic sequences that could be misinterpreted as the results of low effort or exaggeration.

The question, therefore, is how clinicians can accurately identify adolescents with SLD who are not investing maximal effort in testing, while also minimizing the risk of misattributing poor but honest performance to low motivation/effort. The purpose of the present study was to assess the influence of severe reading and learning difficulties on AST performance and evaluate the extent to which such students might be incorrectly classified as noncompliant. We examined AST performance in a group of grade 7 students with identified SLDs. These students were participating in a transition program, a component of which involved updated psycho-educational testing to identify their specific learning needs as they made the transition to secondary school. Given that these students already had academic accommodations in place within their schools, and given that each student had a documented history of learning problems dating back to the early grades, it was felt that they were an ideal SLD group on whom to evaluate this question as they had little external incentive to feign or exaggerate their learning problems.

Method

Participants

Participants were 83 adolescents (69.9% male) aged 12.3 (SD = 0.44) who completed psycho-educational assessments at a university assessment center between 2014 and 2017. These students were referred by their schools to participate in a comprehensive program designed to assist students with SLD with their transition from elementary to secondary school. Psycho-educational assessments were performed by clinical psychologists who, in the course of any assessment, ensure that students are compliant and not fatigued. All students had been assessed and identified under the Ontario Ministry of Education criteria for exceptionality as "learning disabled"[1] some time prior to fifth grade. As shown in Table 1, adolescents in the current sample were of average intelligence (mean FSIQ = 94.4, SD = 9.8, n = 35; mean GIA = 87.6, SD = 8.8, n = 48). Most students participated in three testing sessions lasting approximately 3 h each over the course of 2 to 3 weeks and were administered at least two stand-alone PVTs as well as this embedded measure. A small subset of students (n = 12) who had a current assessment (within the past 2 years) attended only one session that included the AST and at least two stand-alone PVTs. The current sample did not include students with any other known neurological or behavioral problems apart from possible co-morbid attention deficit hyperactivity disorder.

Parents and students provided informed consent before testing began. The study was approved by Queen's General Research Ethics Board and is in accordance with the ethical standards of the 1964 Helsinki declaration and its later amendments.

[1] 1. The Ontario Ministry of Education classifies individuals as learning disabled as "having a learning disorder evident in both academic and social situations that involves one or more of the processes necessary for the proper use of spoken language or the symbols of communication, and that is characterized by a condition that (1) is not primarily the result of impairment of vision, impairment of hearing, physical disability, developmental disability, primary emotional disturbance, or cultural difference; (2) results in a significant discrepancy between academic achievement and assessed intellectual ability, with deficits in one or more of the following: receptive language (listening, reading), language processing (thinking, conceptualizing, integrating), expressive language (talking, spelling, writing), or mathematical computations; and (3) may be associated with one or more conditions diagnosed as follows: a perceptual handicap, a brain injury, minimal brain dysfunction, dyslexia, developmental aphasia." (Taken from http://www.oise.utoronto.ca/adaptivetech/Special_Ed/Communication_Exceptionality/Learning_Disability/index.html)

Table 1 Demographics and mean test results for AST, IQ, and achievement tests

	Pass PVT (67.6% male)			Fail PVT (100% male)		
	N	Mean	SD	*N*	Mean	SD
Age	78	12.2	0.4	5	12.2	0.2
IQ scores						
WISC-IV FSIQ	31	95.1	10.0	4	89.0	7.3
WJ-IV GIA	47	87.6	8.8	1	89.0	
IQ score ranges	*N* Average	Range	*N* Low	Range		
WISC-IV FSIQ	25	85–112	4	80–84		
WJ-IV GIA	32	85–107	16	67–84		
AST scores						
Recite alphabet time	77	6.8	4.3	5	9.6	3.6
Recite alphabet errors	78	1.1	0.3	5	1.4	0.5
Counting time	78	5.1	1.2	5	6.2	1.6
Counting errors	77	1.0	0.0	5	1.2	0.4
Days of the week time	78	3.6	1.7	5	6.0	4.1
Days of the week errors	78	1.0	0.2	5	1.2	0.4
Months of the year time	76	10.7	7.9	5	7.4	2.3
Months of the year errors	77	1.5	0.5	5	1.4	0.5
Achievement scores						
WJ broad reading	47	79.7	11.0	1	46	
WJ letter-word ID	48	82.2	13.3	1	50	
WJ oral reading	45	83.7	12.0	1	54	
WJ reading fluency	72	84.1	13.1	5	74.2	14.5
WJ spelling of sounds	36	82.4	8.8	1	41	
WJ reading vocabulary	29	89.9	10.1	1	53	
Towre-2 sight word	25	91.1	8.5	4	78.0	11.9
Towre-2 phon. decoding	25	84.8	11.7	4	69.0	11.9
CTOPP elision	26	7.8	3.1	3	5.3	3.2
CTOPP blending	25	8.3	2.8	3	4.7	1.5
KTEA III reading comp	23	93.3	10.8	4	79.3	17.7
KTEA III reading	22	90.4	13.1	4	74.3	11.6
KTEA III LW recognition	24	90.9	13.2	4	72.0	8.8

Measures

Students in the transition program were administered a comprehensive test battery that included a measure of general intellectual ability (either the Wechsler Intelligence Scale for Children—Fourth Edition subtests (WISC-IV; Wechsler 2003) or the Woodcock-Johnson-IV Test of Cognitive Abilities (WJ-IV; Schrank et al. 2014)); measures of academic achievement (either the Woodcock-Johnson IV Test of Achievement or the Kaufman Test of Educational Achievement—Third Edition, KTEA-3; (Kaufman and Kaufman (with Breaux, K. C). 2014); phonological awareness (Comprehensive Test of Phonological Processing, CTOPP: Wagner et al. 1999), and speed of word decoding (Test of Word Reading Efficiency-2 (TOWRE-2); Torgesen et al. 2012) and reading speed (from the WJ-IV). All participants were also given the AST, either the Green Word Memory Test (WMT; Green 2003) or the Medical Symptom Validity Test (MSVT; Green 2004), and another validity test to identify exaggerated reading problems (The Dyslexia Assessment of Simulation or Honesty: Harrison et al. 2008).

Procedure

Adolescents with a previous identification of a specific SLD were referred by their schools to participate in an ethics-approved research project designed to assist in their successful transition from elementary to secondary school. An updated psycho-educational assessment was provided as part of the research program to help the students better understand their specific learning needs and, where appropriate, to inform school personnel regarding the interventions and supports suggested for each student once they began high school. The assessment did not occur within the school, and so the results were not shared with school personnel without the express permission of the student and his/her family.

Two local school boards were informed that a total of 25 students from each board could participate in the program each year, and each board was provided with application forms to distribute to students in grade 7 with a longstanding SLD identification. Students came with their parents for an initial intake interview and provided their informed consent to participate in the study at this time and allow their test data to be used for research purposes.

The AST was administered according to the protocol outlined by Kirkwood et al. (2014). Determination of invalid performance was based on the optimal cut scores recommended by Kirkwood et al., that is alphabet (≥ 8 s), counting to 20 (≥ 6 s), days of the week (≥ 4 s), months of the year (≥ 10 s).

Results

Although there is evidence to support that children with severe phonological decoding deficits may perform poorly on the WMT and MSVT when investing good effort (Green and Flaro 2003; Larochette and Harrison 2012), we wanted to ensure that the scores being evaluated in this study were reflective of good effort and motivation. As such, five participants were placed into a "questionable effort" group as they performed below published threshold on one or more of the first three indicators of either the MSVT or WMT. Even though three of these adolescents produced a profile that suggested a Genuine Memory Impairment Profile (GMIP; Green et al. 2009) and would thus not usually be classified by the MSVT/WMT as malingering (i.e., if known to have a genuine neurological impairment that interfered with their performance then they would not be classified as investing low effort), we felt that any student with questionable validity status should not be included in the main analyses; their data are reported separately. Table 1 includes scores obtained by both groups on the measures of relevance.

As shown in Table 2, after removing the five adolescents who failed at least one stand-alone PVT, anywhere from 22.1 to 40.8% of adolescents with SLD performed above the cut scores recommended by Kirkwood et al. (2014). Intelligence in general was negatively related only to time to count to 10 ($X^2 = 4.77$, $p = .029$); however, those with lower IQ scores had a higher rate of subtest failure. Specifically, those with overall intelligence scores below the 16th percentile ($n = 22$) had between a 29 and 45% failure rate on at least one of the AST subtests. Even those whose overall intelligence was average ($n = 56$) failed all four subtests at a high rate (20–41%) due to slow speed of reciting these sequences.

While Kirkwood et al. (2014) make no mention of analyzing errors made in completing these tasks, Table 2 shows that a sizeable proportion of students with SLD in the present study made errors, especially when reciting months of the year (46.2%) and the alphabet (12.8%). One might therefore question whether the higher failure rate in our study was due primarily to students who made errors when reciting these sequences, thus inflating the total time taken to complete the task. Table 3 shows that students who have made no errors still take longer than recommended by Kirkwood et al. to recite sequences, with the percentage of students exceeding recommended cut scores ranging from 8 to 28% for students who made no errors at all, and from 22 to 40% for students who made no error on at least one subtest.

Reading skill was somewhat related to the time it took students to recite sequences. The time needed to recite the days of the week was associated with broad reading ($X^2 = 10.85$, $p = .001$), oral reading ($X^2 = 5.3$, $p = .021$), and reading

Table 2 Percentage of students who passed a PVT exceeding time cut offs and percentage of errors on the AST for all students and as a function of IQ

	All students	IQ ≤ 16th percentile	IQ > 16th percentile
N	78	22	56
AST subtest	%	%	%
	Percentage exceeding published cut scores		
Recite the alphabet time	22.1	28.6	19.6
Count to 10 time	29.5	45.5	23.2
Name days of the week time	35.9	36.4	35.7
Name months time	40.8	40.0	41.1
	Percentage of errors		
Recite the alphabet errors	12.8	13.36	12.5
Count to 10 errors	0	0	0
Name days of the week errors	2.6	0	3.6
Name months errors	46.2	61.9	41.1

Table 3 Percentage of students who exceeded published cut offs on the AST but (1) made no errors on any subtest, (2) made no errors on a given subtest, and (3) made no error on at least one subtest

AST subtest	No errors on any subtest ($n = 36$) %	No error on a specific subtest %	No error on at least one subtest ($n = 78$) %
Recite the alphabet time	8.3	12.1 ($n = 66$)	22.1
Count to 10 time	27.8	28.0 ($n = 75$)	29.5
Name days time	22.2	36.5 ($n = 74$)	35.9
Name months time	11.1	17.1 ($n = 41$)	40.8

Note: The percentage of students who made no error on a specific subtest includes those who made no errors at all. The percentage of students who made no error on at least one subtest includes those in the previous two columns

fluency ($X^2 = 14.7$, $p < .001$), and the time needed to recite the months of the year was associated with letter-word identification ($X^2 = 5.58$, $p = .031$) and reading fluency ($X^2 = 4.2$, $p = .041$).

Conclusions

Even when investing good effort and with no obvious motivation to malinger, the automatized sequences test appears difficult for adolescents with SLD. Anywhere from 22 to 40% of SLD adolescents investing good effort failed one or more of the tasks included in the AST. Impaired reading fluency in particular appears to interfere with speed of completing two of the AST subtests (reciting days of the week and months of the year), and impaired speed of decoding was associated with longer time taken to recite the alphabet.

Those with low overall intelligence had much more difficulty with all tasks compared with those whose intelligence was above the 16th percentile, but there was no correlation between IQ and time to complete tests except for counting. Furthermore, IQ alone did not account for the high rate of false-positive identification of poor effort in these students with SLD. Even in those with average or better IQ scores, between 19 to 37% of these students would have been identified by the AST as investing poor effort.

Although not specifically discussed in the original Kirkwood et al. (2014) paper, a significant number of errors were made by students with SLD on tasks that were supposedly "automatized," and this, in turn, increased the time taken to complete each of these tasks. While basic skills such as counting, saying the alphabet, or reciting days or months may indeed become automatic for the average child, such skills clearly remain impaired for a large number of adolescents with SLD. This is consistent with research by Wolf, Bally and Morris (1986), who documented that students with reading disorders fail to acquire normal levels of automaticity in lower level retrieval processes such as recalling names of letters or numbers. Staels and Van den Broeck (2017), too, identified that those with reading disorders show a general implicit sequence learning deficit, making them slower and less accurate in recall of sequences such as those tested by the AST. While one might suppose that those students who made errors on this test were artificially slowed in their speed, which in turn resulted in a higher rate of test failure, it was also the case that students who made no or only one error also failed these subtests at an unacceptably high rate. Thus, it appears that speed of retrieval of this information is impaired in adolescents with SLD even when the sequence of information was learned accurately.

As hypothesized by Kirkwood et al. (2014), those whose overall IQ was below the 16th percentile failed the AST subtests at rates higher than those with normal or better intelligence. A good PVT should be one that is insensitive to innate abilities such as IQ; our study shows clearly that pre-accident IQ status could indeed influence failure rates on this PVT, thus falsely accusing children with lower IQs of investing poor effort.

It has been suggested that slower performance on AST subtests may reflect slower processing speed; however, we found no relationship between measures of processing speed on either the WISC-IV or the Woodcock-Johnson IV and any of the subtests of the AST. Thus, while many students take longer to complete AST subtests, it does not appear to be related to their overall processing speed.

A few limitations of this study should be identified. First, although we believed that the students who participated in this transition program had no motivation to exaggerate their level of impairment, we cannot be sure that this is accurate. While positive scores obtained by the existing PVTs used in this study may accurately identify those who are demonstrating non-credible symptoms, they are not perfect in their ability to correctly classify all such individuals and the false-negative rate for these tests is not known. Further, it may be that these tests fail to capture the skills that these adolescents felt would be impaired in someone with SLD, and so such exaggeration might avoid detection. In other words, some of the adolescents classified as investing adequate effort in this study may have been producing non-credible symptoms. Future studies should employ different PVTs to classify task compliance.

Second, our adolescent sample was mainly Caucasian, and they came from families with average socio-economic status. The adolescents' age range was relatively small, only about 2 years. These findings may not extrapolate to other age groups with SLD, or to those from different socio-economic or cultural backgrounds.

Last, although our sample was relatively large for a clinical study, only five were removed for poor performance on another PVT. With such a small number, we cannot know if these students were false-positive identifications or if the AST truly identified those investing low effort. Certainly, these adolescents appear significantly more impaired on other academic and processing tasks than did those who passed other PVTs. However, it is of interest to note that this group completed only two of the four AST tasks more slowly than did the students who passed existing PVTs (alphabet recital and days of the week). Although difficult to obtain, future studies of the AST should be undertaken with a larger group of SLD students who are suspected of non-credible performance.

In conclusion, this study demonstrates that impairments associated with specific reading disabilities may cause adolescents with this condition to be falsely accused of investing poor effort when employing the AST. Clinicians should therefore be cautious if using this PVT with individuals who have a documented history of reading or learning problems, or in those who have a history suggestive of lower cognitive potential.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Human and Animal Right All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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CORRECTION

Correction to: Automatized Sequences as a Performance Validity Test? Difficult If You Have Never Learned Your ABCs

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In the original article the name of author Allyson G. Harrison was misspelled. The original article has been updated and her name is correct here.

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