

Summer 2019

Developing a School-Age Language Screening for SLI

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DEVELOPING A SCHOOL-AGE LANGUAGE SCREENING FOR SLI

by

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Bachelor of Arts
University of South Carolina, 2016

Submitted in Partial Fulfillment of the Requirements

For the Degree of Master of Speech Pathology in

Speech Pathology

The Norman J. Arnold School of Public Health

University of South Carolina

2019

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ABSTRACT

Purpose: This study explored past tense marking in oral reading as a clinical marker of specific language impairment (SLI). A School-Age Language Screening Assessment (SALSA) was evaluated to determine whether it can be used to improve the identification of school-age children with SLI. The first aim was to calculate overall accuracy with children with TL and SLI on reading regular and irregular past tense verbs in oral reading of connected text. The second aim was to determine the overall diagnostic accuracy of SALSA.

Method: 96 children with TL and 3 children with SLI (N = 99) in grades 2-4 were administered the SALSA measures in addition to language measures. Each past tense verb was categorized into one of three response types: (a) accurate, (b) incorrect, and (c) unscorable. Performance across each group was compared. Additionally, sensitivity, specificity, and diagnostic accuracy were calculated at multiple cut-points for evaluating the effectiveness of past tense marking on the SALSA measures in children with SLI.

Results: Children with SLI produced fewer correct readings of regular past tense verbs than children with TL. There were no group differences on irregular past tense. A cut-off of 88.1 for regular past tense accuracy yielded the highest sensitivity of 100% and a reasonable diagnostic accuracy of 83.8%.

Conclusions: The results of this study indicate that regular past tense accuracy in oral reading is a promising clinical marker for diagnosing SLI in school-age children. The SALSA measure yielded high sensitivity and reasonable diagnostic accuracy.

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LIST OF ABBREVIATIONS

AUC	Area Under the Curve
ROC	Receiver Operating Characteristic Curve
SALSA	School-Age Language Screening Assessment
SLI.....	Specific Language Impairment
TL.....	Typical Language

CHAPTER 1

INTRODUCTION

Specific language impairment (SLI) is the most common form of developmental language disorder in which individuals exhibit difficulties in language production, comprehension, or both, that cannot be accounted for by hearing loss, intellectual disability, neurological damage, or any other developmental disorder (Leonard, 1998; Schwartz, 2009). SLI occurs in children who have normal nonlinguistic aspects of development (self-help skills, social skills) and normal non-verbal IQ (Bishop, 2006).

At school entry, children who meet the diagnostic criteria for SLI are often unidentified (Tomblin et al., 1997). For example, Tomblin et al. (1997) reported that the prevalence of SLI is 7.4% in kindergarten children. Thus, it is one of the most common childhood learning disabilities, but fewer than one-third of parents of kindergarten children with SLI had been notified that their child struggled with speech or language acquisition (Tomblin et al., 1997). Perhaps more unnerving, only 9% of the children in this SLI group who did not have concomitant speech deficits received intervention services (Zhang & Tomblin, 2000). If children with SLI learned language in a similar manner as other children, only with a delayed start, then the under-identification of SLI at school entry wouldn't cause as much concern. Yet these children do not "catch up" to their same-age peers and these language-learning difficulties persist into adolescence (Catts et al., 2002; Tomblin & Nippold, 2014). Adults with a history of SLI often have

difficulty establishing friendships and pursue future careers that do not require a high level of language and literacy ability (Whitehouse et al. 2009).

The problem of the under-identification of SLI has also been reported in other population-based research studies (Oetting, McDonald, Seidel, & Hegarty, 2016; Redmond, Ash, and Hogan, 2015). For example, Oetting et al. (2016) reported that 8% of 669 African American kindergarteners met the diagnostic criteria for SLI. Only 25% of the children with SLI in this study, however, were receiving services (Oetting, McDonald, Seidel, & Hegarty, 2016). Additionally, Redmond, Ash, and Hogan (2015) found that only 54.5% of children identified with SLI were enrolled in school-based language services. Based on these three studies, which occurred in different regions of the United States and across dialects, the prevalence of SLI is pretty consistent at 7-8% and the vast majority of the children meeting the criteria aren't receiving services.

Current Groups Receiving Services for SLI

To minimize the chances of a child with SLI being unidentified, it is crucial to identify SLI at an early age for intervention. Prior research confirms children with language delays who receive intervention in the early years have better academic outcomes when they reach school-age in comparison to children who don't receive early intervention (van Agt, van der Stege, de Ridder-Sluis, Verhoeven, & de Koning, 2007). Early identification of SLI, however, is challenging (Bishop & McDonald, 2009). First, children with developmental disabilities such as Down syndrome and autism spectrum disorder have differentiating physical and behavioral features but children with SLI do not (Bishop & Norbury, 2002). Second, education in the United States isn't mandated to begin until kindergarten for some states and first grade for others. Therefore, clinical

signs of language impairment may not be identified due to the low rate of finite omissions once children begin elementary school (Rice et al., 1998). Lastly, identifying SLI in kindergarten children is difficult in discriminating between the children with true language impairment and those who fall on the low end of normal (Conti-Ramsden & Durkin, 2012). Furthermore, a strong and robust clinical marker for school-age children with SLI is in need because there is a gap between spoken language in preschool and school-age children with SLI.

In order for a child to qualify for services in a school setting for SLI, he or she must be referred for an evaluation, identified as language impaired from the results of the evaluation, and considered eligible for receiving intervention from a speech-language pathologist. Previous literature confirms that children with SLI are at a significantly higher risk of low academic performance (Beitchman, Wilson, Brownlie, Walters, & Lancee, 1996; Werfel, Schuele, & Reed, 2019; Young et al., 2002). This performance is due, in large part, to the high linguistic quantity of verbal and oral material in classrooms (Catts et al., 2002; Isoaho, Kauppila, & Launonen, 2016).

Current research suggests that only particular subgroups of preschool children currently are receiving services for SLI. In a recent study conducted by Wittke and Spaulding (2018), the preschool children with SLI whose mothers had higher formal education, and whose teachers identified them as having low executive functioning were most likely to receive intervention. Additionally, children with SLI from lower socioeconomic backgrounds are already at a greater risk for academic difficulty and are less likely to be referred for intervention services by their parents (Archibald & Gathercole, 2006; Fujiki, Spackman, Brinton, & Hall, 2004; Montgomery, 2002).

Tense Marking as a Clinical Marker of SLI in Preschool Children

The term ‘clinical marker’ is defined as consistent behaviors that are shown to be suggestive characteristics of a condition, or disability, such as SLI (Rice et al., 1996). These markers are crucial for the accurate identification of children with SLI. A clinical marker for SLI in preschool is finite marking, or specification of grammatical tense in spoken language (Tager-Flusberg & Cooper, 1999). This is agreed to be a useful clinical marker because children with SLI inconsistently omit surface level tense markers in elicited tasks and spontaneous language through age eight (Rice et al., 1998). However, children with typical language are at near-adult like use of these grammatical morphemes by age five (Rice et al., 1998). As children advance in elementary school, the omission of past tense marking in spoken language more closely resembles their typical peers (Rice et al., 1998). Thus, there is a need for school-age clinical markers due to the decline of utility of finite marking in spoken language beyond first grade (Rice et al., 2009; Rice, Tomblin, Hoffman, Richman, & Marquis, 2004).

Researchers have explored using written language as a method of measuring finite marking in older children (Windsor et al., 2000). By the time children enter elementary school, there is too much overlap in finite marking in spoken language to continue to be a reliable clinical marker between children with SLI and children with typical language. Children with SLI indeed exhibit difficulties in more challenging linguistic tasks that involve written language. Windsor et al. (2000) reported that correct productions of inflections in written language in 10- to 12-year-old students were more difficult for children with SLI. Written and spoken language samples were compared to age and

language-matched controls, and the children in the SLI group consistently made grammatical errors in written language; past tense omissions were the most common error, affecting 26% of verbs in obligatory contexts (Windsor et al., 2000). Written language is more linguistically challenging than spoken language, and the present study examined the hypothesis that these past tense markers reemerge as reliable clinical markers of SLI when written language tasks are used to tax children's linguistic systems.

The Need for a School-Age Clinical Marker

Because SLI does not resolve and because SLI has negative impacts on academic outcomes, a reliable and valid clinical marker for identifying language impairment in school-age children is needed (Rice, Hoffman, & Wexler, 2009). A clinical marker must have high specificity - the level at which it classifies individuals who do not have the disorder as not having the disorder - and high sensitivity - the level to which it classifies individuals who have the disorder as actually having the disorder (Dollaghan, 2007).

Werfel, Hendricks, and Schuele (2017) conducted a preliminary investigation of past tense marking as a clinical marker of SLI in grades second through fourth. They categorized child oral readings of past tense verbs into six types of productions: correctly marked past tense, over-marked past tense, bare stem, other verb inflection, non-verb, and no response. Children with SLI produced fewer correct readings of past tense regular verbs than children with TL. Sensitivity, specificity, and diagnostic accuracy were calculated at five cut-offs for accuracy and finiteness marking in oral reading. Werfel et al. (2017) reported that a cut-off of 90% produced diagnostic accuracy of 76%, with 81% sensitivity and 73% specificity. Although this cut-off would identify most children with SLI, further assessment is warranted for typical language children due to the lower

specificity (Werfel et al., 2017). An important limitation of this study was that the passages used were from a standardized reading assessment, and were, thus, pre-created without a focus on the ability to specifically assess regular past tense marking with the same number and types of verbs across passages (Werfel et al., 2017).

Having a reliable school-age clinical marker for SLI with high sensitivity and high specificity would advance clinical practice in several ways. First, classroom teachers report that they often don't know when to refer a child for a language evaluation (Jessup, Ward, Cahill, & Keating, 2008; Williams, 2006). Second, there are currently few screening assessments focused on school-age language to determine if a full diagnostic evaluation is needed (Werfel et al., 2017). Lastly, the lack of a school-age clinical marker for children with language impairment makes universal screening very challenging (Gersten et al., 2012).

The Current Study

To further explore past tense marking in oral reading as a school-age clinical marker of SLI, the purpose of this study was to determine whether the School-Age Language Screening Assessment (SALSA), a measure developed by Dr. Werfel's lab can be used to improve the identification of school-age children with SLI. Specifically, we addressed two research questions:

- (a) In oral reading of connected text, are children with SLI less accurate than peers with TL on reading regular and/or irregular past tense verbs?
- (b) What is the diagnostic accuracy of SALSA for identifying SLI?

CHAPTER 2

METHOD

All study procedures were approved by the University of South Carolina Institutional Review Board.

Participants

Ninety-nine children (44 males and 55 females) participated in the study: 35 second, 37 third, and 27 fourth graders. Participants were recruited from a private elementary school in South Carolina with 101 students in grades 2 through 4. The principal of the private school mailed a letter home to second, third, and fourth graders stating that all students in these grades would participate in data collection that was conducted during library time. Two parents responded with requests that their children not be included; therefore, the final sample consisted of 99 students.

Participant inclusionary criteria included (a) English as primary language, and (b) receive a standard score of 80 or greater on the Test of Nonverbal Intelligence – Fourth Edition (TONI-4; Brown, Sherbenou, & Johnsen, 2010). We categorized participants as SLI or TL based on an 80 standard score cut-off on the Core Language Index from the Clinical Evaluation of Language Fundamentals- Fifth Edition (CELF-5; Semel, Wilg, & Secord, 2013), which is reported in the published test manual to be the optimal cut point for this measure.

Table 2.1 summarizes the group means, standard deviations and ranges for inclusionary measures and additional descriptive measures.

Table 2.1

Means, Standard Deviations, and Ranges on Inclusionary and Descriptive Variables

	N	Minimum	Maximum	Mean	SD
CELF-5 Core Language	99	73	145	106.51	12.68
TONI-4	99	82	130	105.59	9.13
TOWRE-2	99	57	145	105.54	14.56

Measures

The current study involved the following measures: TONI-4 (Brown, Sherbenou, & Johnsen, 2010), CELF-5 (Semel, Wilg, & Secord, 2013), Test of Word Reading Efficiency- Second Edition (TOWRE-2; Torgesen, Wagner, & Rashotte, 2012), and the School-Age Language Screening Assessment (SALSA).

Inclusionary measure. The TONI-4 evaluates problem-solving and abstract reasoning tasks that include one of more of the following characteristics: shape, position, direction, rotation, contiguity, shading, size, and movement. Children must respond to these tasks nonverbally as nonverbal intelligence is minimally influenced by linguistic knowledge. The raw score is the number of correct responses prior to the ceiling of the TONI-4: three incorrect responses out of five consecutive items. Children ages 10 years and older begin at item 20 and receive credit for all previous items (If a basal of the highest 5 consecutive correct responses is not established, items below 20 are administered in reverse order until a basal is established). The test-retest reliability of this norm- referenced measure is .83-.89.

Descriptive measure. The TOWRE-2 measures a child's ability to pronounce printed words accurately and fluently. We administered two subtests: the Sight Word Efficiency Subtest, which measures the ability to recognize familiar words and the Phonemic Decoding Efficiency Subtest, which measures the ability to sound out words quickly and accurately. Each child was asked to read as many words and non-words as quickly as he or she can in 45 seconds. Performance on the Sight Word Efficiency and Phonemic Decoding Efficiency subtests specific to a child's age are combined to determine overall word reading abilities in a Total Overall Word Reading Score.

Reference standard. The CELF-5 evaluates receptive (understanding) and expressive (speaking) language. Performance on subtests specific to a child's age are combined to determine overall language ability in a Core Language Score. We administered four subtests from this measure: Word Classes, Recalling Sentences, Formulated Sentences, and Semantic Relationships for ages 9-13. For ages 5-8, we administered the following four subtests: Sentence Comprehension, Word Structure, Formulated Sentences, and Recalling Sentences. The performance of children on each of these four subtests allows for a Core Language Skills composite, which reflects the child's overall language skills. Sentence Comprehension measures comprehension of grammatical rules at the sentence level. Word Structure measures the acquisition of English morphological rules. Word Classes measures the ability to understand relationships between associated words. Formulated Sentences measures the ability to formulate semantically and grammatically correct sentences of increasing length and complexity. Recalling sentences measures the ability to recall and reproduce sentences.

Lastly, Semantic Relationships measures the ability to interpret sentences that include semantic relationships. The CELF-5 reports sensitivity and specificity of .97.

Experimental measure. The SALSA task is an experimental oral-reading fluency task designed to identify school-age children with and without language impairment. The primary focus of the task is evaluating past tense marking in oral reading. All participants were required to read four passages, two expository passages (Passages A and B) and two narrative passages (Passages C and D). Passages A-D were different for each grade and reflected an age-appropriate reading level, measured by Flesch-Kincaid reading levels. Each passage includes multiple lexical verbs marked for regular past tense with the allomorphs /d/, /t/, and /əd/ and irregular verbs. Consistent with the standardized administration of the WRMT-III (Woodcock, 2011), each participant was instructed to, “Read this out loud but don’t rush. Read in your regular voice.” Additionally, each passage was timed from start to finish.

Passages A-D each contain 15 past tense verbs (5 regular /d/, 5 regular /t/, 5 regular /əd/) and 5 irregular past tense verbs. Appendix A provides a list of the regular past tense and irregular past tense verbs by passage. Each passage contains different verbs and the words are not the same across same-genre passages in each grade. Participants were scored on how they read the target verbs in connected text; verb productions were scored as accurate, incorrect, or unscorable. For example, if the target word was “wanted” and the participant said, “wanted” then it was scored as accurate. If the participant used a different past tense verb but marked it correctly then he or she still received credit. For example, if the target word was “jumped” but the participant used “raised”, it was scored as accurate because the past tense /d/ was correctly read. If a

participant omitted the ending of a verb then it was scored as incorrect. For example, if the target word was “painted” but the participant explicitly read “paint”, then it was scored as incorrect. Lastly, if a participant produced a word that was not a verb or omitted a verb, then it was scored as unscorable. For example, if the target word was “started” and the participant said “sun” or omitted the verb, then it was scored as unscorable. Additionally, if the participant read the past tense target as a verb marked for a different tense, then it was scored as unscorable. For example, if the target word was “decided” and the participant said “decides” or “deciding” then it was scored as unscorable.

Procedures

Study participation included administration of the four measures. The majority of assessment was conducted by the first author; additional assessment was conducted by master’s students in speech-language pathology, graduate assistants, a post-doctoral lab member and undergraduate students who were trained and familiar with the measures. Measures were administered individually in the cafeteria or science lab at the private elementary school during the students’ library time. All measures were administered in a random order for each participant. Randomized orders of assessment for each participant were generated using an Excel macro. Testing sessions were scheduled for no more than 40 to 45 minutes at one time. The number of testing sessions per participant was between one to three sessions, depending on the participant’s current reading level ability and school schedule. No words were removed from the analysis because all transcriptions were noted as reliable.

The passages were scored and double-scored only by trained lab members at the Written Language Lab at the University of South Carolina. Research assistants trained in

phonetic transcription and familiar with the procedures of the study were permitted to score these measures. The trained research assistant categorized each participant's oral reading for each past tense verb into three different response types: (a) accurate past tense, (b) incorrect past tense, and (c) unscorable. Table 2 defines the three response types with examples. To verify the reliability of the experimental tasks measure, a different research assistant separately listened to the recordings and scored the passages, following the same procedures. Disagreements were rare and were resolved by consensus. Inter-rater reliability was judged by a separate lab member who scored 30% of the SALSA measures, following the same procedures described above. Inter-rater-reliability was 99%.

Table 2.2

Categories for Oral Readings of Past Tense Text Targets

Category	Definition	Regular Verb Examples	Irregular Verb Examples
(a) Accurate	Child read the past tense text target with the correct past tense form or child read the incorrect text target with the correct past tense form (i.e. “raised” for “jumped”)	<i>wanted</i> <i>raised</i> <i>jumped</i>	<i>chose</i> <i>spent</i> <i>did</i>
(b) Incorrect	Child read the past tense text target as a verb not marked for tense.	<i>paint</i> <i>hunt</i> <i>jump</i>	<i>choose</i> <i>spend</i> <i>do</i>
(c) Unscorable	Child read the past tense text target with a non-phrase inflectional ending, child produced a word that was not a verb, or child did not produce a word for the target word (e.g., omitted the verb token when reading).	<i>decided</i> <i>decides</i> <i>sun</i> <i>no</i> <i>response</i>	<i>choosing</i> <i>spends</i> <i>doing</i> <i>where,</i> <i>who</i> <i>no response</i>

CHAPTER 3

RESULTS

This study represents an initial evaluation based on a study conducted by Werfel, Hendricks, and Schuele (2017) which explored the utility of past tense marking in oral reading as a clinical marker of SLI in grades second through fourth. For this study, the child readings of past tense verbs were categorized into three types. Analyses focused on overall accuracy and diagnostic accuracy of past tense marking on the SALSA screener as a clinical marker of SLI in school-age children.

Comparison of Response Types between Children with SLI and Children with TL

To address the first research question we compared the overall accuracy of past tense marking in oral reading, as well as accuracy across the four specific allomorphs of past tense: /t/, /d/, /ed/, and irregular verbs, across groups. Regular verbs were considered separately from irregular verbs. To test for differences in the response types of past tense production in oral reading of children with SLI and children with TL, we compared the group means for each of the three response types using a series of independent samples t-tests.

Regular and irregular verbs. Four comparisons were conducted for regular and irregular verbs using a series of independent samples t-tests for the variables: /t/ accuracy, /d/ accuracy, and /ed/ accuracy. Table 3.1 displays standard deviations, means, and *p*

values for each of the response types for regular and irregular verbs. Children with SLI produced fewer correct readings of regular verbs than children with TL. In contrast, overall accuracy was not significantly different for irregular verbs. Therefore, irregular past tense marking does not appear to be a clinical marker of SLI. These results further support the exploration of past tense marking in oral reading as a clinical marker in school-age children.

Table 3.1

Descriptive Statistics for Proportion of Production Types for Regular and Irregular Past Tense Verb Targets by Group

		N	Mean	SD	Sig.
(a) Overall accuracy	TL	96	.92	.10	
	SLI	3	.70	.15	.001
(b) /d/ Accuracy	TL	96	.92	.11	
	SLI	3	.67	.20	.001
(c) /t/ Accuracy	TL	96	.89	.12	
	SLI	3	.67	.07	.004
(d) /əd/ Accuracy	TL	96	.91	.14	
	SLI	3	.70	.21	.017
(e) Irr Accuracy	TL	96	.97	.07	
	SLI	3	.77	.16	.158

Note. This analysis defined SLI as a standard score below 80 on the CELF-5 Core Language Index.

Diagnostic Accuracy of SALSA

To address the second research question, we evaluated the effectiveness of past tense marking on the SALSA measures as a clinical marker of SLI in school-age

children. This research question considers performance on all twenty regular and irregular verbs. We examined classification function of the SALSA measures using different cut-offs for accuracy. To do this, we created receiver operating characteristic (ROC) curves for the SALSA measures. A ROC curve measures the accuracy of the screener by how well it separates the individual groups being tested into those with and without the characteristic in question. For the purpose of this study, we focused on distinguishing between SLI and TL. One overall index of screener classification accuracy is the area under the curve (AUC; Hosmer & Lemeshow, 2000). In addition to examining AUC, we evaluated sensitivity, specificity (the false-negative rate), and diagnostic accuracy at each possible cut-off. These values allowed us to identify the optimal cut-point on the SALSA measures to maximize identification of children with SLI while minimizing children incorrectly identified as having SLI.

To investigate the utility of regular and irregular past tense accuracy in oral reading as clinical markers of SLI in school-age children, we calculated diagnostic accuracy via sensitivity and specificity at multiple cut-points for each variable. Sensitivity, the level to which it classifies individuals who have the disorder are classified as actually having the disorder, was calculated by dividing the number of true positives by the sum of the true positives and false negatives.

Specificity, the level to which individuals who do not have the disorder are correctly classified as not having the disorder, was calculated by dividing the number of true negatives by the sum of the false positives and true negatives. We reported the false-positive rate (1-specificity), which was calculated by dividing the false positives by the false positives + true negatives. Diagnostic accuracy was calculated as the sum of the true

positives and true negatives divided by the total number of participants in each group. A test with high sensitivity but low specificity results in many individuals being told that they have the probability of having the disorder and therefore, need further assessment.

AUC scores between .7 and .8 are considered acceptable, AUC scores between .8 and .9 are considered good, and AUC scores above .9 are excellent. Thus, an area of 1 represents a perfect test (Hosmer & Lemeshow, 2000). The overall AUC obtained for SALSA in discriminating children with SLI from those with TL was .932, (95% CI= .847 - 1.00).

Table 3.2 reports sensitivity, specificity, and diagnostic accuracy at each cut-off for past tense accuracy. A cut-off of 88.1% yielded the highest sensitivity, 100%, with 16.7% overall false-positive rate and 83.8% diagnostic accuracy. A cut-off of 88.1% was identified as the optimal cut-point because this screening cut-off would catch all children with SLI but would refer a small percentage of children with typical language for further assessment. The analyses indicate that the past tense accuracy on the SALSA measures at an 88.1% cut-off shows great promise as a clinical marker of language impairment.

Table 3.2

Accuracy of SALSA Cut-Scores for Identifying SLI

Accuracy Cut-Off	Sensitivity	False-Positive Rate	Diagnostic Accuracy
81.9%	66.7%	7.3%	91.2%
84.4%	66.7%	13.5%	85.9%
88.1%	100%	16.7%	83.8%
90.6%	100%	27.1%	73.7%
93.1%	100%	37.5%	63.6%
95.6%	100%	51%	50.5%
98.1%	100%	77.1%	25.3%
100%	100%	100%	12.1%

CHAPTER 4

DISCUSSION

The purpose of this investigation was (a) to explore overall accuracy between children with SLI and TL on oral reading of regular and irregular past tense verbs and (b) to determine the diagnostic accuracy of SALSA for identifying SLI. Previous research suggested that school-age children with SLI continue to show linguistic deficits in more complex tasks, such as writing and oral reading. Based on these previous findings, we hypothesized that children with SLI would be less accurate at marking past tense in oral reading than children with TL. We also hypothesized that past tense marking in oral reading was very likely to be a robust clinical marker for school-age children with SLI. The results of this study supported both hypotheses. Overall, we found that children with SLI were less proficient at reading past tense verbs in oral passages as compared to their peers with TL. Additionally, a cut-point of 88.1% yielded reasonable diagnostic accuracy on the SALSA measures.

Accuracy across Regular and Irregular Past Tense

Children with SLI were less accurate at marking regular past tense in oral reading tasks in comparison to their peers with TL. This finding was consistent across all three regular past tense markers: /t/, /d/, and /əd/. Therefore, our findings are consistent with and build upon those of Werfel et al. (2017), who reported that past tense marking in oral reading showed promise as a school-age clinical marker of SLI.

In contrast, no significant differences on accuracy or types of variables occurred for irregular verbs. Thus, it appears that irregular past tense marking in oral reading tasks may not be a robust clinical marker of SLI in school-age children, but regular past tense marking is. These results further support the results of Werfel et al. (2017) that school-age children have difficulties with past tense marking in oral reading tasks; however, this is limited to regular past tense marking only.

Utility of Regular Past Tense Marking as a Clinical Marker of SLI in School-Age Children

Our second research question explored this issue further. We calculated sensitivity, specificity, diagnostic accuracy, and AUC to determine the efficacy of SALSA in identifying children with SLI. As previously discussed, an effective clinical marker should have high diagnostic accuracy, sensitivity, and specificity. Diagnostic accuracy for the SALSA screener was promising, with an AUC level of .932. The SALSA screener provided high sensitivity and therefore can be used to identify school-age children who should be referred for comprehensive testing for SLI. Using an 88.1% accuracy cut-off in regular past tense marking in oral reading on the SALSA measure provided the best combination of sensitivity, specificity, and overall diagnostic accuracy. Although lower accuracy cut-offs yielded higher specificity and diagnostic accuracy, we consider the 88.1% cut-off to be identified as the optimal cut-point for our screener, as it has high sensitivity to be used as an initial step toward identifying children for SLI in school-age children. For diagnostic assessment, cut-scores are recommended to maximize both sensitivity and specificity, preferably cut-scores above .80 (Spaulding et al., 2006). However, Oetting, Gregory, and Riviere (2006) recommend that sensitivity should be

optimized over specificity for screening measures. Therefore, it's better for a child with TL to fail a screening rather than a child with SLI pass.

Clinical Implications

Previous research showed that parents of children with SLI typically have not been notified that their child is struggling with speech or language acquisition (Tomblin et al., 1997). This is due in large part to classroom teachers not knowing when to refer a child for a full language evaluation (Jessup, Ward, Cahill, & Keating, 2008; Williams, 2006). Additionally, few screening assessments focus on school-age language to determine if a full diagnostic evaluation is needed (Werfel et al., 2017). Lastly, the lack of a school-age clinical marker for children with language impairment makes universal screening very challenging (Gersten et al., 2012). Therefore, the SALSA screener can be used clinically to determine whether school-age children would benefit from full diagnostic evaluation that doesn't rely on a single test score. The structure of SALSA will allow classroom teachers to make more informed decisions about who and when to refer a child for a diagnostic by an SLP.

Another important strength of the current study is that it is based on a community sample, similar to that for which a universal screen would typically be administered. For example, much of the prior research has used clinically referred samples to indicate whether a child needs a full language evaluation, which typically involves children with more severe deficits, for example, speech sound disorders and severe language deficits (Catts et al., 2005).

Limitations and Future Directions

To further explore past tense marking in oral reading as a clinical marker of SLI in school-age children, our future studies will address the limitations of the current study in several ways. First, we determined that 21 out of 96 children with TL were in the false positive group. Additionally, out of these 21 children with TL, six had reported reading diagnoses. Since approximately 30% of these children with TL appear to show reading deficits, our future research will control for reading deficits on past tense marking in oral reading. Overall, we might want to consider this measure not as only a language screener but also as a reading screener. Additionally, we will continue work to determine if a below-benchmark score on SALSAs should result in a referral for a full diagnostic assessment of language *and* literacy, rather than simply a full language assessment.

The SALSAs screener is proven to be diagnostically sensitive in identifying SLI in school-age children. Therefore, with more experimentation, SALSAs could potentially be used on a wide-spread scale by teachers and paraprofessionals to diagnose SLI. Future studies need to be conducted with larger sample sizes with larger base rates of children with diagnoses of SLI. In addition, more research is warranted to determine if SALSAs's accuracy is impacted by different variables.

First, we may consider re-writing the SALSAs passages to focus on regular past tense only, rather than both regular and irregular past tense verbs. This is due in large part to irregular past tense marking revealing no significant differences between groups and therefore, not a robust clinical marker for SLI. Second, we may consider administering the SALSAs screener to children with dyslexia to determine if diagnostic accuracy impacts school-age children with SLI. Lastly, the two text genre types (narrative and

expository) may be investigated to determine the efficacy and effectiveness of the overall diagnostic accuracy of SALSA. Lastly, we may consider exploring whether four passages are needed to yield a stable measurement.

CHAPTER 5

CONCLUSION

Overall, the findings of this study indicate that the SALSA screener can be used to guide teachers when to refer children for a full language evaluation. An 88.1% accuracy cut-off for regular past tense marking accuracy produced high sensitivity and reasonable diagnostic accuracy. The results of this study suggest that regular past tense marking in oral reading tasks is a promising clinical marker of SLI in school-age children. Additionally, looking at reading deficits in children with SLI has the potential to be able to use SALSA as a reading measure

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APPENDIX A

VERBS IN SALSA ORAL READING TASK BY GRADE

Second Grade

Passage	Reg /d/	Reg /t/	Reg /əd/	Irregular
A	lived owned named sailed captured	worked dressed picked stopped escaped	protected visited collected treated created	grew stole took heard hid
B	loved enjoyed imagined called allowed	worked liked hoped watched finished	wanted started created decided visited	heard made drew did built
C	tried learned filled bloomed called	checked talked looked finished jumped	added hated sprouted shouted planted	went gave set took saw
D	owned raised filled hired loved	fixed chopped cooked picked milked	painted started decided needed wanted	grew woke came rode had

Third Grade

Passage	Reg /d/	Reg /t/	Reg /əd/	Irregular
A	saved arrived loved played enjoyed	stopped purchased crashed finished picked	wanted started landed texted waited	bought found told won came
B	loved peered covered changed yelled	looked jumped skipped walked laughed	shouted skated decided invited rested	forgot ran froze made spent
C	roamed stayed played died dried	worked pushed walked crushed dropped	acted tasted hunted flooded visited	ate grew had went got
D	tried proved explored traveled named	hoped asked watched stopped helped	treated expected succeeded respected presented	chose knew made became wrote

Fourth Grade

Passage	Reg /d/	Reg /t/	Reg /əd/	Irregular
A	loved saved grabbed played pedaled	stopped picked watched laughed ended	wanted started ended decided needed	rode bought went got fell
B	continued learned filled watered longed	asked helped splashed worked finished	included planted counted started decided	took sat drank got began
C	lived believed earned named listened	asked worked purchased reached liked	rejected completed expected succeeded accepted	heard believed fought became flew
D	served called admired killed died	liked promised marched worked helped	elected started ended succeeded printed	spoke became did made shot