TECHNICAL MANUAL

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Acknowledgements

Overview of the Assessment

Articulation and Phonology Video Assessment Tool (VAT)

T he *Articulation and Phonology Video Assessment Tool (VAT)* is a standardized and norm-referenced articulation and phonology assessment for children and young adults ages 2 through 21 years old. It is video based and composed of short video segments where individuals are asked to name or label items while the clinician listens to, and notes any articulatory or phonological errors. The test is broken down into three versions based on age. A separate video test is used for age groups 2:0 – 2:11, 3:0-5:11, and 6:0-21 years old. *The Articulation and Phonology VAT* is an accurate and reliable assessment for speech intelligibility that yields standard scores, percentile ranks, interpretation values, and test-age equivalents. Normative data of this test is based on a nationally representative sample of 1006 children and young adults in the United States.

Articulation and Phonology VAT

The video-based assessment tool is composed of short video segments focusing on 45-55 target words. Sounds are located across all positions in initial, medial, and final position of words. Vowels are also assessed.

Testing Format

The Articulation and Phonology VAT is administered from a computer/laptop or tablet. The test is composed of short pre-recorded video segments, which contain 45-55 target words. Individuals are asked to label or name specific items in the videos. The clinician listens carefully to the production of each word and records any distortion, substitution, omission, or lisp of the targeted sounds. The clinician also makes note of any phonological process, such as stopping, fronting, initial consonant deletion, or gliding. The assessment yields a raw score, standard score, percentile rank, interpretation value, and test-age equivalent. The clinician can complete the protocol online or print the PDF to have a hardcopy, and then transfer the results to the "Raw Score" page on the assessment website. The raw scores can then be converted to standard scores, which will also reveal a percentile rank.

Administration Time

Administration time for the assessment takes approximately 25-30 minutes.

Articulation and Phonology VAT Uses and Purpose

The Articulation and Phonology VAT should be used to assess children or young adults who have a suspected or previous diagnosis of a speech sound disorder. This tool will aid in the identification or continued diagnosis of an articulation or phonological disorder. Using videos as the subject material provides test-takers with an interactive medium to maintain engagement. The results of the *Articulation and Phonology VAT* provide comprehensive information on articulatory and phonological skills of children and young adults. By utilizing the *Articulation and Phonology VAT*, we are able to develop a better understanding as to how a student's articulation and phonology skills may impact their academic performance and progress in school.

Code of Federal Regulations – Title 34: Education

34 C.F.R. §300.7 Child with a disability. (c) Definitions of disability terms. (11) Speech or language impairment means a communication disorder, such as stuttering, impaired articulation, a language impairment, or a voice impairment, that adversely affects a child's educational performance.

The Individual's with Disabilities Act (IDEA, 2004) states that when assessing a student for a speech or language impairment, we need to determine whether or not the impairment will negatively impact the child's educational performance. In order to determine whether an articulation or phonology impairment exists, we can collect a speech sample of the individual, and analyze intelligibility and the impact of the impairment on academic success.

Contextual Background for Articulation and Phonology VAT

A speech sound disorder is an umbrella term that refers to the difficulty, or combination of difficulties, with perception, production, and/or phonological representation of speech sounds and speech segments (American-Speech-Hearing Association [ASHA], 2016). When these speech sound disorders do not have a known cause, they are referred to as either articulation or phonological disorders. Difficulties in articulation may result in sound distortions, substitutions, and omissions of individual speech sounds (ASHA, 2016). Phonological errors are predictable and result from difficulties in the comprehension and use of a speech sound system and it's governing rules (Bauman-Waengler, 2004). For example, a child with a phonological disorder may engage in final consonant deletion or fronting of speech sounds.

The current assessment tool is composed of target words that address articulatory and phonological speech sound errors. Table 1.1 reviews common phonological processes.

Table 1.1 Phonological Processes	
Phonological Process	*Definition/Example*
Backing	An alveolar sound (e.g., /t/ and /d/) is substituted with a velar sound (e.g., /k/ and /g/)
Fronting	A velar or palatal sound (e.g., /k/, /g/, and /ʃ/) is substituted with an alveolar sound (e.g., /t/, /d/, and /s/)
Gliding	An /r/ becomes a /w/, or /l/ becomes a /w/ or /j/ sound

Stopping	A fricative (e.g., /f/ or /s/) or affricate (e.g., /tʃ/) is substituted with a stop consonant (e.g., /p/ or /d/)
Affrication	A nonaffricate is replaced with an affricate (e.g., /tʃ/)
Deaffrication	An affricate (e.g., /tʃ/) is replaced with a fricative or stop (e.g., /ʃ/)
Alveolarization	A nonalveolar (e.g., /ʃ/, /m/) sound is substituted with an alveolar sound (e.g., /t/, /n/)
Depalatalization	A palatal sound (e.g., /ʃ/) is substituted with a nonpalatal sound (e.g., /t/)
Assimilation	A consonant sound starts to sound like another sound in the word
Denasalization	A nasal consonant (e.g., /m/ or /n/) changes to a nonnasal consonant (e.g., /b/ or /d/)
Reduplication	A complete or incomplete syllable is repeated
Cluster Reduction	A consonant cluster is reduced to a single consonant
Initial Consonant Deletion	The initial consonant in a word is left off
Final Consonant Deletion	The final consonant in a word is left off
Syllable Deletion	The weak syllable in a word is deleted
Epenthesis	A sound is added between two consonants, typically the "uh" sound

Theoretical Background of the Articulation and Phonology VAT

Articulation and phonological disorders typically occur in preschool and school-aged children between 2:0 and 21:0 years old. When articulation or phonological errors occur, there can be negative impacts to a child's academic performance. Previous research has suggested that students with early speech-language problems are behind their peers in reading, writing, and in other academics areas (Aram & Nation, 1980; King, Jones, Lasky, 1982; Hall & Tomblin, 1978). More specifically, preschool children with speech sound disorders are at a higher risk for difficulties with phonological awareness (PA), which can lead to difficulties with spelling and reading (Peterson, Pennington, Shriberg, & Boada, 2009; Bird, Bishop, Freeman, 1995; Nathan, Stackhouse, Goulandris, & Snowling, 2004). Additionally, children who present with speech sound disorders in kindergarten have been associated with lower literacy outcomes (Overby, Trainin, Smit, Bernthal, & Nelson, 2012). Data from the National Health Interview Survey (2012) estimated that almost half (48.1%) of the children between the ages of 3 and 10 years-old who have been classified as having a communication disorder present with speech sound disorders only (Black, Vahratian, & Hoffman, 2015). Moreover, a recent large-scale study revealed that 18% of 8-year-old children present with unresolved speech sound errors (Roulstone, Miller, Wren, & Peters, 2009) and additional reports suggest that 11% to 40% of children with speech sound disorders also have a related language impairment (Eadie et al., 2015; Shriberg et al., 1999).

There is a clear need for assessment tools that aid in the identification of articulation and phonological disorders because without appropriate assessment and intervention, there can be serious impacts on a child's academic performance. According to the American-Speech-Hearing Association (2016), assessment of speech sound disorders includes the evaluation of accurate productions, specifically, a student's ability to produce sounds in various positions (initial, medial, final) and in different phonetic contexts, sound combinations such as consonant clusters or blends, and syllable shapes such as simple consonant-vowel-consonant (CVC) to more complex consonant-consonant-vowel-consonant-consonant (CCVCC). Assessment should also evaluate sound errors and looks at the type of errors (e.g., omission, substitution, distortion), the consistency of sound errors, and the distribution of errors (e.g., position of the sound in a word) (ASHA, 2016). Lastly, assessment of speech sounds should look at error patterns, specifically, phonological patterns and whether there is a systematic sound change or simplification that affects a class of sounds (e.g., stops), sound combinations (e.g., consonant clusters), or syllable structures (e.g., multisyllabic words) (ASHA, 2016).

Articulation and phonology disorders can have adverse effects on various aspects of language development, as well as academic performance, and peer relationships. For example, a child who feels

embarrassed about their speech sounds may avoid social situations or conversations that require them to verbally communicate, which may result in a social language impairment. It is important that speech and language assessments be efficient and accurate to best serve our students. By assessing students with the *Articulation and Phonology VAT*, speech-language pathologists can better identify those individuals who have a suspected or an existing diagnosis of a speech sound disorder.

Administration and Scoring Procedures

T he following testing guidelines represent specific administration, scoring, and interpretation instructions for the *Articulation and Phonology VAT*. These procedures are considered best professional practice required in any type of standardized assessment as described in the Standards for Educational and Psychological Testing (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education [AERA, APA, and NCME], 2014). Strict standardized administration procedures must be followed to obtain reliable and accurate results. The Standards for Educational and Psychological Testing specifically emphasizes the importance of adhering to specific standardization procedures (Standard 6.1) and documenting deviations from the standardization procedures (Standard 6.3).

Examiner Qualifications

Professionals who are formally trained in the ethical administration, scoring, and interpretation of standardized assessment tools, who hold appropriate educational and professional credentials, may administer the *Articulation and Phonology VAT*. Qualified examiners include speech-language pathologists, school psychologists, special education diagnosticians and other professionals representing closely related fields. It is a requirement to read and become familiar with the administration, recording, and scoring procedures before using this test.

Confidentiality Requirements

As described in Standard 6.7 of the Standards for Educational and Psychological Testing (AERA et al., 2014), it is the examiner's responsibility to protect the security of all testing material and ensure confidentiality of all testing results.

Eligibility for Testing

The *Articulation and Phonology VAT* is appropriate to use for individuals between the ages of 2:0 and 21:0 years of age. This assessment tool is particularly helpful for individuals who are suspected of or who have been previously diagnosed with articulation and phonology deficits.

Testing Time

Administration of the *Articulation and Phonology VAT* takes approximately 25-30 minutes.

Test Materials

The *Articulation and Phonology VAT* is broken down into three versions based on age. A separate video test is used for age groups 2:0-2:11, 3:0-5:11, and 6:0-21 years old. The *Articulation and Phonology VAT* is accessible online. The test and the accompanying converting software are available on the *Video Assessment Tools* website.

Accessing Articulation and Phonology VAT online

Begin by logging onto your Video Assessment Tools account: www.videoassessmenttools.com

Next, select the "All Tests" tab and scroll down to the *Articulation and Phonology VAT*.

Select the *Articulation and Phonology VAT* by clicking on the picture or clicking the "See more…" tab.
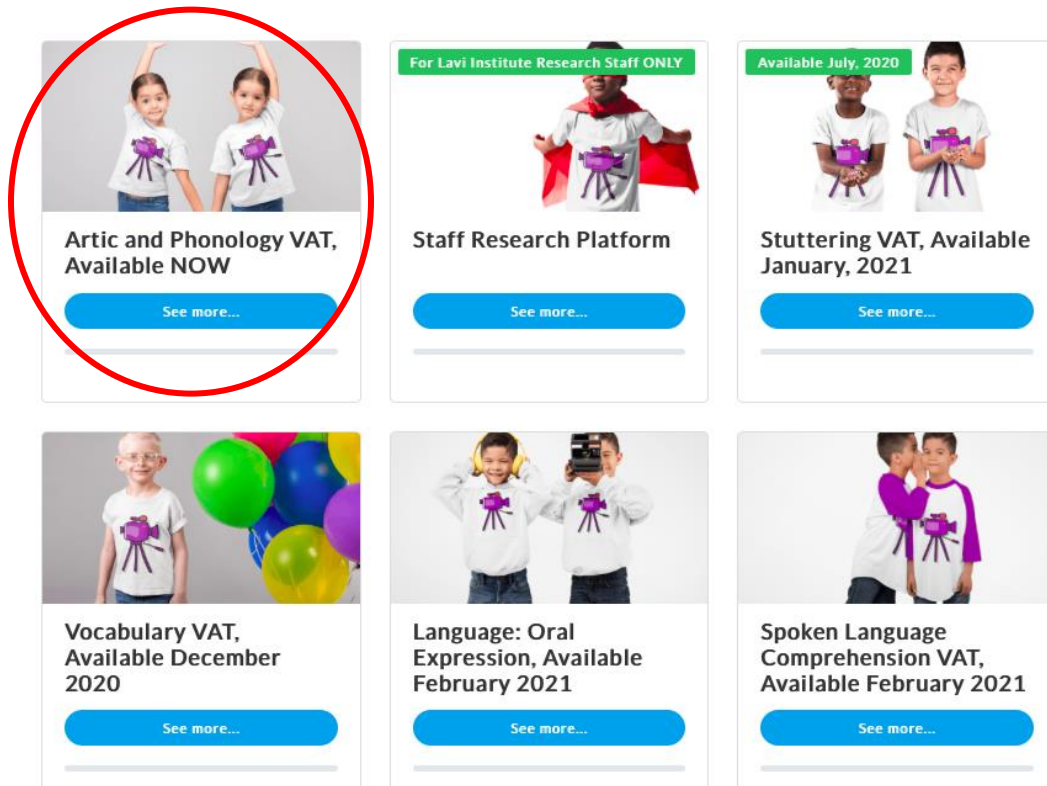
Administration Instructions

Step 1: Select the "Administer now" tab to load the *Articulation and Phonology VAT*. Be sure to select the test that targets your student's age range.

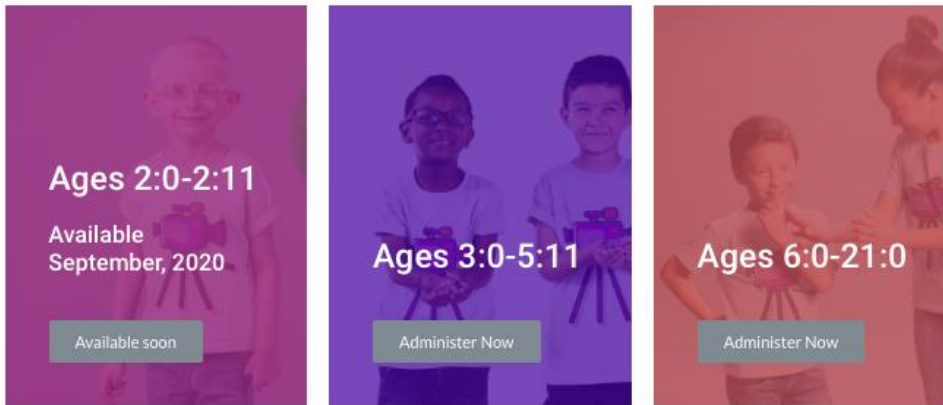**Step 2**: Once the assessment loads, there will be two viewing options available. *Option A* allows you to use buttons to navigate through videos. *Option B* allows you to view videos individually. Both options contain the same videos and test items, choose the option you prefer. For example, you may prefer *Option B* if the test is being administered over the course of a few days. Here, you will also see a "Download protocol here" tab. Select this tab to download a PDF copy of the test protocol. The PDF can be worked on online or printed.
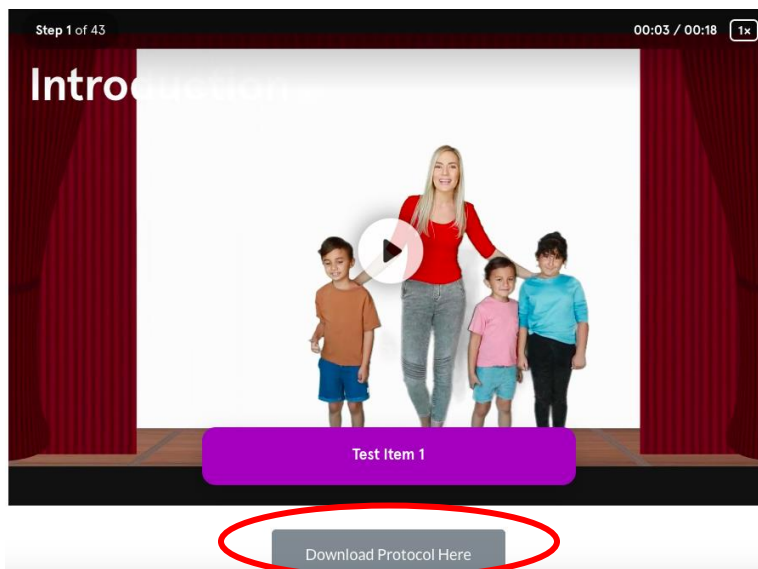
Step 3: Begin administering the test. Tell the examinee that, "We are going to watch some videos. Tell me what you see." Start with the practice item. On the protocol, circle each sound that is produced incorrectly. Record examinee's sound distortions, substitutions, omissions, and lisps and make note of phonological processes.

Artic and Phonology VAT, Available NOW

- ○ **Test Items (3:0 to 5:11 years)**
- ○ Test Items (6:0 to 21:0 years)
- ○ Get Raw Scores (3:0-5:11 years)
- ○ Get Raw Scores (6:0-21:0 years)
- ○ Get Standard Scores
- ○ Generate Report

Step 4: When you are done with the assessment, look to the toolbar on the left side of the screen and select the "Get Raw Scores" tab that corresponds to the testing age range. Here you will complete the Articulation/Phonology Scoring Sheet online. You will record all articulation errors and comment yes/no as to whether there were any phonological errors observed. Enter your own (the examiner's) email address to receive a PDF copy of scoring sheet.

Step 5: Next, select the "Get Standard Scores" from the side toolbar. Here you will enter the student's raw score and age to arrive at a standard score and percentile rank.

Step 6: Lastly, use the optional report generator to assist you in writing the articulation and phonology write-up portion of your evaluation.

Standardization and Normative Information

T he normative data for the *Articulation and Phonology VAT* is based on the test performance of 1011 examinees across 11 age groups (shown in Table 4.1) in 17 states (Arizona, California, Colorado, Nevada, Idaho, Illinois, Iowa, Kansas, Ohio, Minnesota, Florida, New York, Pennsylvania, Florida, South Carolina, Texas, Washington).

Table 4.1: Representation of the Sample, by Age Group

Age Group	Age	*N*	%
1	3-0 to 5-11	85	8.21
2	6-0 to 6-11	82	7.92
3	7-0 to 7-11	92	8.88
4	8-0 to 8-11	102	9.85
5	9-0 to 9-11	75	7.24
6	10-0 to 10-11	79	7.63
7	11-0 to 11-11	82	7.92
8	12-0 to 12-11	81	7.82
9	13-0 to 13-11	92	8.88
10	14-0 to 14-11	84	8.11
11	15-0 to 21-0	181	17.48
Total Sample		1035	100%

The data was collected during the school-year of 2019-2020 by 36 state licensed speech-language pathologists recruited through Go2Consult Speech and Language Services, a certified special education staffing company. All standardization project procedures were reviewed and approved by IntegReview IRB, an accredited and certified independent institutional review board. To ensure representation of the national population, the *Articulation and Phonology VAT* standardization sample was selected to match the US Census data reported in the ProQuest Statistical Abstract of the United States, 2017 (ProQuest, 2017). The sample was stratified within each age group by the following criteria: gender, race or ethnic group and geographic region. The demographic table below (Table 2.2) specifies the distributions of these characteristics and shows that on the whole, the sample is nationally representative.

Table 4.2: Demographics of the Normative Sample vs. US Population			
Normative Sample Size = 1035			
Demographic	N Normative Sample	% Normative Sample	% US Population
Gender			
Male	497	48%	49%
Female	538	52%	51%
Total	1035	100%	100%
Race			
White	704	68%	77%
Black	155	15%	13%
Asian	21	2%	4%
Other	42	4%	6%
Total	1035	100%	100%
Hispanic	114	11%	12%
Clinical Groups			
	none	none	none
US Regions			
Northeast	176	17%	16%
Midwest	217	21%	22%
South	372	36%	38%
West	269	26%	24%
Total	1035	100%	100%

Criteria for inclusion in the normative sample

A good assessment is one that yields results that will benefit the individual being tested or society as a whole (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education [AERA, APA, and NCME], 2014). One way we can tell if an assessment is a good test, is if it includes adequate norms. Previous research has suggested that utilizing a normative sample can be beneficial in the identification of a disability and that the inclusion of children with disabilities may negatively impact the test's ability to differentiate between children with disorders and children who are typically developing (Peña, Spaulding, & Plante, 2006). Since the purpose of the *Articulation and Phonology VAT* is to help to identify students who present with articulation and phonological deficits, it was critical to exclude students from the normative sample who have diagnoses that are known to influence articulation and phonology (Peña, Spaulding, & Plante, 2006). Thus, students who had previously been diagnosed with articulation, phonological impairments, or motor planning deficits were not included in the normative sample. In order for students to be included in the normative sample for this assessment tool, students must have met criteria of having typical articulation and phonological development, and show no evidence of speech intelligibility difficulties. Students used in the present normative sample had no other diagnosed disabilities and were not receiving speech and language support or any other services. Thus, the normative sample for the *Articulation and Phonology VAT* provides an appropriate comparison group (i.e., a group without any known disorders that might affect articulation/phonology) against which to compare students with suspected disorders. The *Articulation and Phonology VAT* is designed for students who are native speakers of English and/or are English language learners (ELL) who have demonstrated a proficiency in

English based on state testing scores and school district language evaluations. Students who were native English speakers and also spoke a second language were also included in this sample.

Norm-referenced testing is a commonly used method of evaluation that compares an individual's scores on a specific test to the scores of a group of test-takers (e.g., age norms) (AERA, APA, and NCME, 2014). Clinicians can compare students' performance on the *Articulation and Phonology VAT* to this normative sample to determine whether a student is scoring within normal limits or, if their scores are indicative of an articulation and/or phonological impairment. Administration, scoring, and interpretation of the *Articulation and Phonology VAT* must be followed in order to make comparisons to normative data.

Validity and Reliability

T his section of the *Articulation and Phonology VAT* manual provides information on the psychometric characteristics of validity and reliability. Validity helps establish how well a test measures what it is supposed to measure and reliability represents the consistency with which an assessment tool measures certain ability or skill. The first half of the chapter evaluates content, construct, criterion, and clinical validity of the *Articulation and Phonology VAT*. The latter half of the chapter reviews the consistency and stability of the *Articulation and Phonology VAT* scores, in addition to test retest and inter-rater reliability.

Validity

When considering the strength of a test, one of the most important aspects to consider is validity. Content validity refers to whether the test provides the clinician with accurate information on the ability being tested. Specifically, content validity measures whether or not the test actually assesses what it says it's suppose to assess. According to McCauley and Strand (2008), there should be a justification of the methods used to choose content, expert evaluation of the test's content, and an item analysis. Content-oriented evidence of validation addresses the relationship between a student's learning standards and the test content. Specifically, content-sampling issues take a look at whether cognitive demands of a test are reflective of the student's learning standard level. Additionally, content sampling may address whether the test avoids inclusion of features irrelevant to what the test item is intended to target.

Single-cut Scores

It is often common practice to use single cut scores (e.g., -1.5 standard deviations) to identify disorders, however, this is not evidence-based and there is actually evidence that advises against using this practice (Spauling, Plante, & Farinella, 2006). When using single cut scores (e.g., -1.5 SD, -2.5 SD, etc.) we may under identify students with impairments on tests for which the best-cut score is higher and over identify students impairments on tests for which the best-cut score is lower. Additionally, using single cut scores may go against IDEA's (2004) mandate, which states assessments must be valid for the purpose for which they are used.

Sensitivity and Specificity

Table 5.1 shows the cut scores needed to identify articulation and phonological disorders within each age range. Additionally, this table demonstrates the sensitivity and specificity information that indicates

the accuracy of identification at these cut scores. Sensitivity and specificity are diagnostic validity statistics that explain how well a test performs. Vance and Plante (1994) set forth the standard that for a language assessment to be considered clinically beneficial, it should reach at least 80% sensitivity and specificity. Thus, strong sensitivity and specificity (i.e., 80% or stronger) is needed to support the use of a test in its identification of the presence of a disorder or impairment. Sensitivity measures how well the assessment will accurately identify those who truly have an articulation or phonological disorder disorder (Dollaghan, 2007). If sensitivity is high, this indicates that the test is highly likely to identify the articulation or phonological disorder, or, there is a low chance of "false positives." Specificity measures the degree to which the assessment will accurately identify those who do not have an articulation or phonological disorder, or how well the test will identify those who are "typically developing" (Dollaghan, 2007).

Table 5.1 *Articulation and Phonology VAT* sensitivity, specificity and likelihood ratios					
Age group	Cut score	Sensitivity	Specificity	Positive likelihood ratio	Negative likelihood ratio
3:0-3:11	77	88	87	4.29	.09
4:0-4:11	77	87	86	6.12	.14
5:0-5:11	77	88	87	6.12	.13
6:0-6:11	78	89	88	4.29	.12
7:0-7:11	77	91	88	4.87	.08
8:0-8:11	77	92	90	4.29	.09
9:0-9:11	77	91	89	6.07	.18
10:0-10:11	77	89	90	6.12	.13
11:0-11:11	78	88	89	6.09	.11
12:0-12:11	77	92	89	6.07	.18
13:0-13:11	77	92	90	6.07	.18
14:0-14:11	78	92	91	6.07	.18
15:0-15:11	77	92	89	6.48	.12
16:0-21:0	77	94	96	7.27	.16

*Age groups 16:0-21:0 are reported together as there were no age-related changes detected after the age of 16.

Content Validity

The validity of a test determines how well the test measures what it purports to measure. Validity can take various forms, both theoretical and empirical. This allows us to compare an instrument with other measures or criteria, which are known to be valid (Zumbo, 2014). For the content validity of the test, expert opinion was solicited. Twenty-six speech language pathologists (SLPs) were asked to review the *Articulation and Phonology VAT*. All SLPs were licensed in the state of California, held the Clinical Certificate of Competence from the American Speech-Language-Hearing Association, and had at least 5 years of experience in assessment of children with articulation and phonological impairments. Each of these experts was presented with a comprehensive overview of test description, as well as rules for standardized administration and scoring. They all reviewed 8 full-length administrations. Following this, they were asked 30 questions related to the content of the video assessment tool and whether they believed the assessment to be an adequate measure of articulation and phonology skills. For instance,

their opinion was solicited regarding whether the questions and the raters' responses properly evaluated production of consonant clusters. The reviewers rated test items on a decimal scale. All reviewers agreed that the *Articulation and Phonology VAT* is a valid measure of articulation and phonology, in students who are ages 3 to 21 years. The mean ratings were 28.1±1.3.

Construct Validity

Developmental Progression of Scores

Articulation and phonology is developmental in nature and skills change with age. Mean raw scores for examinees should increase with chronological age, demonstrating age differentiation. Mean raw scores and standard deviations for the *Articulation and Phonology VAT* are divided into thirteen age intervals displayed in Table 5.2 below.

Table 5.2: Normative Sample's mean raw scores and standard deviations on the *Articulation and Phonology VAT*	
Age Group	**Mean Raw Scores and Standard Deviations**
3:0-3:11	32 (2.7)
4:0-4:11	28 (2.8)
5:0-5:11	19 (2.4)
6:0-6:11	4 (1.7)
7:0-7:11	4 (1.4)
8:0-8:11	3 (1.2)
9:0-9:11	3 (1.0)
10:0-10:11	2 (0.9)
11:0-11:11	1 (0.8)
12:0-12:11	1 (0.8)
13:0-13:11	1(0.7)
14:0-14:11	0 (0.2)
15:0-15:11	0 (0.2)
16:0-21:0	0 (0.2)

Criterion Validity

In assessing criterion validity, the *Articulation and Phonology VAT* was correlated to other measures of articulation and phonology: *Arizona Articulation and Phonology Scale - Fourth Edition* (Arizona-4; Fudala & Stegall, 2017) and the *Diagnostic Evaluation of Articulation and Phonology* (DEAP; Dodd, Holm, Crosbie, & Ozanne, 2003). Time between test administrations ranged from the same day to 5 days.

The concurrent validity was assessed using Pearson's correlation among all measures. Correlation coefficients of ≥0.7 are recommended for same-construct instruments while moderate correlations of ≥ 0.4 to ≤0.70 are acceptable. The level of significance was set at p≤0.05. When assessing validity, the *Articulation and Phonology VAT* was substantially correlated with the *DEAP* and the *Arizona-4*: 0.87, and 0.83 respectively, p<0.001.

Table 5.3: Pearson's Correlations between three measures of articulation and phonology (N = 21)

Articulation and Phonology Tests	DEAP	Arizona-4
Articulation and Phonology VAT [†]	.87	.83

Abbreviations: DEAP, Diagnostic Evaluation of Articulation and Phonology (2006); Arizona-4, Arizona Articulation and Phonology Scale - Fourth Edition (2017).
[†] significant at an alpha of 0.001 level of significance.

Group Differences

Since an articulation and phonology assessment tool is designed to identify those examinees with articulation and/or phonological impairments, it would be expected that individuals identified as likely to exhibit articulation/phonological impairments would score lower than those who are typically developing. The mean standard scores for three clinical groups of examinees (articulation impairment, articulation impairment secondary to hearing loss, phonological [reduced speech intelligibility due to multiple phonological processes]) were administered the *Articulation and Phonology VAT* and are listed in Table 5.4. The mean for the outcome variables were compared among the three clinical groups and the typically developing group of examinees using Kruskal Wallis analysis of variance (ANOVA). The level of significance was set at $p \leq 0.05$. Table 5.4 reviews the ANOVA, which reveals a significant difference between all three groups.

Table 5.4: Scaled Score Means (and Standard Deviations) of Subtests for Three Clinical Groups and a Demographically Matched Typically Developing Group, (N = 193)

	AI (n=52)	HL (n=36)	SIP (n=49)	TD group (n=56)	p –value[*]
Age Range: 3-5 years [a,b,c]	42 (2.9)	54 (3.4)	41 (3.6)	29 (3.1)	<.001
Age Range: 5-6 years [a,b,c]	39 (3.1)	51 (3.1)	43 (3.9)	19 (2.9)	<.001
Age Range: 6-8 years [a,b,c]	20 (3.1)	48 (3.9)	39 (3.4)	4 (1.5)	<.001
Age Range: 8-10 years [a,b,c]	9 (3.1)	14 (2.7)	11 (3.8)	3 (1.7)	<.001
Age Range: 10-14 years [a,b,c]	6 (2.9)	10 (2.6)	8 (1.8)	1 (0.6)	<.001

Abbreviation: AI, articulation impairment; HL, hearing loss; SIP, speech impairment secondary to phonological processes; TD, typically developing;
[*] Kruskal-Wallis Analysis of Variance test
[a] significant difference between AI and TD groups
[b] significant difference between HL and TD groups
[c] significant difference between SIP and TD groups

Inclusion/Exclusion Criteria for the Group Differences Study

Typically developing participants were selected based on the following criteria: 1) exhibited hearing sensitivity within normal limits; 2) presented with age-appropriate speech and language skills; 3) successfully completed each school year with no academic failures; and 4) attended public school and placed in general education classrooms.

Inclusion criteria for the articulation impairment group was: 1) having a current diagnosis of articulation impairment or delay (based on medical records and/or school-based special education eligibility criteria); 2) currently attending a local public school, and enrolled in the general education classroom; and 3) exhibited hearing sensitivity within normal limits.

Inclusion criteria for the articulation impairment secondary to hearing loss group was: 1) having a current diagnosis of articulation impairment or delay (based on medical records and/or school-based special education eligibility criteria); 2) currently attending a local public school, and enrolled in the general education classroom; and 3) exhibited hearing loss based on medical records and audiologist reports.

Finally, the inclusion criteria for the phonological group was: 1) having a current diagnosis of speech impairment (based on medical records and/or school-based special education eligibility criteria, and exhibiting at least two documented phonological processes that impact speech intelligibility); 2) being enrolled in the general education classroom based on medical records; and 3) exhibited hearing loss based on medical records and audiologist reports.

Standards for fairness

Standards of fairness are crucial to the validity and comparability of the interpretation of test scores (AERA, APA, and NCME, 2014). The identification and removal of construct-irrelevant barriers maximizes each test-taker's performance, allowing for skills to be compared to the normative sample for a valid interpretation. Test constructs and individuals or subgroups of those who the test is intended for must be clearly defined. In doing so, the test will be free of construct-irrelevant barriers as much as possible for the individuals and/or subgroups the test is intended for. It is also important that simple and clear instructions are provided.

Inter-rater Reliability

Inter-rater reliability measures the extent to which consistency is demonstrated between different raters with regard to their scoring of examinees on the same instrument (Osborne, 2008). For the *Articulation and Phonology VAT*, inter-rater reliability was evaluated by examining the consistency with which the examiners are able to follow the test scoring procedures. Two clinicians simultaneously rated students. The results of the scorings were correlated. The coefficients were averaged using the z-transformation method. The resulting correlations for the subtests are listed in Table 5.5.

Table 5.5: Inter-rater Reliability Coefficients, Articulation and Phonology VAT	
Age Group	**Reliability**
Age Groups: 1, 2, & 3	.89
Age Groups: 4, 5, & 6	.91
Age Groups: 7, 8, 9, 10, & 11	.93

Test-Retest Reliability

This is a factor determined by the variation between scores or different evaluative measurements of the same subject taking the same test during a given period of time. If the test is a strong instrument, this variation would be expected to be low (Osborne, 2008). The *Articulation and Phonology VAT* was completed with 59 randomly selected examinees, ages 3-0 through 21-0 over two testing periods. The interval between the two periods ranged from 16 to 20 days. To reduce recall bias, the examiners did not inform the examiners at the time of the first testing session that they would be testing again. All subsequent testing sessions were completed by the same examiners who administered the test the first time. The results are listed in Table 5.6. The test-retest coefficients for the various age groups were all greater than .80 indicating strong test-retest reliability for the *Articulation and Phonology VAT*.

Table 5.6: Test - Retest Reliability, Mean Standard Scores and Standard Deviations						
		1st Test		2nd Test		Correlation Coefficient
Age Groups	N	Mean	SD	Mean	SD	
1,2, & 3	21					
Clinician		99	2	100	2	0.88
4,5, & 6	20					
Clinician		101	1	101	1	0.92
7, 8, 9, 10 & 11	18					
Clinician		100	1	100	1	0.91

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