Better, Faster, Stronger: Outcomes of a Language Sample Transcription and Coding Training Study

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Abstract

Although language sample analysis (LSA) is considered an important tool for high-quality child language assessment, surveys have found that its use is quite limited by school-based speech-language pathologists (SLPs). Two of the reasons often cited are limited time and limited expertise (Kemp & Klee, 1997; Pavelko et al., 2016). This study aims to evaluate the outcomes of a language sample training program on SLP students' accuracy, efficiency, and confidence with language sample transcription and coding. Upper-division SLP undergraduates and graduate students participated in a self-paced language sample training and practice program. Participants completed online language transcription and coding training and practiced transcribing 7-10 narrative child language samples. After each one, they entered information into the quiz tool in the university's online learning management system and received automated, individualized, and specific feedback. The accuracy and time needed for the language transcriptions were recorded and analyzed. The results indicated that the participants significantly increased their accuracy and reduced the time needed for transcription and coding. They also reported a significant increase in their confidence level with language sample transcription. The results suggest that increased training and practice opportunities that involve specific feedback will better prepare new clinicians to use language sample analysis in clinical practice.

Keywords

Cover Page Footnote

Comprehensive language assessment for school-age children with potential language impairments is crucial for ensuring that children with a range of disabilities receive the intervention and support they need to participate effectively in their school curriculum. Norm-referenced assessment is a common assessment tool used by speech-language pathologists (SLPs). However, it is limited in its ability to assess natural language production skills. It should not be the only measure of language used for determining eligibility for school services per the Individuals with Disabilities Education Act (IDEA, 2004). Criterion-referenced (CR) assessment is also essential to comprehensive language assessment. Language sample analysis (LSA) is a rich CR tool that can provide a wealth of information for preschool and school-age children who primarily communicate verbally. LSA has long been considered an important part of high-quality, comprehensive language assessment (Nelson, 2010; Paul et al., 2018). The general purpose of the present study is to evaluate the outcomes of an LSA training program on speech-language pathology students' efficiency, accuracy, and confidence with language sample transcription, coding, and identification of inflectional morphology and complex sentences.

The strength of LSA as an assessment tool is its ability to provide detailed information about children's specific abilities in morphology, syntax, semantics, and pragmatics (Miller et al., 2016; Overton & Wren, 2014). Furthermore, it has greater ecological validity as an assessment tool as compared to norm-referenced tests as it makes use of and evaluates actual language production (Costanza-Smith, 2010; Heilmann et al., 2010; Miller et al., 2016; Overton & Wren, 2014; Paul et al., 2018; Thomas, 1989) in relevant contexts, including conversation, narrative, and/or expository contexts. Additionally, LSA has a vital role in obtaining converging evidence that a child does or does not have a language impairment when evaluated along with other sources of information (Castilla-Earls et al., 2020). LSA is a genuinely individualized form of assessment that can identify individual children's language strengths and weaknesses and help determine which aspects of a child's language have the most impact on effective communication (Miller et al., 2016; Price et al., 2010). LSA can be used throughout the assessment and treatment process to help diagnose language disorders, generate treatment plans and goals, and assess progress and post-treatment status (Kemp & Klee, 1997).

Although LSA is quite flexible and provides a wealth of information about language use in a variety of children with language impairments, surveys have indicated that LSA is not used as widely as might be expected (Kemp & Klee, 1997; Pavelko et al., 2016). Pavelko et al. (2016) conducted a nationwide survey of school-based SLPs that found that many school-based SLPs do not consistently use LSA in regular practice. Only 67% of SLPs used any language sampling and most of those analyzed less than 10 samples during that school year. Even if they did use some LSA in their practice, most did not report using systematic procedures such as recording samples, using set protocols, or eliciting production of complex syntactic forms. For example, less than half of the survey respondents used audio recordings of language samples, and more than half indicated that they transcribed samples while the child was speaking. Using systematic procedures adds consistency and structure to the LSA process. It would help guide the process of language sampling for SLPs to ensure that they are collecting and using the most informative language data for children of particular ages and abilities. In a survey of professionals, including SLPs, who specifically worked with children who are Deaf/hard of hearing (DHH), Blaiser and Shannahan (2018) found that most of these professionals used some language sampling as part of intervention. However, only about 21% indicated that they used LSA as an assessment tool when evaluating the

language of children who are DHH. Thus, LSA is used in assessment less often than expected by school-based SLPs in general, as well as by more specialized professionals.

Pavelko et al. (2016) identified that the most frequently cited reasons for not conducting LSA regularly are: 1) SLPs have limited time for conducting LSA, 2) there are limited resources for LSA, and 3) they have limited training/expertise in LSA. Surprisingly, caseload size was not a differentiating factor among those who reported limited time as a reason for not using LSA. Regardless of caseload size, lack of time was overwhelmingly identified as the primary reason for not conducting LSA. If SLPs are not using LSA very often, they may not fully appreciate the valuable information it provides and may become less inclined to use it. Although unfortunate, these concerns are real barriers to consistent and systematic LSA use in schools. Many SLPs do have considerable demands on their time in addition to conducting assessment and intervention, including completion of paperwork, meetings, etc. (American Speech-Language-Hearing Association, 2022).

The concerns that LSA is too time-consuming and that SLPs feel they lack the necessary training and expertise may be related to each other. Because there was no significant relationship between caseload size and the report of LSA being too time-consuming, the concern may not be with the proportion of time that LSA takes overall. Rather, the concern may be with how long it takes at the individual client level since it is not an easy task. As most SLPs seldom use LSA (Pavelko et al., 2016), the lack of expertise felt by SLPs may result in LSA being more time-consuming than necessary. If the task is difficult, it will likely take longer and reduce the likelihood of future use. Based on the studies of LSA use (Kemp & Klee, 1997; Pavelko et al., 2016), many SLPs may not have had the opportunity to learn to do language sampling deeply enough and practice it often enough to develop the proficiency level needed to use it effectively. This may be the barrier to using it often and consistently in clinical practice.

Language Sample Analysis Training

Currently, there is limited information on how LSA training takes place in most SLP educational programs. There is a need for a better understanding of how LSA training is implemented and how that may contribute to its use or lack of use in clinical work. Based on the first author's personal experience as an instructor in child language development and disorders, as well as collegial conversations with other instructors and clinical supervisors, there are several potential challenges to in-depth LSA instruction during SLP educational programs. Student challenges include many students reporting the task to be very difficult due to limited explicit language knowledge and limited opportunities for practice to develop efficient skills. Instructor challenges include the considerable time and effort needed for grading and providing specific feedback to students, which may preclude many from providing feedback that is as detailed as they would like. These factors may contribute to training being limited to only a few transcripts during a student's educational program, which may limit LSA application in clinical practice. Therefore, exploring approaches to LSA instruction and looking for possible remedies is important. Two potential barriers to instruction in LSA are similar to those cited by school-based SLPs: limited time and limited training and expertise in LSA and language analysis in general. These are likely closely related factors that impact instruction.

Time Limitations. Even as the SLP scope of practice has continued to grow over time, most graduate programs remain as two to two and a half year programs that need to cover a broader range of information and clinical skills in the same amount of time. This may lead to reduced opportunities for students to develop solid skills in LSA, and potentially other areas of SLP, as many such skills develop over time with practice and feedback. In the area of child language disorders, classroom and clinical instructors have a great deal to teach as our current scope of practice includes oral and written language across various discourse contexts and age ranges (i.e., 0-21 years). This broad scope of content and the limited time to teach this content may place considerable constraints on the depth of LSA instruction and feedback.

Although LSA is a valuable tool, it is also complex. It involves a multi-step process that includes collecting/recording language samples, transcribing and coding them, and analyzing and interpreting those samples. If computer-assisted language sample analysis is taught, there is also the additional step of having students learn how to use the software. Each of these steps needs to be addressed during instruction, in addition to many other concepts and skills involved in child language disorders. There are helpful tools available to assist in student training, such as the self-paced training modules offered by the Systematic Analysis of Language Transcripts website (SALT Software, n.d.). However, students often still need additional support and specific feedback in learning the various aspects of the LSA process as well. Furthermore, LSA is a skill that requires considerable practice and feedback to develop to a point where it can be used confidently and efficiently. This presents a challenge for instructors. Having students collect original language samples is a good experiential learning task. However, it would take an instructor an exorbitant amount of time to provide specific line-by-line feedback on the accuracy of transcription and coding for original language samples for an entire class. Even if this were feasible, it would be feasible only for a few language sample assignments. Alternatively, when instructors provide a specific language sample for transcription, coding, and analysis, they can provide a key for the students to compare with their transcriptions. This requires students to spend a considerable amount of time conducting a careful comparison and there is no efficient way for an instructor to verify that students completed such comparisons. Thus, the process of instructing students in language sample analysis results in limited opportunities for students to transcribe and code language samples while getting specific feedback. It is likely that most students may complete one or two language transcripts in their language disorders coursework and perhaps conduct a couple of additional language sample transcripts in their clinical training settings.

Limited Expertise and Explicit Knowledge of Language. In addition to reduced time for LSA training specifically, research has indicated that some SLPs may have limited explicit language knowledge expertise, which would likely impact the ability to identify and code key aspects of morphology and syntax in children's language samples (Blackley et al., 2008; Brimo & Henbest, 2020; Brimo & Melamed, 2017; Courtney, 2018) and to interpret it effectively for use in diagnosis and treatment. Blackley and colleagues (2008) found that SLP students in ten different graduate programs who completed an explicit language knowledge instrument had a mean of only 68% accuracy on morphology tasks and 38% accuracy on syntactic items, including identifying sentence types and parts of speech. Brimo & Melamed (2017) surveyed pre-professional undergraduate and graduate students from various academic backgrounds, although the majority indicated speech-language pathology as their major. The survey targeted the explicit syntax knowledge needed for analyzing children's syntactic abilities. Overall, total performance was only

at about 47% accuracy. There was no difference between those students with and those without previous language development coursework. This result suggests that language development coursework is inadequate for providing the type of explicit syntactic knowledge needed for language analysis in speech-language pathology and that students need more language science instruction to apply syntactic knowledge to language analysis in assessment and intervention.

In another study, Courtney (2018) administered a 30-question multiple choice test to SLP graduate students and practicing SLPs from 54 different graduate programs. The test questions targeted various areas of syntax, including identification and counting of clauses and then applying explicit syntax knowledge to identify if children's errors in sentences were related to syntax or to a different domain of language. The participants in both groups had about 70% accuracy on the test, suggesting that overall performance was below proficient as measured by typical graduate school standards. Although we did not find other studies that explicitly addressed knowledge of inflectional morphology by SLPs or SLP students, Good (2019) surveyed SLPs on various issues related to morphological awareness and found that 46.7% and 21% indicated only moderate or minimal confidence, respectively, for teaching morphological awareness.

Thus, there appears to be a considerable need for more explicit teaching of morphological and syntactic analysis skills in SLP education so that SLPs have the explicit knowledge and skills needed for efficient coding and, more importantly, analyzing children's language samples. This may contribute to the increased time and lack of expertise and confidence in conducting LSA specifically and assessing and treating morphology and syntax in children more generally. Increased practice opportunities with LSA may also lead to better explicit language skills overall and support greater use of LSA.

Purposes of the Training Program and Outcomes Study

The first author developed the LSA training program described here after hearing many students report that they do not see language sampling used frequently in their clinical placements and that they do not envision themselves regularly using language samples in their future practice due to the time and effort required. The training aimed to provide more opportunities to develop transcription and coding skills than what may be available in the general curriculum. An independent study course was used as the training program format and offered to undergraduate and graduate SLP students. The purposes of the training program described here were to:
- provide an independent but guided language transcript analysis learning experience using the Systematic Analysis of Language Transcripts (SALT) training modules (SALT Software, n.d.);
- provide ample practice opportunities for language sample transcription with automated feedback;
- increase students' efficiency, accuracy, and confidence in language sample transcription skills;
- provide additional training on inflectional morphology identification;
- provide additional training on the identification of complex sentences and counting clauses.

Overall, the purpose of the outcomes study itself was to determine if the training program, which involved seven to ten transcription experiences, would result in reduced time needed for

transcription, increased accuracy of coding and identification of inflectional morphology and complex sentences, and increased confidence in SLP students' ability to complete and use LSA.

Hypotheses

There were three hypotheses:
1. Students would increase their accuracy of transcription, coding, and identification of inflectional morphology and syntactic complexity.
2. Students would significantly reduce the time needed to transcribe language samples over the course of the program.
3. Students would report increased confidence in their ability to conduct language sample analysis.

Method

The study took place within the context of an independent study course. It was approved by the Idaho State University Institutional Review Board (IRB) as IRB-FY2018-56. The IRB indicated, however, that as an educational outcomes study, it did not require IRB review or formal consent. The researchers, however, still required all participants to give informed consent before beginning the study. The participants consented to participate in the study by completing an electronically presented questionnaire in which students indicated that they understood the following: (a) the purposes of the independent study were to train students in language sample transcription and to collect data for an educational outcomes study on language sample training; (b) a student research assistant, who was trained in maintaining the confidentiality of data and who was possibly a classmate, would see their data; and (c) the de-identified data would potentially be used in research presentations and publications.

Participants. The participants in the study were 16 upper-division undergraduate students in communication sciences and disorders and 7 first-year graduate students in speech-language pathology at Idaho State University who enrolled in a one-credit-hour independent study course entitled *Independent Study: Language Sample Transcription*. All students were strongly encouraged to complete the training portion of the study within one month and to complete the practice transcriptions throughout the rest of the semester for undergraduates and two semesters for graduate students (due to additional time commitments involved in graduate students' clinical practicum responsibilities). Grading for the course was based on successfully completing the training and transcription tasks rather than on language sample performance. One of the students misunderstood the directions for the program, so their data was excluded. As a result, the total number of students whose data were included in the study was 22. All participants were female adults who appeared to speak Mainstream American English (MAE). Language background data was not collected. Three cohorts of participants enrolled in the independent study course during one of three different semesters. The goal was for each student to complete ten language transcripts during the course. However, the first time the course was offered, the students ($n=3$) completed seven transcripts. On subsequent offerings of the course, students completed ten ($n=19$) transcripts.

Language Sample Characteristics. The program involved 10 de-identified narrative language sample audio recordings randomly selected from data collected for a previous language study

(Wallin & Ogiela, 2016). Five transcripts were selected from children with typical language (TL), and five were from children with Developmental Language Disorder (DLD). All of the children were monolingual speakers of Mainstream American English between the ages of 6 years 2 months and 8 years 9 months with normal hearing and non-verbal cognitive skills who resided in southwestern Idaho. The language sample for each child was elicited using the three expressive stories of the *Test of Narrative Language* (Gillam & Pearson*,* 2004*)*. The mean language sample length was 46 utterances for children with TL, and 35 utterances for children with DLD. These lengths were deemed appropriate for the purpose of the study as it has been shown that language sample characteristics tend to be stable even with < 50 utterances (Heilmann et al., 2010, 2013).

Learning Management System Quiz Tool Parameters. The training program was developed with regard to several premises. In order to reduce at least some of the barriers to LSA instruction, the program had to meet the the following criteria:

- increase the number of opportunities for students to practice language sample transcription with multiple transcripts;
- provide specific feedback for learning and generalization;
- have automated feedback so that specific feedback could be provided efficiently and individually, while not requiring an instructor to evaluate each student's transcript individually.

The program addressed this innovatively using tools in the university's online Learning Management System (LMS) to provide training and immediate and specific feedback on practice transcriptions. The file tool in the LMS provided the participants with documentation, slide presentations, and the language sample audio files. To automate the specific feedback, each of the ten language samples was converted to a quiz in the LMS system. The conversion process was time-intensive; however, the initial time investment was worthwhile as the quizzes could be used with an unlimited number of students. Each utterance of the language sample had a set of five questions associated with it. (See the Appendix for a sample of the questions associated with each utterance in a language transcript and the feedback provided regarding correct or incorrect responses.) This particular quiz tool used by the LMS system allows for various types of questions. Its *Information questions* do not involve any responses. They simply provide information that a student can use to answer the set's remaining questions. Thus, the first question for each utterance was an *information question* containing the orthographically transcribed target utterance. The second question was a *short answer question* that asked, "How many words are in this utterance?" The third question was a *short answer question* that asked, "How many morphemes are in this utterance?" The fourth question was a *short answer question*: "Indicate the subordination index number for this utterance." The subordination index number is the number of full finite clauses in each utterance that have an independent subject and verb. The fifth question was a *multiple choice/multiple answers allowed question* that asked participants to "Indicate the morphemes included in this utterance." This question included all 14 early inflectional morphemes (Brown, 1973) as well as semi-auxiliaries and an option for "None." Because the default settings for a *multiple choice / multiple answers allowed question* would not count wrong choices as incorrect, the scoring system was set to deduct a percentage for wrong choices. Each student used their language sample transcripts as the basis for entering their information into each quiz. The quiz allowed the student to review their accuracy immediately after completing it. The review would provide the student with their answer, whether correct, incorrect, or partially correct, and the

correct answers (see the Appendix). Thus, the participants received specific feedback for each utterance immediately after completing each language sample quiz.

Procedure.

Orientation. Each student had access to the online course on the LMS website. The program initially involved an orientation to the program with instructions about the various stages of the program. The orientation meetings took approximately 1 hour and took place through in-person or video conference meetings. There were typically two to three orientation meetings depending on the size of the student cohorts and their needs.

Training. The students completed online training on the conventions of language transcription using eleven self-paced training modules through the SALT program (SALT Software, n.d.) and three online training modules developed by the first author. At the time of the study, the on-campus students had access to the SALT program either by purchasing the student version or using the departmental computer labs with site licenses. Online students without access to the campus computer labs had to purchase the student version to participate. During the training period, the students met with the first author or a teaching assistant on an as-needed basis to ask questions. Such meetings took place in person or through videoconferencing, depending on the student's preferences or location (two campuses and an online program). Students could also post questions in a discussion forum in the LMS and receive a written response.

The eleven SALT modules and three additional lab-specific training modules included the following:

- Introduction to LSA (SALT)
- Transcription Quick Start (SALT)
- Transcription - Getting Started (SALT)
- Transcription - Transcript Format (SALT)
- Language Sample Parsing and Coding (lab-specific)
- Transcription - Utterance Segmentation (SALT)
- Transcription - Conventions Part 1 (SALT)
- Transcription - Conventions Part 2 (SALT)
- Transcription - Conventions Part 3 (SALT)
- Additional Coding Conventions for Inflectional Morphemes (lab-specific)
- Transcription - Practice Samples (SALT)
- Identifying Clauses in Complex Sentences (lab-specific)
- SI – Subordination Index (SALT)
- Analysis – Fundamentals (SALT)

Based on past teaching experience, students seem better able to use the SALT training modules on utterance segmentation and coding more effectively after an introduction to C-units and T-units and the general concept of transcript coding. For this reason, an instructor-created module entitled *Language Sample Parsing and Coding* was introduced before the students completed the SALT *Utterance Segmentation* module. Instructions for segmentation followed the SALT rules for segmentation based on T-units. After completing the SALT transcription conventions parts 1, 2,

and 3, the students completed an instructor-created module entitled *Additional Coding Conventions for Inflectional Morphemes*. Although the SALT conventions include coding for bound inflectional morphemes, they do not include codes for free inflectional morphemes or distinguishing between copula and auxiliary "be" forms. This module provided instruction on identifying these morphemes and using additional codes to indicate them. Based on past teaching experience, students tend to have difficulty correctly identifying the number of clauses in utterances, which can lead to difficulty accurately identifying the correct Subordination Index number in the SALT transcripts. Therefore, before completing the SALT module, *Subordination Index*, students completed the instructor-created module, *Identifying Clauses in Complex Sentences*, to provide a stronger foundation for conducting this task. This topic tended to be the most difficult for students, resulting in the most questions and requests for additional meetings with the research assistant or instructor.

Practice. After the initial training, the students were each assigned audio files for the language samples on an individualized spreadsheet that was also used to record the start and end times of their initial transcription and coding to measure the amount of time needed for each transcription. The students were asked to complete each child's transcript in one sitting, if possible. If not possible, they were asked to complete at least the transcription of each story in one sitting. The transcript orders were uniquely randomized for each participant to avoid the possibility that a set order could influence the time and accuracy of the transcriptions. Also, randomizing the order for each student controlled for differences in time and accuracy that could be due to particular children producing language samples that were more difficult to transcribe rather than indicating improvement in skill.

The instructions for transcription and coding were similar to the SALT conventions for transcription with some additional coding. Because students often have difficulty identifying all 14 early inflectional morphemes (Brown, 1973), they were instructed to code all of them, including the free inflectional morphemes, to promote automatic recognition. SALT only codes for bound morphemes and does not require a distinction between copula and auxiliary "be" forms. This likely required extra time for the students but was deemed important for learning purposes. Additionally, students were instructed to be cautious about not coding past participle "-ed" and present participle "-ing" when they are not used in tensed verb phrases. As this identification is often challenging, it likely added time to the transcription process.

Trained research assistants had previously transcribed the language samples used for the study. A trained graduate research assistant rechecked the parsing and coding of the transcripts, and discrepancies were resolved by the first author. Using the LMS quiz tool necessitated having the students use transcripts that were parsed in the same way. After each file was transcribed using the SALT software (Miller & Iglesias, 2012) and submitted, the student received a parsing key to compare their transcript to and make changes so that their final transcript would be parsed the same way as the transcript in the quiz. Students were encouraged to ask questions about any parsing differences between their personal transcript and the transcript key. The students used their final transcript to complete the quiz for each transcript. After each quiz was submitted, they had immediate access to their score and specific feedback for each utterance in the transcript. Each quiz also provided general feedback on frequently missed items for that transcript. See the Appendix for examples of the feedback provided to the students. Completing the quiz is an added

step for the students. However, it allows for their transcripts to be scored on key aspects with feedback on accuracy without requiring an instructor to score them individually.

Post-training Questionnaire. After completing the transcriptions and quizzes, students anonymously responded to a questionnaire regarding the experience. It included questions about their pre-training experience and confidence with LSA, as well as their confidence and skills with various aspects of language transcription, and the helpfulness of various aspects of the program. The scale for questions that involved a rating was:
- 1 = not confident/helpful/beneficial/improved
- 2 = somewhat confident/helpful/beneficial/improved
- 3 = moderately confident/helpful/beneficial/improved
- 4 = very confident/helpful/beneficial/much improved

Using an even-numbered scale ensured that respondents would need to consider the choices and could not default to selecting the middle item. Because the questions focused on the amount of confidence, helpfulness, benefit, or improvement, and allowed for a response of 1 to indicate *none,* there was no need for an otherwise neutral response. The questions and mean ratings are in Table 1 below.

Data Analysis. A repeated-measures ANOVA was performed on the accuracy of transcription and identification of the number of words and morphemes, inflectional morpheme identification, and SI assignment based on the quiz scores obtained for each transcript. Another repeated-measures ANOVA was performed on the time needed for transcribing each language sample from the beginning to the end of the training. Additionally, because the difference in students' confidence levels before and after the LSA training program was repeated measures categorical data, the non-parametric Wilcoxon signed-rank test was used to evaluate this data. The remaining questionnaire data is presented descriptively, and students' qualitative responses are discussed.

Results

Overall, the participants significantly increased their accuracy and reduced the time needed for transcribing language samples due to the program. There was also a significant increase in the students' reported confidence level from the beginning to the end of the program.
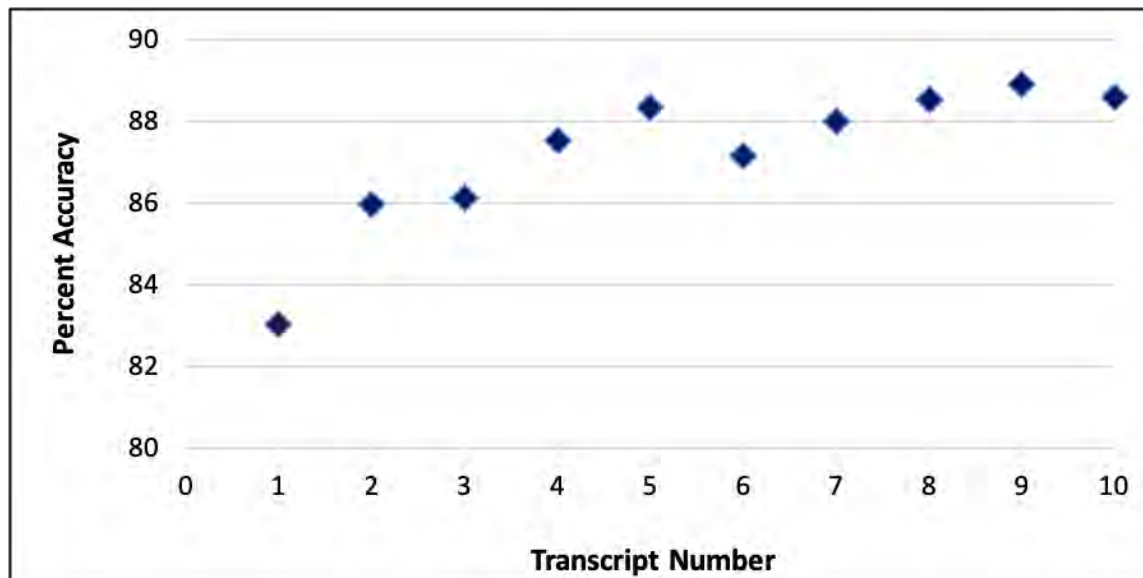
Accuracy. A repeated-measures ANOVA supported the first hypothesis indicating that the students significantly increased their accuracy of transcription, coding, identification of inflectional morphology, and identification of syntactic complexity, $F(9,21) = 2.91, p = .003$, with a large effect size, $\eta^2 = .19$ (see Figure 1). Interpretation of the magnitude of η^2 is as follows: $\eta^2 = 0.01$ indicates a small effect, $\eta^2 = 0.06$ indicates a medium effect, and $\eta^2 = 0.14$ or greater indicates a large effect (Fritz et al., 2012). With experience, the participants increased their accuracy from a mean of 83% for the first transcript to a mean of 88.5% for the last transcript.

A general review of the quiz results suggested that certain aspects tended to be problematic. These included the misidentification of participles as tense morphemes, confusion between auxiliary and copula "be" forms, identification of when contracted negative morphemes should be counted separately from the verb (e.g., "is/n't") and when they should not (e.g., in irregular negative

contractions such as "won't"), identification of compound words and identification of the SI number for complex sentences.

Figure 1

*Mean Percent Accuracy on Language Transcript Quizzes across 10 Transcriptions*

Time. A repeated-measures ANOVA supported the second hypothesis indicating that the students significantly reduced the time needed to transcribe language samples over the course of the program, $F(9,21) = 19.6$, $p < .0001$ with a large effect size, $\eta^2 = .45$ (see Figure 2). The amount of time needed for transcription and coding was quite variable. The mean time needed for the first transcript was 135 minutes, with a range of 40-265 minutes, and the mean time for the last transcript was 55 minutes, with a range of 24-150 minutes. Notably, the second longest time for the last transcript was 84 minutes, which is more than an hour less. Through informal discussions with some of the participating students, it became apparent that some students spent more time listening to the audio recordings or portions of the audio recordings multiple times while other students listened to them only once or twice.

Confidence. On the post-training questionnaire, the participants indicated their confidence level before and after the training program. A non-parametric Wilcoxon signed-rank test indicated that the students' reported levels of confidence in their ability to transcribe and code child language samples significantly increased from before participation to after participation in the program, ($Z = -4.08$, $p < 0.001$) with a large effect size ($r = 0.89$). Interpretation of the magnitude of r is as follows: $r = 0.1$ indicates a small effect, $r = 0.3$ indicates a medium effect, and $r = 0.5$ or greater indicates a large effect (Fritz et al., 2012).

Figure 2

Mean Number of Minutes for Transcribing Language Samples across 10 Transcriptions
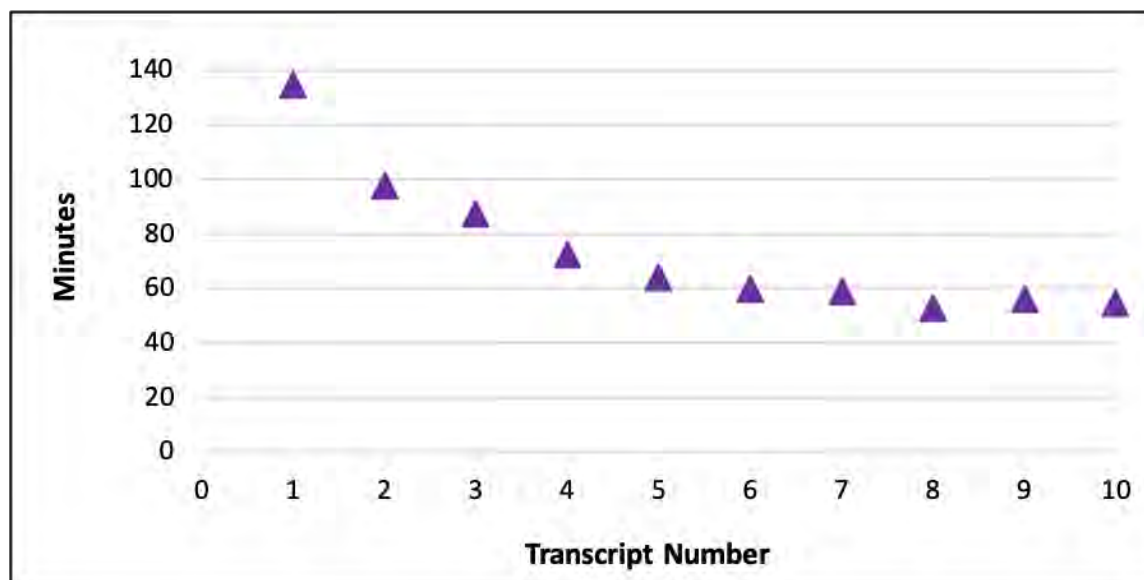
Additional descriptive data from the post-training questionnaire are also displayed in Table 1. Notably, most participants reported transcribing either no language samples ($n = 7$) or one language sample ($n = 10$) prior to their participation in the program. Only five participants had previously transcribed more than one language sample (2 transcripts, $n = 3$; 3 transcripts, $n = 1$; 4 transcripts, $n = 1$). Overall, participants reported that improvements in their confidence and skills increased in all the areas addressed. Only one student reported moderate confidence in their language sample transcription skills prior to the beginning of the project, five students reported being somewhat confident, and the rest indicated that they were not confident at all. After the training process, the mean responses to all the questions about level of confidence and skill were 3 or above, with the majority of the ratings at the 3 or 4 level, suggesting moderate to high increases in improvements and confidence. Likewise, the mean rating for the level of helpfulness of the various training materials and tools was also moderate, with the majority of ratings at the 3 or 4 level. There was more variation in responses to the question, "Did you think that the quiz format of correcting your language transcripts was beneficial to your learning experience (as compared to comparing your transcript to an answer key)." Although the majority of the participants ($n = 13$) answered *yes,* seven participants answered *not sure,* and two participants answered *no*.

Table 1

Mean Responses to Rating Questions on the Post-Training Questionnaire

Question	Mean Response
Prior to completing your first transcript for this project, how confident were you in your ability to transcribe and code a child language sample?	1.32
How confident are you now in your ability to transcribe and code child language samples?	3.05
How much do you think your speed in transcribing and coding improved as a result of this project?	3.50
How much do you think your accuracy in transcribing and coding improved as a result of this project?	3.36
How confident are you in your ability to recognize auxiliaries and copulas?	3.55
How confident are you in your ability to recognize simple, compound, and complex sentences?	3.32
How confident are you in your ability to identify present and omitted inflectional morphemes in a language sample?	3.23
How helpful do you think that the SALT online training modules were in helping you to learn to transcribe and code child language samples?	3.14
How helpful do you think that the auxiliary/copula training notes were in helping you to learn to transcribe and code language transcripts?	3.14
How helpful do you think that the complex sentence training notes were in helping you to learn to transcribe and code child language samples?	3.00

Note. The means above are based on the following rating scale: 1 = not confident/helpful/beneficial/improved; 2 = somewhat confident/helpful/beneficial/improved; 3 = moderately confident/helpful/beneficial/improved; 4 = very confident/helpful/beneficial/much improved.

The participants were able to provide additional comments on their experience in learning to transcribe and code language samples. Although most of the comments were positive and indicated that the students benefited from the experience, there were also some negative comments. The following comments from participants are generally representative of the types of positive comments that were submitted:

> "I feel more comfortable with the idea of completing a language sample in clinical practice now compared to the start of this course. It is not nearly as overwhelming of an idea as it was previously and I plan on continuing to use language sampling

throughout my career. I have heard classmates say how they don't like the idea of completing long language samples because of the time commitment but it does not take me nearly as long now that I have had the extra experience and practice from this course.”

"After 27 years of life, I now believe I have a better grasp on English Grammar. I also appreciated the exposure to potential cases I may come across in my profession. I enjoyed developing an ear for particular errors and being able to figure out what was being said. My pace in all sense improved from being able to process what was being said, to transcription, to identifying speech/ language errors as I transcribed. It was hard work, and there were many trials and errors, but it was a great experience!"

“I feel far more confident than I did at the beginning of this process, although I am still learning. I definitely understand more about how to use SALT as a tool and will hopefully have the skills necessary to incorporate language sampling into my practice as an SLP. I also have a better understanding of Brown's morphemes and how to listen to a sample, transcribe what is being said, and code my transcription in a meaningful way.”

“I am very grateful that I took this class because I learned a lot and now transcribing and analyzing a sample doesn't seem like that much work.”

Overall, comments such as these above indicated that for most of the students, the training program was fairly challenging, but provided them with a good learning experience and a foundation on which to build their skills.

A few of the comments about the experience were negative. Examples of those include:

"The question had come up as to why more clinicians aren't utilizing programs like SALT to complete language samples in clinical settings. From what I can see, it is because it is extremely time-consuming. Even if the clinician becomes proficient in transcribing, having to code everything and then go back through and type out everything plus all of the codes is ridiculous and no one has time for it."

“I honestly stopped referencing the keys given after finishing a transcript because I was looking for guidance regarding coding and that was rarely represented on the keys.”

“I think this independent study was a good start, but I think I need about 30 more transcripts (and the ability to see the correctly coded manuscript AND the ability to have conversations about it) before I would start to feel confident in my abilities.”

These comments indicate that although the participants' skills improved, the program may not have been adequate for all participants to feel confident and comfortable using LSA and that improvements could be made to the program.

Discussion

The implemented training program included online training with SALT with additional support, self-paced transcription and coding practice with narrative language samples, and automated feedback. The significant improvement in accuracy and speed of transcription and coding indicated that such a training program could promote students' transcription and coding skills. The significant difference between the participants' confidence levels before and after the program suggested that clinicians may be more confident in their ability to use LSA in their future clinical practice after such training.

Accuracy. Although there was a significant difference in the accuracy of transcription, coding, and recognition of inflectional morphemes and complex sentences, it was initially anticipated that accuracy levels would be higher by the end of the program. Although several individual participants reached over 90% accuracy, none of the group means were above 90% accuracy. However, there was considerable variation and individual differences across participants. For example, at Transcript 10, accuracy ranged from 77 % to 98.89% accuracy. Also, each student had a different transcript at each transcript number, so there was also variation in the potential difficulty level of the transcripts at different transcript numbers, as some children had TL, some had DLD, some had reduced intelligibility, etc.

As there is a great deal of detail in language samples, there is going to be variation in transcription and coding even among experienced transcribers due to several factors, including speaker intelligibility, audio clarity, familiarity of the transcriber with the speaker, and the context in which the language sample was collected, etc. In some instances, subjective judgments may need to be made while transcribing, including interpreting the speaker's intended message, identifying which portions of an utterance are mazes and which portions are the message, interpreting ambiguity, etc. Such differences can occur across transcribers even when they follow transcription guidelines. Due to the amount of detail that we are looking for in transcription and coding, and that this process is often taking place as quickly as possible, it is expected that even experienced transcribers may make occasional errors. Thus, expecting 100% agreement between multiple transcribers would be unreasonable.

When considering accuracy expectations for language transcription, we need to consider the purpose of LSA. For research purposes, when we have more time and resources, we are very keen to obtain as high of a level of inter-rater reliability as possible. However, for clinical purposes, we conduct LSA to obtain an ecologically valid sample of an individual's expressive language skills, to measure various aspects of language output, and to identify potential patterns within the language sample that will inform the clinician about the child's strengths and weaknesses for diagnosis, treatment planning, and progress monitoring. If the transcription and coding of the language sample are generally accurate, these purposes are achievable even if there are some inconsistencies or errors. Expecting perfect language transcriptions is unreasonable as it would require a lot of repeated listening, proofreading, and revision, which would preclude its practical use as a clinical tool. Thus, the goal of the training program was not to reach 100% accuracy or agreement with the instructors but to offer students the opportunity to learn and practice language transcription and coding so that they could reach reasonable levels of consistency and accuracy in order to use LSA functionally as a valuable clinical tool. Thus, the authors consider accuracy levels

in the range of 85% to 95% (depending on other factors) to be reasonable for students participating in the training program as long as they are not consistently parsing T-units incorrectly, consistently missing bound morphemes, or are missing error patterns produced by the speaker. Below this level, key characteristics of an individual's language skills would likely be missed.

Several aspects of language continued to be challenging for some students. These included identifying past participles vs. past tense, distinguishing copula and auxiliary "be" forms, identifying when to break up negative contractions and when not to, and identifying individual T-units and complex sentences. Although the training program addressed these issues, they are often subtle distinctions that tend to be challenging.

Identifying participles vs. tensed morphemes is not an issue that has had much attention in the literature. However, two studies have found that children with DLD have fewer omissions of the past participle "-ed" morpheme than past tense "-ed" morpheme (Leonard et al., 2003; Redmond, 2003). This was explicitly addressed in the training because distinguishing between past participle "-ed" and past tense "-ed" tends to be challenging. The first author has observed several treatment plans in which the goal was to target past tense "-ed" production, but the contexts presented in treatment were actually past participle "-ed" contexts. Therefore, it was worthwhile to address the participle distinction in training. However, this decision was based on informal clinical observations.

Overall, issues with counting morphemes are relatively minor for most school-age children as mean length of utterance in morphemes (MLU-m) is less sensitive at later ages, and MLU in words (MLU-w) is a valid index to use with school-age children (Rice et al., 2006). However, at the preschool level, counting morphemes can be more important if MLU-m is used as a general measure of syntactic complexity. The challenge that some students have identifying copula vs. auxiliary "be" forms may have limited impact on treatment as long as they are still recognizing omissions of these morphemes, as children with language impairment have difficulty with tense marking in general (Leonard, 2014; Rice et al., 2004; Rice & Wexler, 1996).

Correctly identifying clauses to indicate SI number per utterance, however, may have a larger impact because the identification of clauses impacts multiple aspects of LSA. For example, identifying clauses is crucial in correctly parsing transcripts by T-units and for identifying if children lack the syntactic complexity expected during the school-age years. Difficulties with complex sentence use are not always exhibited as errors but by the absence of complex sentences. Thus, the ability to identify clauses and complex sentences is essential. This observed challenge suggests that SLP students would benefit from more explicit language analysis instruction, especially at the clause level.

In the future, additional learning mechanisms could be added to the program to target these areas during the transcription practice phase, which may improve overall performance and explicit language knowledge. For example, after completing each transcript, while the student is reviewing their results, they could self-identify any patterns of difficulty that they had in the transcript. The student could then be directed to complete practice exercises that target the persistently challenging aspects of language samples to increase their ability to identify those language features easily.

Time. There was a significant difference in the mean amount of time that it took the students to transcribe from the beginning of the project to the end, indicating that practice reduces the time needed for transcription. However, at the shortest durations, it still took students an average of just under an hour to complete each of the last four transcripts. Some of this time could be attributable to the additional coding included in the project to provide more practice for developing stronger explicit language knowledge, which is not part of typical transcription conventions. These include coding all of the early inflectional morphemes and not only bound morphemes, distinguishing between copula and auxiliary "be" verbs, and attending to participles. Although it may have increased the time for transcription, this practice seems worthwhile for developing better language analysis skills. Another aspect of the process that took additional time was making decisions about the participles and assigning SI numbers to the T-units. These aspects seemed to have a similar impact on time as they did on accuracy and suggest that students would benefit from additional focus on explicit language analysis skills.

There was considerable variability across students for transcription time. At Transcript 10, the time to transcribe ranged from 24 minutes to 150 minutes. The student who took 150 minutes on the final transcript consistently had the longest transcription times. The time it takes for transcription may be related to many factors, from the level of explicit language knowledge to how many times the student felt the need to check and recheck their transcript or to the individual characteristics of the transcripts, such as intelligibility and frequency of mazes. With regard to explicit language knowledge, it is noteworthy that although over half of the students had taken a course in language science, others had language development coursework, but not necessarily coursework that focused on language structure and analysis. Future research should collect specific data on previous academic coursework and experience and evaluate if and how these factors impact transcription training. This would be especially interesting in light of the findings of Brimo and Melamed (2017) that language development coursework alone did not appear to improve students' explicit language knowledge and that there is a need for additional education in language analysis.

Several factors impact the amount of time that language sample collection, transcription, and analysis take, including the developmental level and intelligibility level of the child, the type of language sample (conversation, narrative generation, narrative retell, etc.), the depth of coding, as well as the clinician's level of skill. Because limited time is often cited as a reason for not completing LSA, it would be helpful to identify a reasonable target time for this task in various circumstances. Pavelko & Owens (2017) measured the time it took trained research assistants to collect, transcribe, and analyze conversational language samples from typically developing children ages 3 to 7 years 11 months using the Sampling Utterances and Grammatical Analysis Revised (SUGAR) protocol. They found that it took an average of 21 minutes to complete the LSA for these children with typical hearing, typical intelligence, and typical expressive morphology. Although these measurements took place under fairly ideal circumstances, this is an important step in understanding how much time should be expected for this task. They point out that in some cases, it may take the same amount of time or less than some standardized tests. Further research is needed to determine time estimates based on various factors, such as the language status of the children (typical or impaired) and different sampling contexts. Regardless, these results (Pavelko & Owens, 2017) suggest that LSA may not be as time-consuming as is often thought, especially if clinicians have adequate training and explicit language knowledge.

Improvement and increased confidence. There was a significant difference in the participants' reported confidence in their ability to transcribe and code a child language sample before and after the training program. Only one student reported no change in their confidence level (2 = somewhat confident before and after training). Before the program, most participants had little experience with language samples, and most had completed only one or none. Most students indicated that their level of improvement and confidence for various aspects of the program rose to moderately to very confident/helpful/beneficial/improved as a result of the training. The task of language sample transcription and coding is complex. Having gained at least a moderate level of confidence should position students well for further developing these skills.

Although most participants reported positive experiences in the program, some indicated that the amount of time needed was still a deterrent to using LSA in the future. In our educational programs, we need to continue emphasizing LSA's benefits. However, as indicated by Schuele (2010), the importance of LSA becomes most apparent through experiences using it and witnessing its benefits clinically. Thus, we must continue to develop effective means of teaching future clinicians to conduct LSA as efficiently as possible so that they can use it, further develop their skills, and reap its benefits for their clients' well-being. One approach to providing LSA training that would likely build confidence in students over time would be to implement a program across upper-division undergraduate and graduate coursework and clinical experiences. Such a program could include a one-credit course for multiple semesters with layers of skills (elicitation, transcription & coding, analysis), ages, and sampling contexts (conversation, personal narrative, narrative retell, expository language) added over time. Additionally, such a program could promote appreciation for LSA's benefits by including it in clinical practicum experiences with actual clients.

Format of training. Most participants found the use of SALT and its online training modules and program-specific training modules to be moderately or very helpful. When asked if the quiz format of correcting language transcripts was beneficial to the learning experience (compared to just comparing transcripts to an answer key), the majority (*n*=13) indicated that it was. Several (*n*=7) indicated they were unsure, and a couple (*n*= 2) indicated that it was not beneficial. The purpose of putting the language transcripts into an automated quiz format was two-fold. The first was to give students immediate line-by-line feedback, which is the aspect that students may find more or less helpful. Its benefit will also depend on how carefully students would otherwise compare their transcripts to an answer key. The second purpose of the quiz format was to provide a means to quickly measure students' proficiency without taking additional instructor time to evaluate individual transcripts. The use of the quiz does present an additional task to the training process because, in addition to creating the language transcript, the students then have to enter their information into the quiz. This layer and the time taken to complete it may be one of the reasons that some students were ambivalent or negative about using the quiz format. Some of the students may have thought that the extra time, in addition to transcription time, was unnecessary for them. They may have preferred that the instructor manually grade the transcripts as it would take them less time individually; however, that would likely make the task of providing specific feedback on multiple transcripts untenable. Thus, it is imperative to explore ways to improve students' access to more language transcription experiences while effectively using instructors' time. Another possible reason for the students being unsure about the benefits of the quiz format is that many of them have not had previous experience trying to make line-by-line comparisons between their transcript and an instructor's transcript. Limited experience may have resulted in difficulty

answering that question. Fatigue may have also played a role. To accommodate other student responsibilities, the independent study was quite flexible with regard to due dates so that students could pace themselves in a way that best suited their schedules. However, pacing can be challenging. Each semester, several students had to complete multiple transcripts at the very end of the semester when they had other academic projects and exams to complete. This may have made the quizzes feel more time-consuming than they may have otherwise. Future training programs should balance flexibility with a more structured pacing guide to spread out the transcription experience more evenly to reduce fatigue.

In planning academic and clinical training programs, it would be good to have a sense of how many language transcription experiences are necessary to help students reach a level of skill that will allow them to further improve their language sampling abilities by using them clinically. Schuele (2010) points out that in order for this to be a possibility, clinical and academic training programs need to make sure that "beginning clinicians are 'proficient enough' in LSA" (p. 36) to continue developing their skills. Although it was not an explicit goal of the current study, visual inspection of Figures 1 and 2 suggested that for both accuracy and time, after seven transcription experiences, there was a plateau in the mean accuracy and time needed for transcription. Therefore, academic training programs may want to incorporate opportunities for students to conduct a minimum of seven to ten detailed language sample transcription and analysis experiences during academic and clinical training to establish a skill level that new clinicians can build on. The current study only addressed narrative language samples for a particular age group. Additional research is needed to determine how much and what type of training is needed for other types of language samples. As discussed earlier, incorporating a program-wide training strategy could allow for deeper training across contexts over a more extended period. The current study used the LMS quiz to address such training with several small groups of students. However, the first author has also used a more basic version of the process (that does not include SALT coding) with up to 50 undergraduate students at a time in a language science course for one to two transcripts as an introduction to LSA and a more elaborate version of the process (that does include SALT) in a graduate school-age language disorders course with up to 50 graduate students (across 3 course sections) for two transcripts per semester. Those experiences served as the basis for conducting the present study. Although the process served the instructor's goal of providing specific feedback on transcription and coding to the students, they were only completing one to two transcripts per semester. They may not have witnessed as much improvement in their accuracy and speed in the same manner as the students in the training program did.

Limitations. Although several studies have evaluated the use of LSA in clinical practice, few studies have looked at the outcomes of LSA training programs or processes. The present study provided insight into the impact that practice opportunities and feedback can have on developing students' transcription and coding skills. However, there were several limitations to the current study. The process described here focused on the accuracy and time of language sample transcription and students' confidence in their transcription abilities. However, there are other critical components of the complete LSA process. Other aspects that need to be addressed include elicitation, analysis, and interpretation of language sample data. Although the transcription aspect is necessary and may be the most time-consuming, the benefits for clients come from effective analysis and interpretation of accurately transcribed data. Expanding the training model to address the analysis and interpretation could be included in future studies.

Several procedural improvements would be helpful for future work. Including a pre-training questionnaire that closely parallels the post-training questionnaire would improve the quantitative analysis of changes in learners' perceptions of various aspects of the program. The pre- to post-training changes in confidence in the present study need to be interpreted cautiously because the pre-training confidence levels were recorded after the training program was completed. Additionally, by asking specific questions about past LSA experiences and coursework in language science, language analysis, and the structure of English before the study begins, we may gain better insight into changes that could be implemented in SLP curricula in order to support the development of LSA skills specifically, and language analysis skills more generally, for new clinicians. By also including more specific demographic data about the participants, such as age, ethnicity, experience with multiple languages, etc., such variables could also be examined. The post-training questionnaire could also be improved. Although students indicated greater confidence in their LSA abilities, they were not asked if they believe they are more likely to use LSA in clinical practice due to the training program. This question would help identify the likelihood of such training programs resulting in greater clinical use of LSA.

Some participants listened to the audio recordings several times, while others listened to the audio recordings only once or twice. Establishing firmer guidelines on these processes may standardize the procedures and reduce the variability in the data. Some participants appreciated the self-paced nature of the program because it was flexible and did not require many mandatory meetings. However, some felt they would have benefitted from more interactions with the instructor and research assistant. Including two to three more class meetings throughout the program and providing practice exercises for challenging aspects of coding, morpheme identification, and SI identification may give more support to students during the process.

As this was our first attempt at this type of formal and controlled LSA training program, we limited the types of language samples to narrative language samples from children six to eight years of age with DLD or TL. However, this is not always the most appropriate approach for all children. Clinicians need to be able to conduct LSA with children of various ages and diagnoses using different types of discourse. Future studies could include samples from a broader range of ages, diagnoses, and discourse types, including conversation, structured interviews, or expository language. Learners would benefit from exposure to multiple contexts.

Conclusion

The current training outcomes study indicated that multiple focused learning and practice opportunities with language sample transcription and coding increased participants' accuracy, efficiency, and confidence in transcribing and coding child language samples. This type of training program may provide students with the foundation and support they need to reach a proficiency level that will allow them to continue to develop and expand their skills. The study is a step toward better understanding what is needed to increase the effectiveness of LSA instruction during SLP education and beyond.

LSA is challenging and time-intensive, but the clinical benefits are substantial and worthwhile. It should not be disregarded because it is a complex process that takes time. Language disorders are

complex, and we need to use complex tools to obtain detailed information about the nature of a child's language skills to understand them better and treat them more effectively. Thus, it is up to SLP education programs to investigate and implement teaching strategies and programs that will lead to more efficient and targeted use of this valuable clinical tool.

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Appendix

Sample Feedback from the LMS Quiz Tool

1. Overall feedback for the quiz (seen by everyone taking the quiz).
   Transcript #6 Commonly Missed Questions:
   > #41/42 something_something should be joined.
   > #62 'oh' doesn't count as a morpheme
   > #64 'gonna' is a semi-aux
   > #70/72 'pouring' is present participle
   > #102 'named' is past participle
   > #106 'walking' is present participle

2. Sample of individual feedback on quiz questions for a set of questions associated with one T-unit

Information ⚑ Flag question	17. So he was looking at the clock.

Question **65** Correct 1.00 points out of 1.00 ⚑ Flag question	How many words are in this utterance? Answer: 7 ✔
	The correct answer is: 7

Question **66** Correct 1.00 points out of 1.00 ⚑ Flag question	How many morphemes are in this utterance? Answer: 8 ✔
	The correct answer is: 8

Question 67

Correct

1.00 points out of 1.00

⚑ Flag question

Indicate the subordination index for this utterance (this includes only full clauses that contain an independent subject and verb).

Select one:

- a. 0
- ● b. 1 ✔
- c. 2
- d. 4
- e. 5
- f. X

Your answer is correct.

The correct answer is: 1

Question 68

Partially correct

0.42 points out of 1.00

⚑ Flag question

Indicate the morphemes included in this utterance.

Select one or more:

- ☑ Progressive marker ✔
- ☐ Plural marker
- ☐ Prepositions *in* and/or *on*
- ☐ Possessive marker
- ☐ Regular past tense marker
- ☐ Irregular past tense
- ☐ Third-person singular marker
- ☑ Article ✔
- ☐ Contractible copula 'be'
- ☐ Contractible auxiliary 'be'
- ☑ Uncontractible copula 'be' ✘
- ☐ Uncontractible auxiliary 'be'
- ☐ Irregular third-person singular marker
- ☐ Semi-auxiliaries
- ☐ None of Brown's grammatical morphemes used

Your answer is partially correct.

You have correctly selected 2.
The correct answers are: Progressive marker, Article, Uncontractible auxiliary 'be'