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THE TRAINING OF PHONETIC TRANSCRIPTION WITH SLP
STUDENTS**

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**INVESTIGATING THE ROLE OF PHONOLOGICAL AWARENESS IN THE
TRAINING OF PHONETIC TRANSCRIPTION WITH SLP STUDENTS**

By

Jennifer Kay Binkley

A.A., General Studies, Weatherford College, 2000
B.A.S., Communication Disorders, Abilene Christian University, 2012
M.S., Communication Disorders, Abilene Christian University, 2014


A Dissertation Submitted in Partial Fulfillment of
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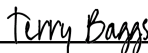
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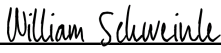
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Chairperson Dr. Jessica McHugh

DocuSigned by:

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Dr. Terry Baggs

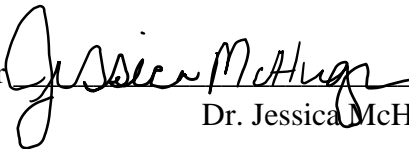
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Dr. Whitney Lucas Molitor

DocuSigned by:

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ABSTRACT

A dissertation study was developed and completed to further explore the relationship between phonological awareness (PA) and phonetic transcription skills in undergraduate speech-language pathology students. A review of the literature provides gaps in knowledge which the proposal seeks to address. Based upon this literature review, the researcher compared PA skills of undergraduate students of various majors, to determine if there was a change in PA by taking a traditional phonetics course, and to explore phonetic transcription outcomes as the result of direct PA intervention with undergraduate SLP students. Quantitative analysis was used to answer three research questions, which were organized into three separate articles. An assessment tool for PA was developed by the researcher based upon synthesis of the literature review. The overarching goal of this dissertation study was to further explore the relationship between PA and the acquisition of phonetic transcription skills so that curriculum development and course design for SLP undergraduate programs can be based upon the evidence.

Dissertation Chair



Dr. Jessica McHugh

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Chapter 1

General Introduction

This dissertation study was planned and designed to address educational outcomes for speech-language pathology (SLP) undergraduate students. The research was intended to address gaps in knowledge regarding the relationship between phonological awareness (PA) and phonetic transcription, particularly within the field of SLP. While SLPs are specially trained to address communication and swallowing disorders across the lifespan, one particular aspect of an SLP's scope of practice is to address speech sound disorders (SSDs), which is when one has difficulty correctly producing the speech sounds for their language (American Speech-Language-Hearing Association [ASHA], 2016). In order to assess and treat SSDs, a clinician will employ the use of the International Phonetic Alphabet (IPA) for phonetic transcription to document and analyze speech. Phonetic transcription provides an accurate and consistent documentation system for a one-to-one ratio of speech sound to symbol, as opposed to orthographic spelling, while also providing consistency of a symbol to sound that is not available with spelling (see Appendix A). Typically, SLPs are trained in phonetic transcription as part of their undergraduate coursework (Crais et al., 2015), and then are expected to use and apply the skill in their graduate coursework and clinical experiences, as well as once they are practicing clinicians (ASHA, 2020).

Background to the Problem

Instructors of phonetics courses have reported that some students appear to have more difficulty than others with learning phonetic transcription. Further, it has been suggested that some students may grow frustrated and even question their choice of major based upon their challenges with learning phonetic transcription (Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011). According to Moran and Fitch (2001), there may be a connection

between phonological awareness (PA) and the acquisition of phonetic transcription. While other researchers have explored this relationship (Hall-Mills & Bourgeois, 2008; Hillenbrand, 2017; Robinson et al., 2011; Werfel, 2017), there is still more to be learned not only about how PA and phonetic transcription are connected, but also whether or not direct intervention of PA can help improve outcomes with phonetic transcription.

PA is an umbrella term that encompasses skills of segmenting, blending, deleting, and manipulating speech sounds as a precursor for reading and writing (Bauman-Waengler & Garcia, 2020). A particular challenge with generalizability of the previous research is that a variety of methods for assessing PA have been used, with only isolated aspects of PA being assessed. Further, some of the research assessing PA skills of SLP students and practicing SLPs has been conducted with written stimuli, despite the fact that PA is understood to be an auditory skill (Bauman-Waengler & Garcia, 2020). The research herein employed an assessment tool that assessed all major areas of PA with orally delivered stimuli. Additionally, while previous research indicates that there appears to be a relationship between PA and phonetic transcription, only one unpublished conference presentation was found within the literature to employ short-term direct PA intervention to address student outcomes (Hall-Mills & Bourgeois, 2008). This dissertation study piloted a structured course, with a longer duration of intervention, to learn if this type of intervention is beneficial to address concerns that have been raised about students' challenges with learning transcription.

Statement of the Problem

The current available research has provided an indication of the importance that well-developed PA skills may have in helping undergraduate SLP students have success with learning phonetic transcription. However, the available literature has analyzed PA skills in a variety of

ways, leaving gaps in understanding as to the full picture of PA skills. Further, it appears that despite the suggestion that direct intervention of PA with undergraduate students may improve outcomes, this intervention has not been studied and reported on since 2008. This dissertation study sought to further examine whether PA skills may have a relationship with the acquisition of phonetic transcription in SLP students. Additionally, it implemented direct intervention of PA training which was piloted in an attempt to improve phonetic transcription skills in SLP students. The goal of this study was to learn more about students' PA abilities prior to coursework, and to explore/compare the effect that different coursework can have on PA skills and phonetic transcription competency. A secondary goal of this research was to pilot a model for structured PA intervention, including opportunities for interprofessional education (IPE) regarding PA between SLP majors and elementary education majors, and to learn about the potential benefits of such intervention on phonetic transcription performance.

Significance

This continued exploration of PA in regard to undergraduate SLP students has the potential to address a variety of educational goals. One aspect is the possibility that strong PA skills appear to have a relationship with successful learning of phonetic transcription (Moran & Fitch, 2001; Robinson et al., 2011). Proficiency with phonetic transcription is required to comply with the standards set forth by the American Speech-Language-Hearing Association for the Certificate of Clinical Competence in SLP due to its clinical use (ASHA, 2020; Robinson et al., 2011; Binkley, 2021a). SLPs must use phonetic transcription to accurately evaluate and treat SSDs (Bauman-Waengler, 2020; Louko & Edwards, 2001; Robinson et al., 2011; Binkley, 2021a). When a clinician utilizes standardized tools for assessment of SSDs, those tests require the clinician to use transcription skills to record the productions of the client, and then to use

knowledge of transcription for scoring and analysis. If improving PA skills in SLP students does, in fact, affect transcription skills, it could be an important addition to the current SLP curriculum.

Additionally, it is an SLP's role to address PA both directly and as supplemental treatment for children at risk for literacy difficulties. PA tasks such as syllable counting, phoneme identification, and phoneme matching are typically discussed within phonetics courses (Shriberg et al., 2019; Small, 2020), but with minimal attention given (Binkley, 2021b). The assumption is that undergraduate students already have developed these skills and only need to demonstrate, apply, and build upon prior PA knowledge to learn transcription skills and to address PA with clients (Binkley, 2021b). However, since the research indicates that this prior knowledge may not be as strong as has been assumed (Hall-Mills & Bourgeois, 2008; Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011; Spencer et al., 2011), there is a strong argument for supplemental learning and training of PA (Binkley, 2021b). In order for clinicians to correctly assess PA skills and provide PA intervention, they must be proficient in PA themselves in order to address the various elements of PA with clients.

Finally, PA intervention falls not only within the scope of practice for SLPs, but also for elementary educators. This means that SLPs and educators will need to collaborate to address PA with children. Interestingly, it appears that SLPs may be superior in their PA skills compared to other educators, including special education providers, possibly due to SLP coursework such as phonetic transcription (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011; Werfel, 2017; Binkley, 2021b). Despite this discrepancy between SLPs' and educators' PA abilities, both groups were found to need improvement with PA skills and knowledge (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011; Binkley, 2021b). An SLP's competency with PA is an integral part of interprofessional practice, as they partner alongside

educators in the classroom to provide appropriate literacy teaching and intervention with students (Kamhi & Catts, 2001; Binkley, 2021b). Therefore, it is important to help SLP students understand their collaborative role in regard to PA, and to have experiential opportunities for application of this collaborative role.

Applicable Theories

An important underlying theory for PA is the concept of phonological processing, which includes PA in addition to phonological working memory and phonological retrieval (ASHA, n.d.-a). Phonological processing theory explains how individuals use the sounds from their language to successfully produce written and spoken language (Bauman-Waengler, 2020; Wagner & Torgesen, 1987). The roots of the concept of phonological processing can be found in the generative phonology theory of Chomsky and Halle, which described a process of manipulating one's sound system from an underlying representation in one's lexicon to the surface form through production (Bauman-Waengler, 2020). Importantly, PA relates to oral language, which provides a foundation for development of printed language skills (Wagner et al., 2013). According to Wagner et al. (2013), PA and phonological working memory appear to be highly correlated with one another. It is believed that these abilities are independent of general cognitive abilities (Wagner & Torgesen, 1987).

It has been suggested that phonetics courses may help develop some PA skills (Werfel, 2017), but that the addition of direct PA training may be beneficial for improving student outcomes with phonetic transcription (Randolph, 2015). The interventions of a traditional phonetics course and a phonetics lab, that directly teaches PA, are based on the educational learning theories of cognitivism. These theories describe the importance of addressing the cognitive load of learning in the process of developing competency (Lattuca & Stark, 2009). As

such, within the broader category of cognitivism are the theories of scaffolding and constructivism (Bates, 2016; Binkley, 2021b). Scaffolding addresses cognitive load theory by providing the necessary supports and then continually modifying these supports as learner demands change (Austin, 2013; Bates, 2016; Taylor & Hamdy, 2013; Binkley, 2021b). Learners who are not provided with these appropriate supports are less likely to integrate knowledge into working and long-term memory, which is needed for them to use the learning in future application (Kirschner et al., 2006; Taylor & Hamdy, 2013; Binkley, 2021b). This theory may help to explain why SLP students appear to have varying levels of difficulty with learning phonetic transcription (Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011). The creation of a course designed to directly teach PA skills and help students apply them to phonetic transcription is based upon the idea that students need more scaffolding than they are currently receiving in order to acquire phonetic transcription skills. Further, the pilot of a one-hour course, Phonetics Lab, can be designed to provide scaffolded information to help students transition between learning concepts and construction of new knowledge (Binkley, 2021b). Students enrolled in Phonetics Lab are taught specific skills of PA, beginning with the least complex, and gradually building on knowledge, (described further in Chapter 3 of this dissertation study) and those concepts are interconnected with the gradual learning of phonetic transcription. For example, as students are taught the PA skill of counting syllables within the Phonetics Lab, they are then also learning to recognize syllable breaks in words in a phonetics course. Students can apply knowledge from the Phonetics Lab to decrease the cognitive load when learning aspects of phonetic transcription.

The educational theory of constructivism, which places an emphasis on constructing knowledge with others, can be accomplished through implementing experiential learning by

integrating problem-based learning, role-play, and case-study learning (Fink, 2013; Merriam & Bierema, 2014; Svinicki et al., 2014). The Phonetics Lab, which is a direct intervention, provides a modality for this type of learning, which is currently beyond the scope of a traditional phonetics course. By providing a combination of scaffolding and meaningful learning experiences, students' cognitive load can be managed throughout the semester, while also providing them with rich learning that is augmentative to the current curriculum delivery. The intervention of an additional course was designed to address gaps in knowledge regarding PA that students appear to demonstrate which may impact learning phonetic transcription (Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011). Cognitive learning theories specifically seek to address students' gaps in knowledge and to help students construct knowledge, which helps them make sense of new knowledge. Therefore, cognitivism is an appropriate underlying learning theory guiding this proposal, which seeks to address the needs of SLP students in relation to PA and phonetic transcription (Binkley, 2021b).

Present Dissertation Study

This dissertation study was developed into a three-article dissertation model, with the hope that the findings of the research will add to the body of available literature and address some identified gaps in knowledge. It is additionally intended that the research will provide suggestions for potential curricular changes that could have a positive impact on SLP student outcomes with phonetic transcription, and with students' understanding of how PA more largely relates to the scope of practice. As this dissertation study piloted a full-semester direct PA intervention, it provides a model for how direct PA intervention could be provided within other SLP programs.

Definitions of Terms

1. Phonetics. The study of both how speech is produced and perceived (Small, 2020).
2. Phonetic transcription. The use of the International Phonetic Alphabet (IPA) to write the sounds of speech produced, regardless of spelling (Small, 2020; see Appendix A).
3. Phonological awareness (PA). An auditory task, demonstrating one's ability to attend to sounds in one's language and identify, segment and manipulate sound segments (Bauman-Waengler & Garcia, 2020). These tasks can include rhyming, blending and manipulation of syllables, onset/rime, and individual phonemes (Kilpatrick, 2016).
4. Onset/rime. Each syllable is made up of the onset and rime, with the onset being consonant(s) prior to the vowel of the syllable, and the rime being both the vowel, also known as the nucleus, and successive consonant(s), also known as the coda, for that syllable (Small, 2020; See Appendix B).
5. Phoneme. Units of spoken speech which have the ability to contrast meaning (Bauman-Waengler & Garcia, 2020; Small, 2020; See Appendix A).

Review of the Literature

Phonetic transcription, the use of employing the International Phonetic Alphabet (IPA) to transcribe speech sounds, is a fundamental skill of speech-language pathologists (SLPs) that is typically taught during undergraduate coursework (Crais et al., 2015; Binkley, 2021a). SLPs use the IPA to document the sounds that are produced in a word without regard to spelling. In the clinical setting, a comparison of a client's production to the intended words is analyzed using IPA, as this provides a 1:1 comparison that is less clear when looking at spelling. SLPs utilize phonetic transcription not only to accurately document speech sound production, but also to analyze and develop appropriate treatment targets. Typically, SLP students must demonstrate

reasonably competent phonetic transcription abilities in order to progress in coursework, as they will need to apply this skill in other coursework (Randolph, 2015). Direct training of phonetic transcription is not often included in graduate curriculum due to time constraints and the assumption that the skill has been acquired and maintained during undergraduate training. The result is that graduate students have varying performance levels of transcription as they are asked to utilize the skill in clinical application (Krimm & Schuele, 2017; Randolph, 2015).

Bauman-Waengler (2020) emphasized the importance of accuracy with phonetic transcription as having a direct impact on client diagnoses and treatment—if a clinician has weak transcription skills, the client’s speech could potentially be inaccurately documented, and inappropriate treatment planned. Since SLPs must utilize phonetic transcription as part of evaluation and treatment of speech sound disorders, competency with this skill is needed to satisfy the standards set forth by the American Speech-Language-Hearing Association (ASHA) for the Certificate of Clinical Competence in SLP (ASHA, 2020; Bauman-Waengler, 2020; Robinson et al., 2011). These standards state that a candidate for certification must have completed a program in order to achieve the ability to have the skills needed for evaluation and intervention (ASHA, 2020). Thus, the ability to use phonetic transcription to make evaluation and intervention decisions would fall within this requirement.

It appears that there is a relationship between phonological awareness (PA) skills and phonetic transcription (Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011; Werfel, 2017). PA is one of three components making up the larger concept of phonological processing, which is the ability to use the sounds of one’s language for speech, reading and writing. Phonological processing additionally includes the components of phonological working memory and phonological retrieval, but often a great deal of emphasis is placed upon PA (ASHA, n.d.-a;

Bauman-Waengler, 2020). PA is an umbrella term for an auditory skill that involves the ability to segment, delete, manipulate, and blend speech sounds in one's language (Binkley, 2021a). An important pre-literacy skill, PA skills demonstrate that one can identify and manipulate the sounds of language separately and without regard to meaning or spelling (Bauman-Waengler, 2020; McLeod & Baker, 2017, Binkley, 2021b). PA encompasses a range of skills, believed to increase in complexity: word and syllable segmentation, onset-rime awareness/production, and phonemic awareness (ASHA, n.d.-a; Bauman-Waengler & Garcia, 2020; Schuele & Boudreau, 2008, Binkley, 2021b). Phonemic awareness tasks are further subdivided and would include the ability to identify the number of sounds in a word (phonemes), as opposed to the number of letters in a word (graphemes), the ability to isolate and blend phonemes, and the ability to manipulate phonemes to create new words.

During phonetic transcription one must identify the phonemes that are produced and ignore the graphemes of the word, thus phonemic awareness is utilized when transcribing and working with speech sounds. Application of this skill can be seen in the need to manipulate phonemes so that appropriate treatment targets and feedback can be provided to clients. While these skills are taught to pre-readers through auditory tasks in the classroom, they are often assumed skills for adult learners without reading difficulties. Current research indicates, however, that competent PA skills cannot be assumed in adult learners, and that PA skill level may provide some explanation as to the challenges SLP students experience when learning phonetic transcription (Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011; Spencer et al., 2011).

Relationship Between PA and Phonetic Transcription

While some SLP students appear to have little to no difficulty acquiring the skill of phonetic transcription, others demonstrate challenges that can lead to frustration and to questioning their choice of major (Moran & Fitch, 2001; Robinson et al., 2011, Binkley, 2021a). With natural connections between PA tasks and learning phonetic transcription, which requires students to pay attention to words in terms of sounds and not spelling, it has been hypothesized that deeper exploration regarding this relationship offers insight into student outcomes (Hall-Mills & Bourgeois, 2008; Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011). As SLP phonetics instructors have sought to learn more about why some of their students struggle with learning phonetic transcription, some have engaged in research with their students to examine this relationship (Hall-Mills & Bourgeois, 2008; Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011; Mackenzie Beck, 2003). Results have demonstrated that PA skills assessed prior to phonetics coursework can serve as a predictor for difficulty with phonetics acquisition (Hall-Mills & Bourgeois, 2008; Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011). Meanwhile, other studies have indicated an increase in PA as an outcome of learning phonetic transcription, indicating that SLPs and/or SLP students who have taken a phonetics course may have greater proficiency with phonological awareness as the result of this coursework alone (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011; Werfel, 2017; Westerveld & Barton, 2016). Thus, there appears to be a relationship between PA skills and phonetic transcription skills, although there is still more to learn about this relationship (Hall-Mills & Bourgeois, 2008; Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011; Binkley, 2021b).

A review of the literature reveals a lack of consistency as to which specific PA skills have been analyzed with undergraduate SLP students. Methodological differences were found in the literature as to how PA was measured in SLP students, thus revealing gaps in knowledge that need to be explored. In looking at the umbrella of PA, the majority of the studies with undergraduate SLP students which were located in the literature did not analyze PA skills at the syllable level, presumably because this is considered to be the least complex PA task. Only one study addressed this aspect of PA (Mackenzie Beck, 2003). However, learning to count and segment syllables is a component that is introduced and taught in phonetic transcription courses (Small, 2020), and this ability cannot be assumed. Similarly, only one study was found which analyzed SLP students' ability to demonstrate onset-rime abilities, by asking students to rhyme with non-English words (Hillenbrand, 2017). Again, understanding onset-rime and rhyming words, which can form what is known as minimal pair words, is also important in learning phonetic transcription. Phonemic awareness tasks have been focused upon primarily in the literature, with the specific tasks of phoneme segmentation and phoneme manipulation being the most commonly assessed (Hall-Mills, 2008; Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011; Werfel, 2017). PA constitutes a variety of discrete tasks, which are believed to increase in complexity, but Adams (1990) cautions that not only can it not be assumed that one has underlying abilities based on more complex tasks, but also that the tasks should be taken more in a holistic view as overall performance. Similarly, Wagner and Torgesen (1987) concluded that PA should be viewed as a single construct of underlying ability rather than individual unrelated tasks. Therefore, it is important that the entire range of PA be examined so that the most predictive specific PA tasks can be determined, and so that students' challenges with PA abilities are more clearly identified. There is little available literature that has examined

the relationship between PA and phonetic transcription. Of those, distinct methodological differences have been utilized, necessitating a more in-depth look at the participants, methods, and outcomes in these studies in order to establish patterns and themes, as well as to identify areas of further exploration.

Research with SLP Phonetics Students

Moran and Fitch (2001) appear to be the first researchers to publish a study which sought to determine if there was a relationship between PA and phonetic transcription skills with SLP undergraduate students (n=21). They chose to measure phoneme switching, phoneme reversal, phoneme counting, and vowel matching, finding phoneme switching and phonetic reversal scores to be most correlated with poorer transcription scores. They additionally found vowel matching to be significantly correlated, which was noted as an error in those students' transcription skills. Based upon this study, Hall-Mills et al. (2007, as cited in Hall-Mills & Bourgeois, 2008) wanted to further explore the relationship between PA and phonetic transcription with a larger sample (n=62). They administered phoneme switching, phonetic reversal, and phoneme counting and added 2 spelling tasks, finding phonetic reversal and the spelling tasks to be correlated with phonetic transcription scores. Hall-Mills and Bourgeois (2008) later followed up on their initial findings by only using phonetic reversal, finding that phonetics instruction was beneficial for improving this skill. Robinson et al. (2011) used these studies as the basis for their research with their undergraduate phonetics students (n=43). Unlike the past studies, they used items from a standardized test, the Comprehensive Test of Phonological Processing (CTOPP), to elicit similar PA tasks of phoneme deletion, phoneme reversal and phoneme segmentation. They also used items from a standardized articulation tool to evaluate transcription skills. Because the CTOPP was utilized, the researchers were able to

compare the student scores (obtained prior to beginning phonetics coursework) to the normal distribution from the test provided for adults up to 21 years old. They found that this group of students had higher scores on the phoneme deletion tasks than would be expected in a normal distribution, and that the phoneme reversal scores were lower than would be expected in a normal distribution. Phoneme segmentation scores were normally distributed. Robinson et al. (2011) were able to demonstrate, by finding this skewness in the student scores, that it cannot be assumed that SLP students have PA skills that are within the normal range when they begin coursework. In comparing the students' PA scores to their phonetic transcription scores at the end of the semester, they found the phoneme deletion and phoneme reversal tasks to have the strongest correlations with transcription scores and found that the combined score of these two subtests were the most predictive of a student's transcription skills. Robinson et al. believed the findings indicated a need for above-average PA in order to successfully learn phonetic transcription, which they demonstrated that some students do not have. They further suggested that research should be conducted to look at how taking a phonetics course impacts PA scores, as they did not administer PA testing following the phonetics course.

As students gain phonetic transcription skills, they learn to listen for and identify phonemes in words and to focus less on graphemes. It would be logical to assume that in learning phonetic transcription, a change in phonemic awareness would occur. Werfel (2017) examined this relationship with undergraduate SLP students (n=55) enrolled in a phonetics course and compared them to SLP students enrolled in an Introduction to Communication Sciences and Disorders course as a control group. Only phoneme segmentation (counting the number of sounds in a word) was measured. Werfel found that those in the phonetics group improved with this skill significantly more than the controls, with a change from 50% to 72%

overall accuracy. This was compared to practicing SLP performance of 76% accuracy with the same task reported by Spencer et al. (2008), indicating a similar performance in the SLP students. Despite this improvement following a phonetics course, it is somewhat surprising that neither group had higher performance with the task of phoneme segmentation, which would be the most logical competency after learning phonetics. Further, this study provided a limited view of potential improvements with PA as a result of learning transcription, in that it only assessed one specific aspect of PA, that of phoneme counting. According to Adams (1990), the interrelatedness of the various aspects of PA make each PA element important to examine. While Werfel's findings are helpful in demonstrating the impact that learning phonetic transcription can have on the skill of identifying the number of phonemes in a word, there is still much to be explored about the inverse relationship of PA skills and phonetic transcription.

Only one study was found to provide a more extensive assessment of a variety of PA skills with SLP students. Hillenbrand, as described in his 2017 convention presentation, asked undergraduate students (n=50) to complete 11 PA tasks and a spelling task prior to phonetics coursework and looked for correlations between PA/spelling scores with transcription tasks and non-transcription tasks related to language. Not only did he find the measures of PA to be predictive of transcription scores, but he also found it to be predictive of language-based items such as syntax and semantics. Further, he found that the non-transcription scores were correlated strongly ($R^2=.88$) with the transcription scores. With regard to spelling, he found it to predict a student's PA score, transcription score and non-transcription score. Hillenbrand's findings indicate that learning more about the PA skills of SLP students may be important for additional areas of SLP coursework beyond phonetic transcription. Further, the findings indicate the potential of a more complex relationship between transcription skills and other areas of language.

Based upon the current evidence, it appears that there is a relationship between PA and phonetic transcription, but there is much still to be understood as to what that relationship is and how it impacts student outcomes. As there has been a lack of consistency in the literature as to the specific PA tasks which have been measured, it is important to continue exploring this relationship further. With regard to tasks such as phonemic segmentation that have been more frequently examined, it is of interest to see if similar results can be found. Appendix C displays a comparison of these studies in regard to which aspects of PA have been measured in SLP undergraduate students, which visually reveals the current gaps in knowledge.

It has been suggested that screening of PA may be beneficial in identifying students who are likely to struggle with phonetic transcription so that they can be provided early intervention (Hall-Mills, 2008; Moran & Fitch, 2001; Robinson et al., 2011). It is important to know which PA items are most predictive in order to develop appropriate screening tools and to learn more about how SLP students' PA skills compare to their same-aged peers. Learning more about these aspects may contribute to better identification of, and appropriate intervention with, students who are more likely to struggle with phonetic transcription. Interestingly, Robinson et al. (2011) have provided some evidence that SLP students may perform differently from expected norms in some aspects of PA. Therefore, it is important to learn more about how SLP students perform in PA as compared to peers in other majors. For example, if SLP students perform higher on certain aspects of PA as compared to same-aged peers, these identified general strengths could be built upon in coursework.

PA and Scope of Practice for SLPs

In the training of SLP students, the issue of competency with PA goes beyond the skill of phonetic transcription. Practicing SLPs are able to assess and treat PA within their scope of

practice and are often called upon to serve as collaborators in the school setting (ASHA, 2010; Kamhi & Catts, 2001; Schuele & Boudreau, 2008; Spencer et al., 2008). PA is widely understood to be a fundamental component of literacy instruction and development, thus PA assessment and treatment is within the scope of practice of an SLPs, as well as that of elementary education professionals (ASHA, n.d-b; Spencer et al., 2008; Spencer et al., 2011; Binkley, 2021c). SLPs need to be able to incorporate PA tasks, particularly regarding clients diagnosed with speech sound disorders who may be at an increased risk for difficulty with reading and writing (McLeod & Baker, 2017; Schuele & Boudreau, 2008). For example, as part of the protocol for the Cycles approach to treat phonological disorders, an SLP will provide PA activities as part of the therapy session (Bauman-Waengler & Garcia, 2020). When SLPs work in the school setting, they should work alongside teachers in a collaborative model in addition to providing individualized services to identified students (Kamhi et al., 2001; McKenna et al., 2021; Powell, 2018; Schuele & Boudreau, 2008). Thus, ensuring that SLP students have adequate PA skills and the knowledge to assess and treat PA is an important component of clinical competency beyond its relationship with phonetic transcription.

Because of this important collaborative role between teachers and SLPs with regard to PA, several studies have compared the PA skills of practicing SLPs, SLP students, and practicing educators in order to learn if there are differences between these professionals and whether or not these professionals are competent with a skill they are supposed to be assessing and teaching. Interestingly, it appears that SLPs may be superior in some PA skills compared to other educators, including reading teachers and special education providers, possibly due to SLP coursework such as phonetic transcription (Messier & Jackson, 2014; Spencer, 2011; Werfel, 2017). Despite this discrepancy between SLPs' and educators' PA abilities, both groups were

found to need improvement with PA skills and knowledge so that they can more effectively provide services (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011; Binkley, 2021a).

PA Skills of SLPs and Educators

With the importance of both educators and SLPs being proficient with PA for their disciplines, examining the literature regarding PA skills of these professionals is important. If these professionals are expected to assess PA skills and provide PA intervention with children who are learning to read, then establishing if they have adequate baseline skills is critical. In their 2008 study, Spencer et al. compared kindergarten teachers, first grade teachers, reading teachers, and special education teachers with SLPs. They assessed only phonemic awareness tasks of phoneme segmentation, phoneme identification, and phoneme isolation. For the phoneme segmentation tasks, they divided the 21 words into two categories, easy and hard, based upon the transparency of counting the phonemes compared to spelling. (For example, the word “sat” with a 1:1 correspondence between graphemes and phonemes would be considered easy, whereas a word such as “though” with a correspondence of 6 graphemes to 2 phonemes would be considered hard.) SLPs were significantly better than all groups of educators on both easy and hard words, but it was noted that none of the participants would be considered proficient with the hard words. They concluded that SLPs did not demonstrate “expert skill” in phonemic awareness and were concerned that educators had a mean accuracy of 22% on the hard words. Following up on their findings, Spencer et al. (2011) recruited SLP undergraduate and graduate students with a variety of coursework experiences and used the data from their 2008 study as a comparison for PA skills. They learned that phonetic coursework was a positive predictor for phonemic awareness, and students with phonetics coursework scored higher than the educators from the

2008 study, but slightly lower than the SLPs from that same study. They emphasized concerns that both SLP students with phonetics coursework and practicing SLPs averaged around 50% on counting the hard words, which are less transparent with grapheme to phoneme correspondence, and concluded that phonetics coursework alone is not sufficiently developing phonemic awareness (Spencer et al., 2011).

Messier and Jackson (2014) added to the literature by exploring a comparison of PA skills in teachers of the deaf (TOD) and SLPs, and then compared the findings to Spencer et al. (2008). Messier and Jackson used two phonemic awareness tasks from the Spencer et al. (2008) study, phoneme segmentation and phoneme isolation, and opted not to include the phoneme isolation task due to their use of Survey Monkey and its constraints. An additional modification made was changing the phonemic awareness tasks to being open-ended to increase validity, rather than providing the multiple-choice format that Spencer et al. had developed. Similarly, they concluded that both SLPs and TODs needed further education in PA, with the two groups having no significant differences in performance with phonemic awareness tasks and demonstrating gaps in knowledge.

Concerningly, these studies have demonstrated a lack of proficiency with PA in both SLPs and educators, who are expected to be proficient in such knowledge (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011). While it appears that the specific training SLPs have in phonetics is facilitative in an increased understanding of PA in comparison to educators (Spencer et al., 2008; Spencer et al, 2011), there is still a discrepancy between performance and what would be expected of these professionals. There is a clear need for both SLPs and educators to have more direct training in PA and to assess competency with PA during their training. With

the interconnectedness of the two professions regarding PA, considering both groups' needs is important to ensure appropriate services are being provided to children.

PA Skills of College-Aged Learners

While PA is not typically assessed in adult learners, as it is an assumed skill in one who is able to read, there is some evidence regarding adult learners and PA skills. The Comprehensive Test of Phonological Processing, 2nd Edition (CTOPP-2; Wagner et al., 2013) has been normed up to age 24;11, and provides some insight as to what the average expectations would be for college-aged students with the PA tasks of elision, blending of words, phoneme isolation, blending of nonwords, and segmenting of nonwords. The phoneme isolation subtest, a PA task included in a variety of the aforementioned studies, has 32 items, and for ages 15;0 to 24;11 an average score of 24-29 (75-91% accuracy), and above average scores ranging from 30-32 (94-100% accuracy), indicating that a high level of accuracy would be expected for most adults (Wagner et al., 2013, p. 120). In considering the findings of Robinson et al. (2011), which utilized the first edition of the CTOPP, it is interesting that SLP students were above average on one subtest, and below average on another subtest. This indicates that learning more about how SLP students compare with PA skills to same-aged college peers may provide further insight.

Students often select their college major based upon their personal interests and strengths, thus it is of interest to know if students in a major related to PA, such as SLP and elementary education, have differences in PA skills as compared to same-aged peers in unrelated majors, such as business, biology, or math. Only two studies were located in the literature comparing college students of various majors; both looked at the larger category of phonological processing. Hurford et al. (2016) compared phonological processing abilities of education majors to non-education majors, using the first edition of CTOPP. They did not find any significant differences

between the two groups, nor did the groups significantly differ from the normative data in the CTOPP (Hurford et al., 2016). In comparing these mean scores from Hurford et al. to those obtained by Robinson et al. (2011), SLP students' mean scores were lower than education majors on all 3 CTOPP subtests administered: elision, phoneme reversal, and segmenting words. With evidence indicating that practicing SLPs and SLP students outperform practicing educators (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011), it is interesting to look at these comparisons. There appears to be more to learn about how these two groups compare before coursework and following coursework in regard to PA. Recently, phonological memory was assessed by Katz and Moore (2021) using the CTOPP-2 with 36 college students enrolled in a public speaking course and an introductory SLP course. The average composite score on this subtest was 93.8, which is considered to be in the average range compared to the normative sample (Katz & Moore, 2021; Wagner et al., 2013). However, Katz and Moore did not provide information regarding PA skills, specifically those of phonemic awareness, that have been more frequently examined with SLP students. While there appears to be evidence that students, regardless of major, will perform within the average range for PA skills, further exploration in regard to this can help determine if the findings of Robinson et al. were related to their sampling, or if there are truly different baseline PA skills in SLP students.

PA Intervention with Students

Researchers who have examined the relationship between PA and phonetic transcription have concluded a potential need for SLP students to have more training and practice in PA (Moran & Fitch, 2001; Robinson et al., 2011; Werfel, 2017). Despite this conclusion, there is currently a lack of evidence for the effectiveness of such intervention with SLP students, and there is little to no evidence for the intensity, frequency or content of such intervention. Only one

unpublished conference presentation (Hall-Mills & Bourgeois, 2008) was found to explore the implementation of direct PA instruction as an intervention strategy with undergraduate SLP learning phonetic transcription skills. The researchers offered 6 sessions lasting 10 minutes, and only 8 out of the 55 participants attended 3 or more sessions. Hall-Mills and Bourgeois (2008) reported this intervention as beneficial in acquiring phonetic transcription, but their intervention was limited in duration and sample size, resulting in a small effect size ($R^2=.08$). While their findings are positive indicators for such intervention, more exploration of direct PA instruction with students enrolled in a phonetics course is warranted, with a larger sample size and longer duration of intervention (Binkley, 2021c). It has been 14 years since Hall-Mills and Bourgeois presented their outcomes, and though it has been suggested that such intervention could be helpful for students in learning phonetic transcription (Randolph, 2015), nothing new in this regard has been disseminated.

There appears to be a need for not only SLP majors but also elementary education majors to receive direct PA training in order to gain proficiency in PA for their scopes of practice (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011). Only one study was found which provided some insight as to the effectiveness of PA intervention with educators and SLPs. Westerveld and Barton (2016) measured pre-course and post-course PA assessments to bachelor's level education students and 1st year master's level SLP students in New Zealand who were engaged in 3 hours of either a tutorial or workshop related to PA related to current coursework. The researchers chose the following PA tasks: identifying syllables, identifying the number of sounds in a word, identifying second or final sound in a word. While the SLP students did perform better than the education students, it was concerning that there was a relatively low post-test measure of SLP students who were at least 80% accurate with counting sounds in a

word and identifying the 2nd sound in a word (63% and 44%, respectively; p.86). Thus, with the importance of competency with these tasks related to professional duties, both SLPs and educators appear to need additional training in PA that is currently not being provided (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011; Westerveld & Barton, 2016). It is possible that efforts to provide a small amount of direct training are promising but do not adequately meet the needs of these students to meet expected competency with PA (Hall-Mills & Bourgeois, 2008; Westerveld & Barton, 2016). Value has been found in interprofessional education (IPE), and providing direct training to both SLP students and elementary education students together for a longer period of time could potentially help address this apparent knowledge gap, and would further help begin laying a foundation for interprofessional practice (IPP) in school-based settings (ASHA, n.d.-a; ASHA, 2017; McKinney & Waite, 2016; WHO, 2010).

Theoretical Applications

PA tasks such as syllable counting, phoneme identification, and phoneme matching are typically discussed within SLP phonetics courses (Shriberg et al., 2019; Small, 2020), but with minimal attention given. The assumption often made is that students already have developed these skills and only need to demonstrate, apply, and build upon prior PA knowledge to learn transcription skills. However, since the research indicates that this may not be the case (Hall-Mills & Bourgeois, 2008; Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011; Spencer et al., 2011), there is a strong argument for supplemental learning and training of PA. Students who do not have sufficient prior knowledge are less likely to successfully manage the cognitive load demands of trying to integrate new information (Cerbin, 2018; Taylor & Hamdy, 2013; Binkley, 2021b).

The educational learning theory of cognitivism discusses the importance of learning in such a way that competence can be developed while recognizing the cognitive load of learning (Lattuca & Stark, 2009; Binkley, 2021b). Within the broader category of cognitivism are the theories of scaffolding and constructivism (Bates, 2016; Binkley, 2021b). Scaffolding addresses cognitive load theory by providing the necessary supports and then continually modifying these supports as learner demands change (Austin, 2013; Bates, 2016; Taylor & Hamdy, 2013; Binkley, 2021b). Learners who are not provided with these appropriate supports are less likely to integrate knowledge into working and long-term memory, which is needed for them to use the learning in future application (Kirschner et al., 2006; Taylor & Hamdy, 2013; Binkley, 2021c). An additional applicable learning theory is that of constructivism/experiential learning, which can be accomplished through integrating problem-based learning, role-play, and case-study learning (Fink, 2013; Merriam & Bierema, 2014; Svinicki et al., 2014; Binkley, 2021b). By providing a combination of scaffolding and experiences, students' cognitive load would be addressed, while also providing them with rich learning that is likely to have a more lasting impact. Cognitive learning theories specifically seek to address students' gaps in knowledge and to help students construct knowledge, which helps them make sense of new knowledge (Binkley, 2021b). Learning more about what gaps are present in SLP students, and developing appropriate supplemental offerings of PA learning that can be applied to phonetic transcription and other PA-related aspects of SLP scope of practice, could address some of the concerns that have been raised with student outcomes.

Summary of the Literature

There is still much to be learned about what predictors are best at identifying students who may have difficulty with phonetic transcription (Binkley, 2021a). There is evidence that PA

skills are predictive of phonetic transcription skills (Moran & Fitch, 2001; Hall-Mills & Bourgeois, 2008; Hillenbrand, 2017; Robinson et al., 2011), and that PA skills are not adequately developed at the end of training for SLPs (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011). While Werfel (2017) provided preliminary evidence that coursework in phonetic transcription contributes to phonemic awareness, Spencer et al. (2011) indicated that it is not sufficient to meet assumed levels of competency for professionals. Of concern is that demonstrating below 80% accuracy with phonemic awareness could indicate a potential lack of proficiency with phonetic transcription, and a lack of overall PA competency. Practicing clinicians and SLP students in a variety of countries have reported varying levels of competency and use of transcription in clinical practice, which has potential to impact service delivery (Knight et al., 2018; Nelson et al., 2020; Shaw & Yanushevskaya, 2021).

As discussed, the current available literature provides a glimpse of PA skills that is lacking in consistency between studies in regard to which specific tasks are assessed and the methods in which those tasks were assessed. It is important to note that PA is considered to be an auditory task, which is trained and evaluated with little to no regard to the printed word (Schuele & Boudreau, 2008). Many of the studies utilized print-based tasks to analyze PA or asked respondents to provide their answers via print (Hillenbrand, 2017; Messier & Jackson, 2014; Moran & Fitch, 2001; Spencer et al., 2008; Spencer et al., 2011; Werfel, 2017), which may have impacted the validity of the outcomes. Careful design of PA tasks, with consideration to its emphasis in ignoring spelling and print, should be considered in future research.

Randolph (2015) suggested that SLP programs need to screen the PA skills of undergraduate SLP students in addition to providing intervention to address PA. Further exploration is needed to learn if direct PA intervention is effective in helping SLP students to be

successful and competent with phonetic transcription (Binkley, 2021a). The need for SLPs to have strong PA skills addresses multiple aspects of the scope of practice. SLPs need to accurately use phonetic transcription as a tool for assessment and treatment, but they also should be able to assess and treat PA, and to serve as consultants and collaborators in the school setting regarding speech, language, and literacy issues (ASHA, 2010). As PA is more broadly related to the scope of practice and interprofessional aspects of the SLP field, the incorporation of direct PA training may not only be important in addressing issues related to phonetic transcription. Current evidence provides an indication that direct training in PA is beneficial (Hall-Mills & Bourgeois, 2008; Westerveld & Barton, 2016), but more exploration regarding supplemental training as an intervention is warranted.

There are potential implications for direct PA training to address scope of practice competency, and there is potential that this training could be implemented through IPE designs of SLP students with other undergraduate majors, such as education (Binkley, 2021c). The evidence suggests that educators, which SLPs will collaborate with, may have even lower PA skills, and thus there is a need for both groups to receive further instruction, training, and practice with PA. Providing opportunities for students to do this through IPE appears to be a logical solution which should be further explored. It is plausible that such efforts could more adequately scaffold student learning, addressing cognitive load needs that may currently exist, thus improving outcomes for these students. Improving student outcomes with these skills has the potential to have a positive impact on the clients that SLPs serve (Randolph, 2015). As SLP programs seek to train their students to be competent and collaborative professionals, it is important that efforts toward addressing these identified issues with PA be continued.

Methodology

A review of the literature has established the importance of phonological awareness (PA) and in the training of speech-language pathology (SLP) students. Not only does there appear to be a relationship between PA skills and learning phonetic transcription, but there also is a need for SLPs to be knowledgeable in all aspects of PA to address this scope of their practice. There were a number of gaps in knowledge which were revealed in a review of the literature and learning more about the relationship between PA and phonetic transcription skills will add to what is currently understood. The goal of this dissertation study was to learn more about ways in which SLP programs can improve student outcomes with phonetic transcription, thus impacting improved service delivery. In order to address these gaps in knowledge, there were three major areas of exploration. First, this study sought to learn if all college students have relatively similar PA skills, or if those skills are different for students who have chosen a major related to PA. Second, was to discover if learning phonetics through an SLP phonetics course results in a change with PA skills. Finally, this dissertation study sought to pilot direct training in PA, through an additional course, to see if it could result in improved outcomes with phonetic transcription skills.

Research Design and Methodology

This dissertation study was conducted using quantitative measures for three major areas of exploration. As each area of exploration had distinct differences in design, participants and analysis, this dissertation study is presented in three separate articles. To provide a better understanding of the measurements of PA and phonetics transcription, an explanation of the tools being used, along with the rationale for the selection and use of the assessment tools is provided.

These tools were systematically developed in order to address identified gaps in the literature, and to be consistent with the underlying theories of PA.

Assessment of PA Skills

PA is a skill of analyzing components of oral language, which then supports the learning of reading and writing (Robertson & Salter, 2018; Schatschneider et al., 1999; Schuele & Boudreau, 2008). Because the skill of PA is based upon the ability to perceive orally presented language, absent from spelling, assessment of PA should be presented orally. Past researchers (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011; Werfel, 2017) have utilized written presentation of stimuli to assess PA skills, however the use of such tools has the potential to interfere with validity since PA is considered to be an auditory task (Bauman-Waengler & Garcia, 2020; McBride-Chang, 1995). Werfel (2017) referred to her study as addressing “explicit phonemic awareness skills” due to the fact that phonemic segmentation tasks were presented in written form (p. 283). Stimuli to assess PA should be delivered orally, it should also be confirmed that the listener is perceiving the stimuli correctly during assessment, and the listener should respond verbally, particularly when there is a need to provide specific phoneme information (McBride-Chang, 1995).

Another important aspect of PA is that it is an umbrella term which encompasses a number of tasks that while considered to be of increasing complexity, are also considered to be interconnected and equally important (Anthony & Lonigan, 2004; Schatschneider et al., 1999; Spencer et al., 2008; Wagner & Torgesen, 1987). PA skills progress from recognizing words in sentences, to identifying syllables (syllable segmentation), to the ability to recognize rhyming and to rhyme words (onset-rime awareness/production), and finally to tasks of phonemic awareness, which is the ability to identify and manipulate the individual speech sounds that make

up words (Bauman-Waengler & Garcia, 2020; Schuele & Boudreau, 2008). A review of the literature revealed that previous studies have only focused on a few aspects of PA, with particular emphasis on phonemic awareness tasks, and less emphasis on syllable segmentation and onset-rime awareness/production. Tasks such as rhyme sensitivity have been found to be highly correlated with and highly predictive of other PA skills in children (Anthony & Lonigan, 2004). It is valuable to assess a variety of skills in all areas of this umbrella of PA, rather than only focusing on phonemic awareness tasks, as this has the potential to reveal additional information about students' PA skills.

The majority of the literature which assessed PA skills in SLP students and/or working professionals (SLPs and educators) utilized researcher-created tools that either they created or that had been created by previous researchers (Hall-Mills and Bourgeois, 2008; Hillenbrand, 2017; Moran & Fitch, 2001, Spencer et al., 2008; Spencer et al., 201; Werfel, 2007). Robinson et al. (2011) chose to use three subtests from the first edition of the Comprehensive Test of Phonological Processing (CTOPP): elision, phoneme reversal, and segmenting words. In its second edition, the CTOPP-2 (Wagner et al., 2013) no longer contains the subtests of phoneme reversal and segmenting words that are described by Robinson et al. (2001). Further, while the CTOPP-2 is normed for individuals up to age 24, the test is aimed to assess the larger umbrella of phonological processing, and thus only addresses a few aspects of PA, namely a few phonemic awareness skills (Wagner et al. 2013).

In an effort to develop a tool for assessing the entire umbrella of PA, and to use tools which have already been created and standardized, the Phonological Awareness Test, Second Edition, Normative Update (PAT-2:NU; (Robertson & Salter, 2018)) was identified as a standardized assessment tool created to address all aspects of PA. Despite the fact that it is

normed up to age 9;11, the items have already been developed and validated by the test creators, and the PAT-2: NU manual indicates that it is highly correlated with the CTOPP-2 for phonological awareness (Robertson & Salter, 2018).

In addition, it was noted that the tools developed by Moran & Fitch (2001) and Spencer et al. (2008) provided additional insight into specific aspects of PA and had been used by other researchers (Hall-Mills & Bourgeois, 2008; Messier & Jackson, 2014; Spencer et al., 2011; Werfel, 2017), offering comparison data. Two tasks created by Moran & Fitch (2001), which were provided along with directions, were determined to be additional beneficial tasks not assessed by the PAT-2: NU, phonetic reversal and vowel matching. Robinson et al. (2001) selected tasks from the first edition of the CTOPP because those tasks were closely related to the ones created by Moran & Fitch (2001). The task of phonetic reversal was noted by Hall-Mills and Bourgeois (2008) to have the strongest correlation with their participants with phonetic transcription scores. Of note is that based on preliminary piloting of the phonetic reversal task, 10 of the 20 items were selected for the assessment tool that was created. Vowel matching was noted by Moran and Fitch (2001) as the only task of the four they conducted which was significantly correlated with all transcription measures they administered. The phoneme counting task that was developed by Spencer et al. (2008), which further divided words into the categories of “easy” and “hard” based on their similarity to spelling are most closely tied to the task of phonetic transcription. However, Spencer et al. (2008; 2011), Messier and Jackson (2014), and Werfel (2017) administered these tasks in pencil and paper form, and it is of value to deliver this task in oral administration, which more closely aligns with the theory of phonological awareness as well as the typical way one utilizes phonetic transcription. The authors did not provide

phoneme counts for these words and based on the variability of phoneme counting for words which contain the possibility of a syllabic consonant, 3 items were removed from this list.

Two additional items were identified as valuable in assessing phonological awareness. With the importance of hearing acuity on the tasks (McBride-Chang, 1995) ensuring that participants have adequate hearing and that they are adequately perceiving speech is important. A hearing screening was individually conducted on all participants to rule out any concerns about hearing difficulties. Therefore, a pure tone hearing screening conducted at 25 dB and at 1000 Hz, 2000 Hz, and 4000 Hz provided cursory information regarding the student's hearing status. Should a participant fail the hearing screening, this was noted so that their data can be analyzed separately, if warranted, and the participant was informed of the results. Second, a task of auditory discrimination from the Test of Language Development: Primary-5th Edition (TOLD: P-5; Newcomer & Hammill, 2019) called Word Discrimination requires an individual to judge whether words differ by one speech sound or not. Not only does this demonstrate auditory perception, but it further analyzes the students' ability to perceive differences between phonemes in the context of a word, which ties back to phonemic awareness. The original subtest item from the TOLD: P-5 contains 38 items, and a decision was made to reduce this to a total of 20 items, with the same ratio of same versus different word pairs. A randomization tool was utilized to randomly select which items were included in the final list of 20 word pairs.

Because phonological awareness is an auditory task, all items for this study were presented orally. When appropriate, items which allow for a binary response (e.g., yes or no, same or different) or numerical response (e.g., 2, 4) were delivered in a group with participants able to record their response on a scoring sheet. These measures took no longer than 15-20 minutes, allowing for time needed for repetition of items upon student request. The remaining

items were administered individually so that verbal responses could be obtained and phonetically transcribed, with the exception of the vowel matching task (Moran & Fitch, 2001), which based on pilot administration was determined to be more appropriate for individualized time. The administration time for this second portion of the PA assessment took an average of 20-30 minutes. All items were presented via pre-recorded audio (recorded in a sound-proof audiology booth) through the same Bluetooth speaker in order to ensure consistency of presentation. A breakdown of the elements for the assessment tool, and how each element ties back to aspects of PA is described in Appendix D. This final tool resulted in a total word/syllable segmenting score of 50, a total onset-rime awareness/production score of 20, and a total phonemic awareness score of 128 (which can be even further broken down into categories). The entire assessment tool had a final total score of 178. The same tasks were administered at pre-test and at post-test, as applicable. This decision was made in order to reduce the likelihood of a lack of equivalency between test versions.

Pilot administration of the group and individual PA tasks was conducted by the investigator with an undergraduate non-SLP major student and a recent SLP graduate student in order to identify any challenges or modifications that were needed prior to administration. Scoring was conducted after all the responses had been recorded. The investigator was blinded to the participants by assigning participants unique identifiers, and two graders were utilized to reduce bias. Occasionally, a graduate student was utilized to score alongside the investigator in order to provide interrater reliability data.

Existing Data Using the Assessment of PA Tool

The Abilene Christian University (ACU) Communication Sciences and Disorders (CSD) department determined a need to develop an additional one-hour course in order to better address

the needs of students who struggle with phonetics. Currently delivered as a special topics course, the Phonetics Lab course was initiated in Fall of 2021 as an optional course designed to be taken currently with the traditional phonetics course. The department's intent was to eventually establish the course within the CSD curriculum, which was approved in the spring of 2022. The Phonetics Lab course is viewed primarily as a structured remediation for students to be provided with direct instruction in PA with explicit connections made to learning phonetics coursework. Its experiential learning components that help make connections with other areas of SLP scope of practice, as well as its elements of interprofessional education (IPE), made it a unique addition to the current course offerings, that was designed to address identified student needs.

Historically, the department has implemented a regular procedure for evaluating students' maintenance of phonetic transcription and related concepts around their junior year and at the start of their Speech Sound Disorders course. This tool has been used for the development of remediation plans and tutoring requirements for students who had not maintained competency. It has been utilized further with incoming graduate students to assess their competency with phonetics and related concepts, also directing decisions regarding remediation plans. With the utility of this tool to guide faculty decisions regarding students' needs for additional remediation, it was believed that a similar tool and process would benefit the guidance of decisions regarding course design and development for the Phonetics Lab course.

The Phonological Awareness Assessment Tool (PAAT) developed by the investigator (Binkley, 2021c; Appendix D) was administered to all undergraduate SLP majors within the first two weeks of the fall semester in the entry-level courses of Introduction to Communication Sciences and Disorders (CSD 235) or Phonetics (CSD 225) so that the department could begin to explore the utility of this tool, to identify patterns within the student population, and to develop

cut-off scores for recommendations. The department planned to use this data as part of the proposal to the university for the addition of the course to the current curriculum, and to determine how the PA tool may be modified and potentially condensed for future departmental administration. This existing data that was collected for educational purposes was utilized as a pre-test measure, which was approved by the University of South Dakota's Institutional Review Board (IRB).

Assessment of Phonetic Transcription Skills

There is no standardized measure available for judging phonetic transcription competency. Tools utilized for assessing phonetic transcription have demonstrated a variety of constructs within the literature. Some researchers have opted to utilize scores from phonetics course exams/quizzes (Hall-Mills and Bourgeois, 2008; Hillenbrand, 2017), while others have opted to create specific transcription tasks (Mackenzie-Beck, 2003; Moran & Fitch, 2001). There are some inherent issues with both of these methods for measuring phonetic transcription, including but not limited to the inclusion of non-transcription content, lack of equal distribution of English speech phonemes, and task complexity. Robinson et al. (2011) opted to utilize the Hodson Assessment of Phonological Processes-3rd Edition (HAPP-3), which is a standardized speech sound disorder assessment tool, due to its representation of all English sounds and its clinical application for words SLPs would transcribe.

In an effort to develop a transcription measurement that is balanced and relevant to clinical application, a similar tool to the HAPP-3 was selected. The Bankson-Bernthal Test of Phonology-2nd Edition (BBTOP-2; Bankson & Bernthal, 2020) was selected due to its presentation of 80 English words which are commonly used with children in assessment and treatment, and also represent a variety of English speech sounds with relatively equal

distribution. The words were pre-recorded and auditorily presented to the participants, with instructions for them to transcribe the word on an answer sheet. No written form of the word was provided to the participants, but multiple presentations of each word will be offered upon request. It took approximately 20-30 minutes to administer these items. The investigator was blinded to the participants' responses by assigning participants a unique ID number, and multiple graders were utilized to reduce bias. Since there are some acceptable variations with phonetic transcription, the investigator and two trained SLP graduate students agreed upon what variations would be accepted as correct.

Summary of the Three Articles

There were three major areas of exploration for this dissertation. First, was learning whether or not undergraduate SLP majors and education majors, who have chosen a major which is related to PA, have different baseline skills with PA as compared to their same-aged peers who have chosen a major that is not related to PA. While a few studies have compared practicing SLPs and practicing educators, and others have compared students majoring in SLP and/or education, it does not appear that these two groups have been compared to others who are in unrelated majors, such as biology, math, or business. Knowing how the baseline skills of SLP students compare to these other groups may be helpful in making decisions about what would be considered average versus above average for PA skills. Therefore, the first research question addressed was: *Is there a difference in phonological awareness (PA) skills between non-PA related majors compared to elementary education majors, and to speech-language pathology majors (prior to any phonetics and/or phonological awareness coursework)?* It was hypothesized that the SLP majors and elementary education majors will have higher baseline PA scores in at least some areas as compared to students in unrelated majors.

The second area of exploration was to determine if simply taking a phonetics course results in a change in PA skills. This was suggested by Werfel (2017) in her study looking at phoneme counting abilities and has further been suggested by other researchers in an attempt to explain why SLPs might have higher PA scores than educators (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al. 2011). This dissertation research examined a broad range of PA skills comparing SLP students enrolled in a phonetics course with SLP students enrolled in an introductory course, who have not taken a phonetics course, as a control group. Therefore, the second research question was: *Does taking a phonetics course increase phonological awareness skills for SLP students?* It was hypothesized that students enrolled in phonetics would have an increase in PA skills at the end of the course that is not seen with students in an introductory course.

The final area of exploration was to pilot a course in order to explore effectiveness of direct PA intervention, in conjunction with a traditional phonetics course, to help achieve improved student outcomes with phonetic transcription. If there is a relationship with PA and learning phonetic transcription, then helping further develop a student's PA skills through direct intervention that is not typically provided in SLP coursework, could be a possible solution. Further, because assessment and intervention of PA are within the SLP scope of practice, an additional benefit of direct PA intervention could be development of clinical skills and introduction of the foundations for interprofessional practice (IPP) with regard to PA. The one-hour course of Phonetics Lab that directly trains PA skills and applies them to phonetic transcription and the SLP scope of practice was piloted, and student outcomes were measured. This serves to answer the third research question: *Does the implementation of direct phonological awareness training (through Phonetics Lab) improve phonetic transcription skills*

in SLP undergraduate students? It was hypothesized that students who were enrolled in and participated in Phonetics Lab would have improved transcription skills compared to those who were only enrolled in a traditional phonetics course.

Article One: Is There a Difference in PA Between College Majors?

Previous research has indicated the possibility that adult learners may have varying PA skills. Spencer et al. (2008) found that practicing SLPs and educators differed in their PA skills, and Robinson et al. (2011) learned that some SLP students performed above average on one PA task, and below expected norms on another PA task. Conversely, Kennedy et al. (2013) and Hurford et al. (2016) reported no significant group differences between education majors and noneducation majors when they were measured on PA tasks. Because it is of interest to learn more about the relationship between PA skills and phonetic transcription skills, learning more about how SLP students' baseline PA skills compare to their same-aged peers was valuable. Additionally, it was helpful to learn more about whether or not students who are in a major related to PA have different baseline PA skills compared to their peers who have chosen majors unrelated to PA.

Question Two: Does Taking a Phonetics Course Improve PA?

It has been suggested that phonetics coursework may explain differences in PA performance between SLP students who have had such coursework and/or practicing SLPs when they are compared with educators (Carroll et al., 2012; Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011; Westerveld & Barton, 2016). An improvement in explicit phonemic awareness skills, with the task of phoneme counting, measured following a phonetics course was found in undergraduate SLP students by Werfel (2017). However, this finding was limited to one specific PA task, which should develop as a direct learning outcome from a phonetics course.

Therefore, more exploration of other aspects of PA development was warranted, which was suggested by Werfel.

Question Three: Does Direct PA Intervention Improve Transcription Skills?

While it has been suggested that direct intervention of PA skills might improve outcomes with phonetic transcription (Robinson et al., 2011), only one unpublished conference presentation (Hall-Mills and Bourgeois, 2008) was located to demonstrate its implementation and efficacy. This study found that a small amount of PA intervention (10-minute sessions) with a small group of students (8 students who attended 3 or more sessions) resulted in some improvements in phonetic transcription skills. Further research that can demonstrate an effective model for how direct PA intervention can be implemented, and that can be replicated by other SLP programs, would be beneficial if such an intervention model can be demonstrated to help with student outcomes.

Summary of the Chapter

This dissertation study was an attempt to add to the growing body of literature regarding the relationship between PA and phonetic transcription. A three-article dissertation model was used for dissemination of findings. The dissertation study attempted to learn more about similarities and differences in a broad range of PA skills among undergraduate students, with particular interest in the skills of elementary education majors and SLP majors due to their professional roles upon graduation. The study expanded on previous work and attempts to address a number of future directions that have been suggested in the literature (Hall-Mills and Bourgeois, 2008; Moran & Fitch, 2001; Robinson et al., 2011; Spencer et al., 2011; Werfel, 2017). A preliminary effort to demonstrate an educational model for direct PA intervention, which also included opportunities for IPE with education majors and SLP majors, provided

information that can guide future research for course development. The results of this study will provide more information that is helpful in the design of a PA screening tool for assessment with SLP and/or education majors. Additionally, the results provide greater insight into the PA skill of undergraduate students prior to any direct instruction, and any differences seen in SLP and education majors. An overarching goal of this dissertation study is that the results can be published so that other SLP undergraduate programs, and possibly elementary education programs, can benefit from what is learned about the relationship between PA and phonetic transcription.

Chapter 2

Phonological Awareness Abilities of Undergraduate College Students:

A Comparison of Students in Related and Unrelated Majors

Instructors of undergraduate speech-language pathology (SLP) courses provide important foundational content for students to develop professional clinical skills. Course content, such as the ability to accurately document a client's speech through phonetic transcription, must be developed through coursework and then later applied clinically. Therefore, it is critical for instructors to develop courses with strong outcomes so that students can continue to build their skills throughout their training. One example of such coursework is phonetic transcription, wherein students learn to document speech sounds utilizing the International Phonetic Alphabet (IPA), typically offered relatively early in the undergraduate sequence.

There is a possible link between phonological awareness (PA) and phonetic transcription. PA involves analyzing components of oral language, which then supports the learning of reading and writing (Robertson & Salter, 2018; Schatschneider et al., 1999; Schuele & Boudreau, 2008). According to Bauman-Waengler and Garcia (2020), PA can be viewed as an umbrella term that encompasses a variety of skills, which can be categorized into three main areas: word/syllable awareness, onset-rime awareness, and phonemic awareness. These skills involve the blending, isolation, deletion, segmenting, and manipulation of speech and units of speech sounds (e.g., syllables, words) as part of the development of reading and writing (Bauman-Waengler & Garcia, 2020). Phonemic awareness, the awareness of individual speech sounds, is particularly important for phonetic transcription. When using the International Phonetic Alphabet (IPA) to transcribe speech, one must be able to isolate, segment, and manipulate words, syllables and phonemes, which requires PA.

SLPs employ the use of phonetic transcription when they assess and treat speech sound disorders (SSDs). It is important that an SLP is accurate with their transcription skills, as this will impact their assessment results and treatment plans (Bauman-Waengler, 2020). Typically, phonetic transcription is taught in undergraduate courses, and then students are expected to maintain and apply the skill in future coursework and clinical experiences (Crais et al., 2015; Tessel & Grover, 2020). Often, when assessing and treating SSDs, clinicians may additionally assess and treat a client's PA skills because there is an interconnectedness of PA with speech and language, and these clients may be a higher risk for literacy difficulties (American Speech-Language Hearing Association [ASHA], n.d., McLeod & Baker, 2017; Schuele & Boudreau, 2008).

SLPs additionally provide an important collaborative role in the educational setting due to their expertise with speech and language (ASHA, 2010; Kamhi & Catts, 2001; Schuele & Boudreau, 2008; Spencer et al., 2008). With PA serving as a critical component of literacy instruction and development, it is within the scope of practice of SLPs, as well as that of elementary education professionals, and it is important that both professions be competent in this area as they collaborate in educational settings (ASHA, n.d.; Spencer et al., 2008; Spencer et al., 2011). For educators, competent PA skills are needed in order to teach reading strategies (Carroll et al., 2012; Kennedy et al., 2013; Sayeski et al., 2017). SLPs must be competent in these skills for their assessments and treatment, as well as in their provisions of collaborative services, and they have the ability to offer a unique contribution to the curriculum planning in the educational setting (Schuele & Boudreau, 2008).

In order for SLP instructors to design phonetics courses with strong student outcomes, they should have an understanding of students' baseline abilities with PA, as this is the

foundation needed to develop phonetic transcription skills. Phonetics textbooks typically present an overview of concepts such as syllable counting and phoneme isolation (Shriberg, et al., 2019; Small, 2020). However, it is expected that students will have these skills already developed and use that foundation to employ the IPA for phonetic transcription. Phonetic transcription requires one to rely solely on what is heard and to ignore orthographic spelling. However, it appears that knowledge of spelling may impact accuracy with PA tasks in adults, such as with identifying phonemes (Scarborough et al., 1998). Therefore, learning more about students' PA skills prior to coursework can help phonetics instructors to understand what areas of PA students may need more explicit practice and instruction.

Review of the Literature

PA Assessment with Undergraduate College Students

While exploring PA skills of undergraduate SLP students is important to have context as to whether there are differences in ability for students who are in a major related to PA, such as education or SLP, is additionally valuable for pre-professional course development. Limited evidence regarding the PA skills of undergraduate college students exists. PA skills of undergraduate college students have primarily been explored in the context of learning disability, due to the increased likelihood that college students with learning disabilities may have difficulty with reading and writing demands at the higher education level (Del Tufo & Earle, 2020; Earle & Del Tufo, 2021; Wilson & Lesaux, 2001), or in the context of examining PA competency with education majors/professionals and SLP majors/professionals due to its role in coursework and professional practice (Carroll et al., 2012; Hall-Mills & Bourgeois, 2008; Hillenbrand, 2017; Moran & Fitch, 2001; Robinson et al., 2011; Sayeski et al., 2017; Spencer et al., 2011; Werfel, 2017; Westerveld & Barton, 2016). Hurford et al. (2016) compared education majors with non-

education majors utilizing the Comprehensive Test of Phonological Processing (CTOPP; Wagner et al., 1999), a measure of phonological processing, including two specific subtests (Elision and Blending) to assess PA skills. This study did not find any differences in phonological processing abilities between the two groups. For the two PA tasks, pre-service teachers outperformed non-education majors, but it did not reach the level of significance, and was within the average range for the normative sample of the CTOPP (Hurford et al., 2016).

There is little published research that explores the PA skills of undergraduate college students that is not in the context of learning disabilities, and further no study found was found to compare the PA skills of undergraduate students in education and SLP majors with undergraduate students in majors where PA does not play a role coursework and professional practice. Of the few studies located that assessed some level of phonological processing and/or PA skill for undergraduate college-aged students with an unspecified major, both studies utilized participants from undergraduate speech-language pathology courses for at least a portion of their participants but did not compare them against participants in the group from other majors (Henbest, et al., 2020; Katz & Moore, 2021). Katz and Moore (2021) examined phonological memory, which is part of phonological processing, but did not directly assess phonological awareness, as their study was focused on word learning and its relationship with acoustic effects. Scarborough et al. (1998) studied grapheme to phoneme correspondence of college students from teacher education courses who had already earned at least a bachelor's degree. Interestingly, it appears that adolescent and adult readers may have variable performance with phonemic awareness that does not always reach a near-perfect score, despite assumptions that they would demonstrate full phonemic skills since they are proficient in reading (Scarborough et al., 1998).

PA Assessment of Undergraduate SLP majors and Education Majors

With the importance of PA skills involved in the training of phonetic transcription, several studies have examined the PA skills of undergraduate SLP majors. Moran and Fitch (2001) were the first to explore the relationship between PA and phonetic transcription skill acquisition, finding the students to have varying abilities with PA tasks and noting that phonetics instructors should not assume established PA skills for students. Further, they found that students who scored lowest on the phonemic switching and phonetic reversal tasks also demonstrated the lowest transcription scores. Other explorations of the relationship between PA skills and phonetic transcription in SLP undergraduate students has indicated that these students not only have varying abilities with PA skills, but that they also may need to be aware of their skill level, and to receive direct instruction in PA to assist with the development of phonetic transcription skills (Hall-Mills et al., 2007, as cited in Hall-Mills & Bourgeois, 2008; Hall-Mills & Bourgeois, 2008; Hillenbrand, 2017; Robinson et al., 2011). On a phoneme counting task prior to taking a phonetics course, SLP majors were less than 50% accurate (Werfel, 2017). However, the varying skills seen in these students indicate the need for comparison of same-aged peers from other majors so that it can be established whether they are similar or different from other students. Robinson et al. (2011) found that the SLP majors in their study had Elision scores that appeared to exceed a normative prediction, while Phoneme Reversal scores were lower than a normative prediction. Based upon these findings, learning more about how SLP majors compare with other same-aged peers will provide valuable information as to whether their abilities with aspects of PA are truly higher or lower than other undergraduate college students.

SLP students and professionals have been compared to education majors and professionals, due to both having PA as part of pre-professional coursework training and in their

professional roles. Westerveld and Barton (2016) compared undergraduate education majors to graduate SLP majors who had already received training in phonetic instruction, with SLP majors outperforming the education majors on all four tasks. However, on two measures, counting the number of sounds in words and on identifying the second sound in a word, they found that the master's level SLP students had low levels of performance, indicating that their prior coursework had not provided them with adequate knowledge for the full range of phonemic awareness. The researchers determined that college students in these majors need phonemic awareness development through coursework (Westerveld and Barton, 2016). Kennedy et al. (2013) compared education majors to non-education majors and determined that education majors significantly outperformed the non-education majors on measures of knowledge of and application of PA at their pretest measure. Of note is that they included eight SLP major undergraduate students within their group of education majors but did not analyze the SLP majors separately.

In examining comparisons with working professionals, several studies have indicated that the PA skills of practicing SLPs exceed those of practicing educators (Carroll et al., 2012; Messier & Jackson, 2014; Spencer et al., 2008). The phonemic awareness skill of phoneme segmentation (counting the number of phonemes in a word) was examined in practicing SLPs and educators, with the data then later compared to SLP undergraduate students (Spencer et al., 2008; Spencer et al., 2011). They found that practicing SLPs outperformed educators, while undergraduate students who had not completed phonetics coursework had similar performance to the practicing educators. This finding suggests that there may be differences with PA skills in undergraduate SLP majors prior to any phonetics coursework from same-aged peers in other majors.

PA Assessment Differences Found in the Literature

A primary issue that was identified within the literature is a lack of consistency in which parameters of PA were measured in determining the PA skills of undergraduate college students (See Appendix E). Many studies only looked at only one or two aspects of the umbrella of PA. McBride-Chang (1995) highlighted this issue within PA research with children, wherein a variety of types and complexities of tasks are administered between studies while still purporting to measure the same general skills. Werfel (2017), who explored the phonemic awareness skills of SLP students suggested that future research should include more parameters of PA. A variety of tools, including researcher-developed tools, have been utilized for assessment in the published research. It does not appear that some areas, such as counting the number of words in a sentence and production of rhyming words, have been explored with undergraduate students. It is possible that this is due to the assumption that such skills would be well-established for young adults who are experienced readers, but Scarborough et al. (1998) suggested that this may not be the case.

Many of the studies located within the literature administered items via pencil and paper tasks. While convenient, PA is an auditory task (Bauman-Waengler, 2020, McBride-Chang, 1995). Therefore, providing stimuli via written words, and/or having participants respond with a written word, would not necessarily yield a valid result for PA ability. In fact, Werfel (2017) acknowledged that their outcomes were a measure of “explicit” phonemic awareness due to the stimuli being presented orthographically and not auditorily (p. 283). It is notable that standardized formal tests created to assess PA are designed with auditory stimuli and verbal responses (Robertson & Salter, 2018; Wagner et al., 2013). McBride-Chang (1995) discusses the importance of stimuli and responses to be provided verbally in order to accurately assess PA.

Thus, in order to accurately assess PA, delivery should be via auditory means and verbal responses should be provided when applicable.

Purpose of this Study

A review of the literature identified several gaps in knowledge that this study intended to address. First, it appeared that there is lack of evidence regarding the PA skills, particularly in regard to the full range of the umbrella, for undergraduate students. The majority of the available literature measured a few aspects of PA but did not assess the full range of skills included in PA. Second, while SLP students, education students, and undergraduate students in majors unrelated to PA have been assessed, no one has compared these three groups to see if differences exist. Therefore, we wanted to answer the following research question: *Is there a difference in phonological awareness (PA) skills between non-PA related majors compared to elementary education majors, and to speech-language pathology majors (prior to any phonetics and/or phonological awareness coursework)?* We hypothesized that undergraduate students who are in majors related to PA, such as education and SLP, would have some differences in PA skills compared to undergraduates in unrelated majors, such as biology and business.

Methodology

Development of an Assessment Tool for PA

The researchers in this study determined that there were two important components for the development of a tool to answer this research question. First, stimuli should be presented orally in accordance with the fact that PA is an auditory skill (Bauman-Waengler, 2020). Many past studies have utilized written presentation of stimuli either via pencil and paper or an online survey (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011; Werfel, 2017), but because the skill of PA is based upon the ability to perceive orally presented language, absent

from spelling, the decision was made by the primary investigator (PI) to present all stimuli orally in this assessment tool. According to McBride-Chang (1995) it is important that stimuli not only be presented orally, but also for the listener to respond verbally, particularly in the instance of the need to provide specific phonemic information. Thus, any answers that were not binary (e.g., yes/no, same/different) or a counting task (e.g., number of words in a sentence) were designed for individual delivery with verbal responses.

Second, the researchers established that an assessment tool including all areas of the PA umbrella should be developed. While the Comprehensive Test of Phonological Processing (CTOPP; Wagner et al., 1999) was utilized by several researchers, this tool is primarily intended for assessing phonological processing, and only addresses a few areas of PA, namely phonemic awareness. Furthermore, its second edition, the CTOPP-2 (Wagner et al., 2013) no longer contains the subtests of phoneme reversal and segmenting words that were described and utilized by Robinson et al. (2011).

To assess the full PA umbrella, and in order to address internal validity of items by the creation of unvalidated items, previously developed items from standardized tests and from other published research were combined into a single assessment tool. Appendix D describes the 15 subtest items that were included to develop a novel PA assessment, and how they address the range of PA. The Phonological Awareness Test, Second Edition, Normative Update (PAT-2: NU; Robertson & Salter, 2018) was identified as an established standardized test which provided a broad range of PA tasks. Even though it is normed up to age 9;11, the items have already been developed and validated by the test creators, and the PAT-2: NU manual indicates that it is highly correlated with the CTOPP-2 for phonological awareness (Robertson & Salter, 2018). The Phonological Awareness Test, Second Edition, Normative Update (PAT-2:NU; Robertson &

Salter, 2018) provided 11 items for this assessment, which were combined with 2 items developed by Moran and Fitch (2001), 1 item developed by Spencer et al. (2008), and 1 item from the Test of Language Development: Primary-5th Edition (TOLD: P-5; Newcomer & Hammill, 2019).

Some adaptations were made for the final assessment tool, which were based upon feedback from pilot assessments. The Vowel Matching task created by Moran and Fitch (2001) was administered during individual sessions, to allow for individual requests for repeats and time to respond, and with the target word being spoken and the matching choices only being printed on the student response form. The Phoneme Counting task created by Spencer et al. (2008) was adapted by presenting the words verbally and by removing three of the items due to the variability in which the phonemes could be counted, related to syllabic consonants. The Auditory Discrimination task that originated from the TOLD: P-5 was reduced from 38 items to 20 items by utilizing an app to randomly select items, while retaining the same ratio of foils. The Phoneme Reversal task developed by Moran and Fitch (2001) was reduced to 10 items, removing the 10 items that were most frustrating to pilot participants. This final tool, the Phonological Awareness Assessment Tool (PAAT) resulted in a total of 178 items, which could be analyzed by individual subtests and combinations of subtests, as can be viewed in Appendix D.

Regardless of how these items had been administered by the originating authors, all items were pre-recorded into digital audio files that were created in a sound-proof audiology booth by the PI for the purpose of auditory delivery. This ensured that all participants were given the same auditory stimuli for all items. For items that could be written, administration could be done with a small group or individually. Oral responses were provided during individual sessions, and were

recorded by the first author, utilizing the IPA. Additionally, the final component was to have the participant's hearing screened bilaterally at 25dB for 1000, 2000, and 4000 Hz.

In order to address internal reliability for scoring, a trained graduate student who was approved by the IRB scored alongside the PI for a small random sample of the assessments, providing inter-rater reliability measures of 99% on scoring of the items. Completed assessments were scored twice by two separate trained graduate students in order to reduce the likelihood of scoring errors. Entry of the data into an Excel spreadsheet was also double checked prior to analysis to reduce the likelihood of entry errors.

Participants

Undergraduate students at a private, religiously affiliated university located in Texas were voluntarily recruited through a variety of undergraduate education courses. In order to recruit speech-language pathology majors and education majors, students were recruited in freshman/sophomore level majors' courses which are offered prior to any instruction regarding PA. Students who completed the entire assessment were entered into a gift card drawing. All participants were provided with and signed informed consent for research procedures that were approved by the Institutional Review Board.

In order to be included, students had to be an undergraduate student, report English as their first language or English proficiency, and report no prior PA instruction in a college course. Students provided their year in school as opposed to credit hours when there was a discrepancy. Participants who self-reported as having a learning disability were not excluded, as they would be included in a typical classroom demographic, and this data was further analyzed as a comparison.

Procedure

To answer the research question, an exploratory/comparative design was employed, as there is no intervention, and only differences between groups were analyzed (Drummond & Murphey-Reyes, 2018; Portney, 2020; Binkley, 2021c). The research procedures and PA Assessment Tool were approved by the University of South Dakota Internal Review Board, with an affiliation agreement with the Internal Review Board for the university where the participants attended. The newly developed PAAT was utilized, totaling 15 separate tasks, and participants were additionally administered a pure-tone hearing screening. Students who did not pass at all frequencies of the hearing screening were immediately informed of the results but were not excluded from the study. Digital recordings for all 15 subtest stimuli were presented to all participants using the same Bluetooth speaker. Stimuli items were replayed upon request by the student. For students who received group administration of subtest items 1-5, individual follow up within a few weeks was conducted to complete the individual administration of the remaining items. For students who had not completed any items, all items were administered during an individual session. The total time for a participant to complete both assessments and the hearing screen took approximately 30-40 minutes.

A total of 119 participants met inclusion requirements and participated in all portions of the assessments. Of these 119 participants, 60 were classified as freshmen, 49 sophomores, 7 juniors, and 3 seniors. Three other major participants who were classified as seniors, and were excluded, since they are not comparable in classification to the entry-level SLP majors or education majors, reducing the total number of participants to 116. See Table 1 for demographic information. The median age for all three major groups was 19, and the total range of ages for the entire participant group was 17 to 21.

Table 2.1

Participant Demographics

Student Major	Student Classification	Total Number
Speech-language Pathology (SLP)	Freshman	16
	Sophomore	9
	Junior	4
Education	Freshman	3
	Sophomore	24
	Junior	1
Other Majors (e.g.: business, biology, kinesiology, graphic design)	Freshman	41
	Sophomore	16
	Junior	2

Statistical Analysis

The PAAT was scored for accuracy on each subtest and input into an Excel spreadsheet and analyzed through SPSS Version 27 (IBM Corporation, 2020). Results were analyzed by individual subtest (13 total subtests), as well as in combination by grouping: overall word/syllable awareness score (segmenting sentences, segmenting syllables, blending syllables), overall onset-rime awareness score (recognition of rhyming words, rhyming production), overall phonemic awareness score (phoneme counting, auditory discrimination, blending phonemes, phoneme segmentation, phoneme isolation, vowel matching, phoneme deletion, phoneme reversal), and overall phonological awareness score (total of all items).

Because it has been reported that college students with learning disabilities score lower on phonological awareness tasks (Del Tufo & Earle, 2020; Earle & Del Tufo, 2021; Wilson & Lesaux, 2001), comparison analysis of this group with those who did not report learning disabilities was conducted. With the data not meeting parametric assumptions, non-parametric testing utilizing the Mann Whitney U Test and the Median Test were utilized to compare the 21

students who reported a learning disability with the 95 students who reported no learning disability. Results of this comparison found no statistical significance between those who reported a learning disability and those who reported no learning disability for any subtest or grouping of subtests (See Table 2.4, Appendix F). Therefore, all further statistical analyses included all 116 participants, regardless of reported learning disability status.

Results

To answer the research question, *Do undergraduate students who are in a major related to PA (such as SLP and education) have different PA skills compared with other undergraduate students?*, participants were categorized as follows: SLP major, education major (including all specialty areas), and other major. The scores were analyzed based on individual subtest score, by combined score (syllable awareness, onset-rime awareness, phonemic awareness, overall phoneme isolation), and by an overall PA score for all items administered, for a total of 20 dependent variables. The median, minimum, and maximum scores for each category by group can be seen on Table 2.5 in Appendix G.

An Analysis of Variance (ANOVA) was attempted, but use of the Kolmogorov-Smirnov Test of Normality determined that the data was not normally distributed, and assumptions for parametric testing were not met. The strong negative skew and kurtosis observed is likely due to the ceiling effects of the subtests.

Next, nonparametric measures were utilized to analyze differences between the three groups using Kruskal Wallis Test and the Median Test. Across all 20 dependent variables, all three groups (SLP, education, other major) were compared for significant differences, using the nonparametric statistics. See Table 2 for overall results of the nonparametric tests and Table 3 for pairwise comparisons. From these analyses, there were three significant differences found in the

dependent variables: Overall Syllable Score, Isolation of Initial Phoneme subtest, and Overall Phoneme Isolation Score.

Utilizing the Kruskal-Wallis Test, there was a significant difference between the distributions of the scores in Overall Syllable Score ($H(2) = 6.998, p = .030$). A pairwise comparison showed the differences were only significant ($p = .013$) for SLP (*median* = 29, *mean* = 29, *min* = 24) compared to other majors (*median* = 29, *mean* = 28.24, *min* = 21), and no significance was found between other group comparisons. The Kruskal-Wallis Test additionally found significance with the subtest of Isolation of Beginning Phoneme ($H(2) = 9.220, p = .010$), with pairwise comparisons determining a significant difference between SLP majors (*median* = 10) compared to both education majors (*median* = 9; $p = .003$) and other majors (*median* = 9; $p = .019$), but not when comparing education majors to other majors. Use of the Median Test provided further insight into the comparison between the three groups. When utilizing this analysis for the Phoneme Isolation Overall Score, there was a statistically significant difference in the medians ($p = .017$), with pairwise comparisons revealing the significant difference ($p = .004$) to be between the median of SLP majors (*median* = 29) versus education majors (*median* = 28). All three of these significant findings indicated that SLP majors, who have not yet been introduced to phonetics or phonological awareness, performed higher than education majors and other majors for these skills.

In utilizing the Kruskal-Wallis Test, a fourth area that was approaching the level of statistical significance ($p = .055$) was for the subtest of Counting Words in Sentences. The Mann-Whitney U Test was used for pairwise comparisons, and it was determined that the distributions were different for SLP majors compared to other majors, with other majors performing worse (*median* = 10, *mean* = 9.27, *min* = 3) than SLP majors (*median* = 10, *mean* =

9.86, *min* = 9; U = 642.50, *p* = .018) for this subtest. For this subtest, there was no statistically significant difference in variance for education majors versus other majors or versus SLP majors.

Table 2.2

Nonparametric Testing Results

PA Assessment Category	Kruskal Wallis (significance)	Median Test (significance)
Overall Phonological Awareness Score	.630	.975
Overall Syllable Awareness Score	.030	.034
Overall Onset-Rime Awareness Score	.403	*
Overall Phonemic Awareness Score	.639	.990
Number of Words in Sentence	.055	*
Number of Syllables in Word	.159	*
Identification of Rhyming Words	.284	*
Counting Phonemes in Words	.384	.791
Auditory Discrimination between Words	.062	.121
Blending Syllables	.849	.848
Rhyming Production	.619	*
Blending Phonemes	.190	*
Phoneme Segmentation	.197	.478
Phoneme Isolation (Beginning Phoneme)	.010	.003
Phoneme Isolation (Final Phoneme)	.973	.922
Phoneme Isolation (Medial Phoneme)	.460	*
Overall Phoneme Isolation Score	.260	.017
Vowel Matching	.637	.502
Phoneme Deletion	.240	*
Phoneme Reversal	.192	.386

*SPSS unable to compute

Table 2.3

Pairwise Comparisons

PA Assessment Area	Statistical Analysis	SLP Majors- Education Majors	SLP Majors- Other Majors	Education Major- Other Major
Overall Syllable Score	Kruskal-Wallis Test	.484	.013	.098
Phoneme Isolation (Beginning Phoneme)	Kruskal-Wallis Test	.003	.019	.288
Overall Phoneme Isolation Score	Median Test	.004	.057	.151
Counting Words in Sentences	Mann Whitney U Test	.231	.018	.297

Discussion

This study compared a wide range of PA skills between undergraduate college students who are in PA-related majors to those who are in non-PA-related majors, as well as to learn more about the overall average PA skill level for undergraduate college students. We found that there were a few specific areas of PA in which SLP majors outperformed their peers prior to any direct instruction in PA. This may suggest that SLP majors begin their coursework with a slightly stronger PA foundation in some areas than their same-aged peers in other majors. It may be that students who are interested in the field of SLP may be drawn to the field due to personal attentiveness to speech sounds. The PA area that all three groups performed similarly was onset-rime production, which was assessed through two rhyming tasks.

The Overall Syllable Score, made up of the combination of three subtests (Number of Words in Sentences, Counting Syllables, Blending Syllables) was likely statistically significant due to the differences seen between SLP majors and other majors in the area of Counting Words in Sentences. During the assessment of these tasks, the PI noted that some students would comment on confusion as to how to count word breaks in the presence of possessive nouns and contractions. This specific task, which was derived from the segmentation subtest of the PAT-2 NU (Robertson & Salter, 2018), is normed for up to age 9-11 and was delivered as an individual subtest, so comparisons to the normative sample cannot be made. No other study was found to have assessed this specific area of PA, likely because of the assumption that undergraduate college students would all be proficient with the task. While the overall group median was 10, which is the maximum possible score, the overall group mean score was 9.51, with a minimum score of 3, and 28.4% of the undergraduate students scored less than 10 on this item. Although

this is considered to be the simplest PA task, these results indicate that even basic PA skills may need explicit instruction and training.

Another area in which SLP majors outperformed their same-aged peers in other majors prior to any direct instruction is that of phoneme isolation, specifically in isolation of the beginning phoneme, as well as for the overall score for isolation of initial, medial, and final phoneme. This is particularly interesting as SLP students must use this skill in a phonetics course to address course outcomes, such as phonetic transcription. This indicates that SLP majors may begin at a slight advantage regarding phoneme isolation, as compared to same-aged peers. However, on phoneme segmentation tasks, SLP majors did not perform differently than same-aged peers prior to direct instruction. This is likely due to the complexity of counting phonemes that do not have a 1:1 grapheme correspondence, which indicates a need for direct and explicit training.

In looking at the median scores for all participants combined, it was evident in which PA areas undergraduate students were approaching competency. The following subtests had a median score of the maximum possible points (ceiling effect) for the subtest when all participants were combined, indicating most participants met competency: Counting Words in Sentences, Syllable Counting, Rhyme Identification, Rhyme Production, Phoneme Blending, Phoneme Isolation of the Medial Consonant, and Phoneme Deletion. Conversely, the Phoneme Counting subtest had the lowest percentage of accuracy for the combined median score (10) compared to the possible score (18), followed closely by the Phoneme Segmentation subtest with a combined median score of 6 out of a possible score of 10. Students also had more difficulty on the phoneme reversal task (combined median 7, possible score 10), and the Vowel Matching task (combined median 16, possible score 20). Thus, it appears that phonemic awareness is the most

challenging area of the PA umbrella for undergraduate students regardless of major, which is the focus area of instruction for a phonetics course.

In regard to the participant demographics, it is of note SLP majors and education majors were over 96% female, whereas the other majors were only 61% female. There is some indication that adult females may outperform adult males on the PA tasks of elision and blending on the CTOPP (Hurford et al., 2016). While this gender difference may have impacted differences seen between SLP majors and other majors, data from the American Speech-Language-Hearing Association (2020) indicated that in 2020, over 95% of practicing SLPs are female. Therefore, this distribution for gender closely represents demographics for both SLP majors and SLPs.

The results of this study indicate that undergraduate students begin coursework without full competency in PA skills. This means that a phonetics instructor cannot assume foundational knowledge when developing and designing a phonetics course. It is possible that the gaps in knowledge that students have with regard to PA may be contributing to the challenges they experience with acquiring phonetic transcription skills. For example, if students cannot count syllables in a word, then asking students to identify the stressed syllable in a word for accurate transcription may prove more challenging than anticipated. Encouragingly, the results of this study also found that SLP students may have some inherent strengths in PA that their peers in other majors may not have. This provides an opportunity for phonetics instructors to help students recognize and use these strengths as a foundation to build phonetic transcription skills, while still recognizing areas where students may need explicit instruction for foundational knowledge.

Limitations

A limitation of this study is that the participants all were from a single university sample, which may not represent peers in other regions of the country and could limit generalizability. A second limitation is the relatively small sample size of participants, which was limited by the enrollment numbers for the introductory SLP and education courses. Despite these limitations, the participants sampling size and lack of institutional variation is similar to other studies which explored PA skills with undergraduate students. As mentioned, another limitation of this study is that the education majors and SLP majors were predominantly female, while the gender of participants from other majors were more evenly distributed. It is possible that some of the differences found between the SLP major, and the other major group could be related to gender differences.

Future Directions

Due to the ceiling effects of many of the subtest items, strong negative skew impacted the ability to make comparisons between groups. The subtest items for this study were selected as a piloting of a comprehensive PA assessment tool, so that more could be learned about what items were challenging for undergraduate students. Future studies could reduce the subtest items to only those which had the most variation in this sample, as well as to offer more challenging items to reduce the likelihood of ceiling effects. Finally, because this sampling was also relatively small and was drawn from only one university. Future studies could assess students from a variety of universities across the United States in order to increase generalizability.

Conclusions

This study represents the first of its kind to explore a wide range of PA skills for undergraduate students and to then compare them to SLP majors and to education majors. Our

hypothesis was that there would be some differences between these groups, which we did find to be true in the areas of Overall Syllable Score, Beginning Phoneme Isolation Score, and Overall Phoneme Isolation Score. This preliminary study indicates the need for more research to explore the PA skills of undergraduate students, particularly those who are in majors related to PA, so that instructors will be more knowledgeable about the baseline skill set for students. While students met the ceiling effects for many subtest items, there were other areas that indicated the need for direct and explicit instruction, particularly in the area of phonemic awareness. Understanding the knowledge gaps that students may have in these areas, rather than building coursework based upon the assumption that the skills are present, could have positive effects on undergraduate student learning and integration of course concepts.

References

- American Speech-Language-Hearing Association. (n.d.). *Speech sound disorders: Articulation and phonology*. https://www.asha.org/practice-portal/clinical-topics/articulation-and-phonology/#collapse_5
- American Speech-Language-Hearing Association. (2010). *Roles and responsibilities of speech-language pathologists in schools* [Professional Issues Statement]. www.asha.org/policy/
- American Speech-Language-Hearing Association. (2020). 2020 Member and Affiliate Profile: Annual Demographic and Employment Data. [PDF].
<https://www.asha.org/siteassets/surveys/2020-member-and-affiliate-profile.pdf>
- Bauman-Waengler, J. (2020). *Articulation & phonology in speech sound disorders: A clinical focus*. (6th ed.). Pearson.
- Bauman-Waengler, J., & Garcia, D. (2020). *Phonological treatment of speech sound disorders in children: A practical guide*. Plural Publishing.
- Binkley, J. (2021c, September 20). *PhD in Health Sciences Dissertation Proposal*. [Submission to dissertation committee]. University of South Dakota.
- Carroll, J., Gillon, G., & McNeill, B. (2012). Explicit phonological knowledge of educational professionals. *Asia Pacific Journal of Speech, Language and Hearing*, 15(4), 231-244.
<https://doi.10.1179/136132812804731820>
- Crais, E., Nunez, L., Bentler, R., DiLollo, A., Folsom, R., Gillam, R., Hewitt, L., Lister, J., Nittrouer, S., Simpson, J., Chapman, K.L., Honaker, J., Koehnke, J., McNeil, M., Rogers, M., Cone, B., & Robinson, S. (2015). *Final report: The role of undergraduate education in communication sciences and disorders*. [PDF].
<https://www.asha.org/siteassets/reports/aab-report-role-undergrad-ed-csd.pdf>

- Del Tufo, S.N., & Earle, F.S. (2020). Skill profiles of college students with a history of developmental language disorder and developmental dyslexia. *Journal of Learning Disabilities, 53*(3), 228-240. doi: 10.1177/0022219420904348
- Drummond, K. E., & Murphy-Reyes, A. (2018). *Nutrition research: Concepts and applications*. Jones & Bartlett Learning.
- Earle, F.S., & Del Tufo, S.N. (2020). Literacy-supporting skills in college students with specific reading comprehension deficit and developmental language disorder. *Annals of Dyslexia, 71*, 282-298. <https://doi.org/10.1007/s11881-020-00211-z>
- Hall-Mills, S., & Bourgeois, M. (2008, November). *Challenges in teaching and learning phonetics: Implications for instruction*. Paper presented at the annual convention of the American Speech-Language-Hearing Association. Chicago, IL.
- Henbest, V.S., Fitton, L., Werfel, K.L., & Apel, K. (2020). The relation between linguistic awareness skills and spelling in adults: A comparison among scoring procedures. *Journal of Speech, Language, and Hearing Research, 63*, 1240-1253. https://doi.org/10.1044/2020_JSLHR-19-00120
- Hillenbrand, J.M. (2017). Some thoughts on teaching and learning phonetic transcription. *The Journal of the Acoustical Society of America, 142*(4, part 2), 2617. <https://doi.org/10.1121/1.5014582>
- Hurford, D.P., Fender, A.C., Swigart, C.C., Hurford, T.E., Hoover, B.B., Butts, S.R., Cullers, K.R., Boux, J.L., Wehner, S.J., Hevel, J.K., Renner, L.P., Overton, K.B., Dumler, J.D., & Wilber, L.M. (2016). Pre-service teachers are competent in phonological processing skills: How to teach the science of reading. *Reading Psychology, 37*, 885-916. <https://doi:10.1080/02702711.2015.1133464>

- IBM Corporation. (2020). IBM SPSS Statistics for Macintosh, Version 27.0. IBM Corporation.
- Kamhi, A., & Catts, H.W. (2001). The role of the speech-language pathologist in improving decoding skills. *Seminars in Speech and Language, 22*(3), 175-184.
<https://doi.org/10.1055/s-2001-16144>
- Katz, J., & Moore, M.W. (2021). Phonetic effects in child and adult word segmentation. *Journal of Speech, Language, and Hearing Research, 64*, 854–869.
https://doi.org/10.1044/2020_JSLHR-19-00275
- Kennedy, M.J., Driver, M.K., Pullen, P.C., Ely, E., & Cole, M.T. (2013). Improving teacher candidates' knowledge of phonological awareness: A multimedia approach. *Computers & Education, 64*, 42-51. <http://dx.doi.org/10.1016/j.comp.edu.2013.01.010>
- McBride-Chang, C. (1995). What is phonological awareness? *Journal of Educational Psychology, 87*(2), 179-192.
- McLeod, S., & Baker, E. (2017). *Children's speech: An evidence-based approach to assessment and intervention*. Pearson.
- Messier, J., & Jackson, C.W. (2014). A comparison of phonemic and phonological awareness in educators working with children who are d/Deaf or hard of hearing. *American Annals of the Deaf, 158*(5), 522-538.
- Moran, M.J., & Fitch, J.L. (2001). Phonological awareness skills of university students: Implications for teaching phonetics. *Contemporary Issues in Communication Science and Disorders, 28*, 85-90. <https://doi.org/1092-5171/01/2802-0085>
- Newcomer, P.L., & Hammill, D.D. (2019). *Test of language development: Primary (5th ed.)*. [TOLD:P-5]. Pro-Ed.

- Portney, L.G. (2020). *Foundations of clinical research: Applications to evidence-based practice* (4th ed.). F.A. Davis.
- Powell, R.K. (2018). Unique contributors to the curriculum: From research to practice for speech-language pathologists in schools. *Language, Speech, and Hearing Services in Schools, 49*, 14-147. https://doi.org/10.1044/2017_LSHSS-17-0059
- Robertson, C., & Salter, W. (2018). *Phonological awareness test (2nd ed.): Normative Update. [PAT-2:NU]*. Pro-Ed.
- Robinson, G.C., Mahurin, S.L., & Justus, B. (2011). Predicting difficulties in learning phonetic transcription: Phonemic awareness screening for beginning speech-language pathology students. *Contemporary Issues in Communication Science and Disorders, 38*, 87-95. <https://doi.org/1092-5171/11/3801-0087>
- Sayeski, K.L., Earle, G.A., Eslinger, R.P., & Whinton, J.N. (2017). Teacher candidates' mastery of phoneme-grapheme correspondence: Massed versus distributed practice in teacher education. *Annals of Dyslexia, 67*, 26-41. doi: 10.1007/s11881-016-0126-2
- Scarborough, H.S., Ehri, L.C., Olson, R.K., & Fowler, A.E. (1998). The fate of phonemic awareness beyond the elementary school years. *Scientific Studies of Reading, 2*(2), 115-142. https://doi.org.10/1207/s1543799xssr0202_2
- Schatschneider, C., Francis, D.J., Foorman, B.R., Fletcher, J.M., & Mehta, P. (1999). The dimensionality of phonological awareness: An application of item response theory. *Journal of Educational Psychology, 91*(3),439-449.
- Schuele, C.M., & Boudreau, D. (2008). Phonological awareness intervention: Beyond the basics. *Language, Speech, and Hearing Services in Schools, 39*, 3-20. [https://doi:10.1044/0161-1461\(2008-002\)](https://doi:10.1044/0161-1461(2008-002))

- Shriberg, L.D., Kent, R.D., McAllister, T., & Preston, J.L. (2019). *Clinical phonetics* (5th ed.). Pearson.
- Small, L.H. (2020). *Fundamentals of phonetics: A practical guide for students* (5th ed.). Pearson.
- Spencer, E.J., Schuele, C.M., Guillot, K.M, & Lee, M.W. (2008). Phonemic awareness skill of speech-language pathologists and other educators. *Language, Speech, and Hearing Services in Schools, 39*, 512-520.
- Spencer, E.J., Schuele, C.M., Guillot, K.M, & Lee, M.W. (2011). Phonemic awareness skill of undergraduate and graduate students relative to speech-language pathologists and other educators. *Contemporary Issues in Communication Sciences and Disorders, 38*, 109-118.
- Tessel, C.A, & Grover, V. (2020). Graduate student retention of prerequisite course content. *Teaching and Learning in Communication Sciences & Disorders, 4*(1).
<https://doi.org/10.30707/TLCSD4.1/ULMQ3912>
- Wagner, R.K., Torgesen, J.K., & Rashotte, C.A. (1999). *Comprehensive test of phonological processing*. Pro-Ed.
- Wagner, R.K., Torgesen, J.K., Rashotte, C.A., & Pearson, N.A. (2013). *Comprehensive test of phonological processing*. (2nd ed.). Pro-Ed.
- Werfel, K.L. (2017). Phonetic transcription training improves adults' explicit phonemic awareness: Evidence from undergraduate students. *Communication Disorders Quarterly, 39*(1), 281-287. <https://doi.org/10.1177/1525740117702456>
- Westerveld, M.F., & Barton, G.M. (2016). The phonological awareness skills of education and speech pathology higher education students during their first semester of study. *Journal of Clinical Practice in Speech-Language Pathology, 18*(2), 84-88.

Wilson, A.M., & Lesaux, N.K. (2001). Persistence of phonological processing deficits in college students with dyslexia who have age-appropriate reading skills. *Journal of Learning Disabilities, 35*(5), 394-400.

Chapter 3

The Development of Phonological Awareness Through Phonetics Coursework

Higher education instructors who teach preprofessional courses have the challenge of providing field-specific content without a full picture of what foundational knowledge these adult learners may bring to the classroom. Speech-language pathology (SLP) students are introduced to the skill of phonetic transcription in their undergraduate training, but may not have the foundational knowledge needed to learn and apply this skill. In learning how to use the International Phonetic Alphabet (IPA) to document speech productions, students must attend to the speech sounds, or phonemes, they are hearing in speech and to remove their focus from the graphemes, or letters, present (Small, 2020). Students must later apply the skill of phonetic transcription for the analysis and treatment of speech (Crais et al., 2015; Bauman-Waengler, 2020).

According to Scarborough et al. (1998), it may be difficult for adults to shift their attention from graphemes to phonemes, which can be seen in their performance with phonological awareness (PA) tasks. PA is an umbrella term that encompasses a variety of discrete tasks intended to draw attention to segments and individual units of the sounds in language. The three main categories of PA are word/syllable awareness, onset-rime awareness (related primarily to rhyming skills), and phonemic awareness. Traditionally, PA tasks are addressed without written words so that the actual sounds are focused upon (Bauman-Waengler & Garcia, 2020; McBride-Chang, 1995). Examples of these tasks include counting the number of words in a sentence, identifying words that rhyme, counting the number of sounds in a word, and deleting a sound from a word. These skills help with foundational needs of reading and writing

and are often directly addressed in the early elementary years (Bauman-Waengler, 2020, Bauman-Waengler & Garcia, 2020; Scarborough et al., 1998; Tolman, 2005).

While it might seem that college students should have all PA skills fully developed, as proficient readers, Scarborough et al (1998) indicated that this assumption cannot be made. Further exploration of the PA skills of undergraduate college students has indicated that variable skills are present among students (Scarborough et al., 1998, Moran & Fitch, 2001). As students are tasked with learning to use phonetic transcription, they must use the underlying aspects of PA to do this. For example, in order to accurately transcribe a word that contains more graphemes than phonemes, a student must correctly identify that letters and sounds do not have a 1:1 correspondence. However, competency with PA goes beyond this aspect of training SLP students. PA assessment and treatment is part of the scope of practice for SLPs, and thus students must be able to not only accurately complete PA tasks, but also apply their understanding of PA in clinical settings (ASHA, n.d.; ASHA, 2010; Kamhi & Catts, 2001; Schuele & Boudreau, 2008; Spencer et al., 2008; Spencer et al., 2011). Understanding the baseline level of PA skills that students have can help phonetics instructors with course design. If, in fact, PA skills can be further developed in adult learners, knowing the specific aspects of PA that develop as a natural part of learning phonetic transcription is important to explore for course development. Understanding what areas of PA may still be underdeveloped after taking a traditional phonetics course, and thus in need of more explicit training, can inform instructors about additional content that should be explicitly addressed to prepare SLP students for their future professional roles.

Review of the Literature

The desire to better understand the relationship that PA skills have with phonetics coursework has stemmed from instructors seeking to improve student experiences and outcomes

(Moran & Fitch, 2001; Robinson et al., 2011; Hall-Mills & Bourgeois, 2008; Hillenbrand, 2017). Moran and Fitch (2001) laid the groundwork by exploring correlations between four measures of baseline PA skill performance with transcription scores during phonetics coursework. While they did not measure PA after the course was completed, they found that there was variation in student abilities of these tasks in their pre-course testing. Hall-Mills et al. (2007, as cited in Hall-Mills & Bourgeois, 2008) followed up by using similar PA measures with their studies and found the students to have a wide range of PA skills. When Robinson et al. (2011) utilized the Comprehensive Test of Phonological Processing (CTOPP; Wagner et al., 1999) to assess their SLP students, they found the measure of elision to be higher than would be predicted by a normal distribution, while the phonetic reversal score was lower than what would be predicted by a normal distribution. SLP students may not start their undergraduate courses with fully developed PA skills, and further, student abilities potentially vary a great deal.

Moran and Fitch (2001) learned that SLP students who have lower performance on PA tasks were more likely to also have lower scores for transcription. Similarly, Robinson et al. (2011) found predictive value of PA scores for success with phonetic transcription was found with specific tasks from the CTOPP, specifically with the elision and the phonetic reversal tasks. Spencer et al. (2011) and Werfel (2017) examined explicit phonemic awareness tasks through researcher-created pencil and paper tasks. Hillenbrand (2017) had the most comprehensive assessment of PA skills in undergraduate SLP students, but he did not look at PA scores following phonetics coursework. While all of these studies have offered insight into the PA skills of SLP students, they have been conducted with a variety of tools, some researcher-created and some standardized, and have measured a variety of specific aspects of PA. Thus, there is a need

to learn more about SLP students' full PA abilities, measuring all areas of the umbrella it encompasses, that is administered in such a way that is true to the auditory nature of PA.

Practicing SLPs have stronger phonemic awareness skills than practicing educators (Messier & Jackson, 2014; Spencer et al., 2008). In order to further examine if this might be related to SLPs' training in phonetic transcription, Spencer et al. (2011) took the data from their study with working professionals and completed a follow up study to learn more about the phonemic awareness abilities of SLP students prior to and after coursework. The results with the student participants were compared to their previous findings with professionals (Spencer et al., 2008). They found that students who had not taken a phonetics course had lower scores on their three measures compared to students who had taken a phonetics course. The students who had completed phonetics coursework scored higher than the practicing educators, but lower scores than practicing SLPs (Spencer et al., 2011). Werfel (2017) used the phoneme counting task created by Spencer et al. (2008) to look at pretest/posttest comparisons between SLP undergraduate students in a phonetics course to those in an introductory course, not receiving phonetics instruction. She found that the students in the phonetics course had significant gains in this task compared to those without phonetics instruction. Werfel noted that future studies should measure more areas of PA. Additionally, it is of note these studies (Messier & Jackson, 2014; Spencer et al., 2008; Spencer et al., 2011; Werfel, 2017) used orthographic spelling with written responses for their assessments. PA is an auditory task, and Werfel referred to this measure as assessing explicit phonemic awareness due to this delivery method. Formal evaluation tools which measure PA, such as the Phonological Awareness Test, 2nd Edition, Normative Update (PAT-2: NU; Robertson & Salter, 2018) and CTOPP elicit PA tasks with auditory stimuli and verbal responses. Thus, tools to assess PA should utilize these types of practices in order to

address the validity of the results (McBride-Chang, 1995). There is no published research that explores the full scope of PA skills with SLP undergraduate students. Further, there is a need to learn more about what areas of PA skills are lower at baseline, and how much improvement in these skills can be achieved through phonetics coursework.

Purpose of the Study

In order to learn more about the impact that taking a phonetics course may have on a student's range of PA skills, we developed two research questions. The primary focus of this study was to explore what, if any changes in PA skills, occur after undergraduate SLP students take a phonetics course. Our first research question was: *Does taking a phonetics course result in an increase in PA?* We hypothesized that there would be change in at least some measures of PA following a phonetics course that would not be seen in those only taking an introduction course. Because some students take these courses simultaneously, while others take them concurrently, we wanted to also see if the sequence of coursework had any impact on the development of PA skills. Therefore, our secondary research question was: *Does the sequence of taking an introduction course and phonetics course have an impact on student outcomes in PA or phonetic transcription?* We hypothesized that there would be no difference in PA outcomes or transcription scores related to the sequence in which the two courses are taken.

Procedure

In order to answer the first research question, a quasi-experimental pretest-posttest design was utilized. To answer the second research question, a multiple baseline design was used to allow for between group comparisons at posttest following intervention of the phonetics course. Procedures were approved by the Institutional Review Board (IRB) at the University of South

Dakota, and with an IRB affiliation agreement for the university at which the participants attended.

Participants

Undergraduate students from a private university in Texas who were enrolled in the Introduction to Communication Sciences and Disorders course and the Phonetics course were recruited during the fall semester. Students were provided with and signed informed consent for the research. Recruited participants were eligible for a gift card drawing if they completed the study. The participants self-reported demographic data including age, gender, learning disability status, and English proficiency for additional analysis. Participants also self-reported that to their knowledge they had never received any prior phonological awareness instruction.

Of 23 participants who voluntarily participated, 12 were enrolled in the Phonetics course (intervention group) and 11 were enrolled in the Introduction course (control group). The median age for the intervention group was 19.5, and the median age for the control group was 19.0. The control group had 11 freshmen, while the intervention group had 2 freshmen, 7 sophomores, and 3 juniors. When asked if they had been diagnosed with a learning disability, 4 students indicated that they had some type of learning disability. These students were not excluded from participation, as students with learning disabilities are typically included in such courses and are provided with appropriate accommodations in their courses throughout the semester.

Students who were in the Phonetics course had the option of concurrently taking a pilot course called Phonetics Lab, wherein they received additional practice with the concepts of PA. In order to determine if the addition of the Phonetics Lab made a difference in overall PA outcomes, the Mann Whitney U test was utilized to compare the score differences from pretest to posttest between those who were in the Phonetics Lab (n=9) and those who were not (n=3).

There were no statistical significances found in any of the scores or combination of scores between these two groups (see Table 3.1, Appendix H). Next, scores were analyzed comparing the control group to the intervention group with and without those who were not in the Phonetics Lab. When compared to the control group, both intervention groups, regardless of whether they were in the Phonetics Lab, had the same four areas of statistical significance when compared to the control group. Thus, the decision was made to combine students who were in the Phonetics Lab and those not in the Phonetics Lab together as a single intervention group (n=12) to compare with the students in the Introduction course (n=11) as the control group.

Measures

Existing data that utilized the Phonological Awareness Assessment Tool (PAAT; Binkley, 2021c), used for departmental assessment related to course development, served as a pretest measure for both groups. The PAAT was developed by combining a variety of previously developed tools (Moran & Fitch, 2001; Newcomer & Hammill, 2019; Robertson & Salter, 2018, Spencer et al., 2008) and adapting some of the testing procedures (see Appendix D). All stimuli were prerecorded in a sound-proof audiology booth by the Primary Investigator (PI) so that there would be consistency in the presentation of assessment items. Students were assessed in class and individually with the PAAT within the first two weeks of school, prior to any phonological awareness or phonetics instruction. This existing data was approved to be used by the IRB, and it was further approved that the same tool was used at the end of the semester as a posttest measure. At the end of the fall semester, students were assessed again utilizing the PAAT as a posttest measure. Students who were in the Introduction course and were taking the Phonetics course in the following spring were then followed and were assessed using the PAAT at the end of the spring semester, as a posttest measure of intervention for multiple baseline analysis.

To address internal reliability, a trained graduate student approved by the IRB was randomly assigned to score alongside the PI, providing interrater reliability of 99%. The students' responses were blind-scored by two trained graduate students and the PI to reduce the likelihood of scoring errors. This data was input into an Excel document and then double checked again to reduce the likelihood of error.

Analyses and Results

To answer the first research question of whether taking a phonetics course results in changes with PA skills, the differences from pretest to posttest for students in the Phonetics course versus those in the Introduction course were analyzed through SPSS Version 27 (IBM Corporation, 2020). Parametric testing of a t-test was attempted, but the data demonstrated strong negative skew and kurtosis that did not meet assumptions for parametric testing. Thus, nonparametric analyses were utilized to answer the research question.

Comparisons Between Groups

The Mann Whitney U Test was utilized to compare the difference from pretest to posttest between the students in the Phonetics course versus the students who were in the Introduction course. These analyses revealed four areas of statistical significance, which are reflective of changes in phonemic awareness: Vowel Matching subtest, Phoneme Counting subtest, combined score of Phonemic Awareness and combined overall PA Assessment score (see Table 3.2, Appendix I).

First, results of the Mann Whitney U Test found that there was a statistically significant difference in the distributions for the Vowel Matching subtest ($U = 23.5$, $p = .007$), with students in the Phonetics course having a statistically significant increase from pretest to posttest in accurately matching the vowel sound heard in a word to a choice of four words (M place = 15.54,

median = 3.5) compared to students who were in the control group (*M* place = 8.14, *median* = 0), who demonstrated little to no change for this area. Second, results of the Mann Whitney U Test found that there was a statistically significant difference in the distributions for the Phoneme Counting subtest ($U = 25.0$, $p = 0.011$), with students in the Phonetics course having a statistically significant increase from pretest to posttest for counting the number of phonemes in word (*M* place = 15.42, *median* = 6) compared to students in the control group (*M* place = 8.27, *median* = 0), who demonstrated little to no change in this ability. Third, results of the Mann Whitney U Test found that the distribution for combined score of Phonemic Awareness tasks between groups was statistically significant ($U = 8.5$, $p < .001$), with students in the Phonetics course having a greater increase in score from pretest to posttest (*M* place = 16.79, *median* = 21) compared to students who were in the control group (*M* place = 6.77, *median* = 4), who showed less improvement in this area. Finally, in the overall PA Assessment score, the Mann Whitney U Test found a statistically significant difference in the distributions ($U = 7.0$, $p < .001$) in the difference from pretest to posttest between the students in the Phonetics course (*M* place = 16.92, *median* = 20) compared to the students who were in the control group (*M* place = 6.64, *median* = 5).

Comparisons Within Groups

Due to the data not meeting the assumptions for parametric testing, the nonparametric Wilcoxon Signed Rank Test was utilized for analyzing pretest to posttest differences within the control group and within the intervention group. The results indicated that the control group had a few changes from pretest to posttest. However, there were more significant changes from pretest to posttest for the intervention group (see Table 3.2, Appendix I).

For the control group, the results of the Wilcoxon Signed Rank Test found two sets of scores to be statistically significant between pretest and posttest: Overall PA score and Overall Phoneme Score. For the control group, the Overall PA score was significantly higher at posttest (*median* = 163) than at pretest (*median* = 159, $z = -2.53$, $p = .012$). For this group, the Overall Phonemic Awareness score was significantly higher at posttest (*median* = 113) than at pretest (*median* = 110, $z = -2.67$, $p = .008$).

However, with the intervention group, the Wilcoxon Signed Rank Test found that students who were in the Phonetics course had a statistically significant difference from pretest to posttest in nine areas: Overall PA score ($z = -3.06$, $p = .002$), Overall Phonemic Awareness score ($z = -3.06$, $p = .002$), Phoneme Counting ($z = -3.07$, $p = .002$), Phoneme Segmentation ($z = -2.96$, $p = .003$), Phoneme Isolation of the Medial Consonant ($z = -2.40$, $p = .016$), Phoneme Isolation of the Final Consonant ($z = -2.207$, $p = .027$), Overall Phoneme Isolation score ($z = -2.37$, $p = .018$), Vowel Matching task ($z = -2.849$, $p = .004$), and Phoneme Reversal task ($z = -2.73$, $p = .006$).

Comparison of Sequence of Courses

To answer the second research question, we wanted to analyze whether there was a difference in student outcomes when students take the Introduction course and the Phonetics course simultaneously versus taking the two courses concurrently. In this study, 8 of the 11 students in the Introduction course (controls) took the Phonetics course the following spring semester. In the fall Phonetics course, 11 took the Introduction course and Phonetics course simultaneously. These 19 participants were analyzed in two groups: taking Phonetics and Introduction courses simultaneously compared to taking the Introduction course and then taking the Phonetics course in a different semester. Utilizing the nonparametric test of the Mann Whitney U Test, the groups were compared for pretest scores from the fall (to see if there were

differences between the groups prior to any instruction or intervention) and posttest scores following the student's Phonetics course (to see if the groups had similar outcomes following intervention; see Table 3.3, Appendix J).

There was a statistically significant difference between the groups prior to any coursework for Rhyming Production ($U = 16.5$, $p = .020$), with those taking the course simultaneously scoring higher ($median = 10$) compared to those taking the Introduction course and then the Phonetics course the next semester ($median = 9$). This resulted in the Overall Onset-Rime score also having a statistically significant difference between the groups at pretest as well ($U = 16.5$, $p = .020$). However, at posttest, there were no statistically significant differences between the groups on any of the measures or combination of measures of PA skills. Thus, it appears that there is not an impact of course sequence on growth in PA skills.

The students' transcription abilities were further assessed at the end of their Phonetics courses by eliciting 80 words from the Bankson-Bernthal Test of Phonology, 2nd Edition (BBTOP-2; Bankson & Bernthal, 2020). The selection of this tool to measure transcription was based upon the variety and clinical relevance of the words, in favor of a researcher-created tool for transcription which might yield less valid and relevant results. The words were prerecorded in a soundproof audiology booth and played through a Bluetooth speaker, with words being repeated and replayed upon student request. A comparison of these scores between the two groups (taking the Introduction course simultaneously versus taking the Introduction course and Phonetics course concurrently) was made utilizing the Mann Whitney U Test, where it was determined that there was no statistical significance ($U = 54.5$, $p = .395$) in the differences between these two groups' scores. Thus, it appears that the overall outcome of transcription ability is also not impacted by the sequence in which these two courses are taken.

Discussion

This study is an important step toward answering some of the gaps that we found in the literature. The results of this study provided evidence that undergraduate SLP students have the ability to grow in their PA skills, with some specific areas of growth resulting from phonetics coursework. Since some of the measures used in the PAAT were taken from previous research, it is interesting to compare the results of this study to those results.

The Vowel Matching task, created by Moran and Fitch (2001), also had significant findings with the SLP students in their study, who were enrolled in a phonetics course were assessed prior to any phonetics coursework, with a mean score for this task of 15.05. They found this specific measure at pretest to be significantly correlated with all subsequent measures of transcription skills. In this study, the mean score at pretest for the fall undergraduate SLP majors ($n = 23$) was 13.83. It appears that the participants in this study had less accuracy with this task prior to instruction than did the participants in Moran and Fitch. However, it is possible that since there was a slight variation in how this item was delivered as compared to the procedure described by Moran and Fitch, this could have influenced scoring. Given that both studies have relatively small sample sizes from a single university within a single semester, more exploration of this specific measure with a larger and more varied group is warranted.

The Phoneme Counting subtest was adapted from Spencer et al. (2008) and has been utilized in several studies (Henbest et al., 2020; Messier & Jackson, 2014; Spencer et al., 2011; Werfel, 2017). One adaptation of this task for this study was that it was reduced from 21 items to 18 items, in favor of removing items that might have variable scoring rather than changing some of the stimuli items as was done by Henbest et al. (2020) and Messier and Jackson (2014). A second adaptation of the task was to present all words verbally rather than orthographically. In

this study, the overall mean score for all 23 participants was 9.17 out of 18 items, representing a percentage of 51% accuracy for this task at pretest. This is similar to the findings of Werfel (2017), who reported a group score of less than 50% accuracy with her 50 undergraduate SLP students at pretest. Conversely, the present study's participants accuracy was higher than the 32 SLP undergraduate students without phonetics coursework assessed by Spencer et al. (2011), whose mean score was around 43% accuracy for the task, as well as for the findings of Henbest et al. (2020) whose 60 undergraduate health profession undergraduate students had an overall score of less than 40% accuracy.

The differences seen in the scores from pretest to posttest between groups indicate that there is growth in phonemic awareness, as well as in overall PA, following a semester-long phonetic course. In the control group, there was some slight improvement in these areas, but not as much as was seen with the students in the phonetics course. It is possible that the changes seen in the control group represent a heightened awareness of speech related to introductory concepts from the Introduction course. However, it is evident that the instruction of phonetic transcription resulted in significant improvement in PA, as students must utilize phonological awareness, particularly phonemic awareness, to accurately meet course outcomes. This reiterates the conclusions that Werfel (2017) came to, which is that learning phonetic transcription improves phonemic awareness.

When investigating the changes from pretest to posttest within groups, it is apparent that the students who were taking the Phonetics course had more changes in overall PA, specifically in the areas of phonemic awareness. The changes in phoneme counting, phoneme segmentation, phoneme isolation, vowel matching, and phoneme reversal all represent phonemic awareness

changes. This supports the findings of Werfel (2017) who found a change in explicit phonemic awareness with undergraduate SLP students after completing a phonetics course.

It is interesting that there were not significant changes within this group for word/syllable awareness nor for onset-rime awareness. Most of the students scored the top possible score for all these items at pretest, making a change in improvement unlikely due to ceiling effects of the test. Future research should be conducted with more challenging items to further analyze word/syllable awareness and onset-rime awareness.

For the control group, the only significant changes from pretest to posttest were with the overall combined score for PA and for the combined score for phonemic awareness, but not for any of the individual subtests themselves. For the Overall PA score at pretest, the 23 participants had a mean score of 149.5 (84% accuracy), with a minimum score of 127 (71% accuracy) and a maximum score of 169 (95% accuracy). Interestingly, for Overall PA score at pretest, the control group had a higher mean score (152.55, 85% accuracy) compared to the intervention group (146.75, 82% accuracy). At posttest, the intervention group had an Overall PA score with a mean of 166.83 (94% accuracy), while the control group had a mean of 156.91 (88% accuracy), demonstrating the impact of the intervention of the Phonetics course. It appears that there were some changes for students taking only the Introduction class, which may be related to a heightened awareness of speech and language due to the introductory course content. Werfel (2017) also found some changes in explicit phonemic awareness with the Phoneme Counting task in control group participants, but their posttest accuracy with phoneme counting for this group remained below 50% accuracy, compared to the intervention group which had 72% accuracy. In the current study, the posttest accuracy for this task was 64% for the control group and 83% for the intervention group. The discrepancies between the findings of Werfel (2017)

and the current study could be related to a variety of factors, including the difference in administration of the items, and further exploration is warranted.

Analysis regarding the sequence of taking an introduction course and phonetics course revealed that there was not a difference between taking these courses simultaneously or concurrently. This is helpful to learn, as it provides valuable information for student scheduling, and provides evidence to be flexible in advising students when to take these two courses. The reason for this is likely due to the fact that an introductory course provides a survey of the field of speech-language pathology and audiology, and would only provide cursory content regarding phonemes. While students in the introduction group had a few changes in their PA by the end of their course, it does not appear that these changes were enough to contribute to a benefit in taking the courses concurrently nor taking the introductory course prior to the phonetics course. It is likely that the skill of PA is more related to the actual coursework from phonetics, and that the introduction course is not providing supplemental benefit to enhance PA skills.

Limitations and Future Directions

A limitation of this study is that it was conducted in the midst of COVID-19 protocols, and as such both students and the instructor had to follow masking protocols at times throughout both semesters. This is not a typical factor in face-to-face delivery of a phonetics course. A second limitation of the study is the limited sample size, which also comes from a group attending a single private university. This sampling effort is not uncommon for similar research (Moran & Fitch, 2001), but does have the potential of limiting generalizability.

As this study did not track students past their semester of taking a phonetics course, exploring the retention of the PA skills gained is also of importance. Future studies should conduct longitudinal tracking of PA skills as well as retention of phonetic transcription. As it has

been noted that some students come to graduate school with a need for a review of these concepts (Krimm et al., 2017; Tessel & Griver, 2020), learning more about any potential attrition would be an important follow up. Finally, as ceiling effects were found for several subtest items, exploring the areas of word/syllable awareness and onset-rime awareness with more complex items would potentially provide more information about students' skills in these areas.

A final limitation is that the comparisons are from a small sample of students from a single university, and only for one academic school year. Further exploration with a larger sample of students, across a variety of universities, is warranted for the results to be generalizable to other programs. However, it is an important first step in learning more about whether there is an importance in the order of which these two courses should be taken for optimal student outcomes.

Conclusions

This study adds to the literature regarding the PA skills of SLP students before taking a phonetics course and after taking a phonetics course. The findings herein corroborate the suggestion that fully developed PA skills of undergraduate college students cannot be assumed (Scarborough, 1998). Our finding that taking a phonetics course increases areas of PA skills is similar to Werfel (2017), with there being evidence that an increase in phonemic awareness is the result of taking a phonetics course. This is encouraging, as strong phonemic awareness skills are needed for several professional SLP skills, and these skills do not appear to be fully developed prior to coursework. However, because of the expanded use of tools for this study, we were able to isolate additional phonemic awareness gains, beyond phoneme counting, that were not assessed by Werfel. Despite the gains that were found as the result of taking a phonetics course, it is notable that many students appear to have room for further growth with PA. Continued

exploration regarding the relationship of PA skills and the acquisition of strong phonetic transcription skills will benefit instructors who seek to design phonetics courses for optimal student outcomes.

References

- American Speech-Language-Hearing Association (ASHA). (n.d.). *Speech sound disorders: Articulation and phonology*. https://www.asha.org/practice-portal/clinical-topics/articulation-and-phonology/#collapse_5
- American Speech-Language-Hearing Association (ASHA). (2010). *Roles and responsibilities of speech-language pathologists in schools* [Professional Issues Statement]. www.asha.org/policy/.
- Bankson, N.W., & Bernthal, J.E. (2020). *Bankson-Bernthal test of phonology (2nd ed.)*. [BBTOP-2]. Pro-Ed.
- Bauman-Waengler, J. (2020). *Articulation & phonology in speech sound disorders: A clinical focus*. (6th ed.). Pearson.
- Bauman-Waengler, J., & Garcia, D. (2020). *Phonological treatment of speech sound disorders in children: A practical guide*. Plural Publishing.
- Binkley, J. (2021c, September 20). *PhD in Health Sciences Dissertation Proposal*. [Submission to dissertation committee]. University of South Dakota.
- Crais, E., Nunez, L., Bentler, R., DiLollo, A., Folsom, R., Gillam, R., Hewitt, L., Lister, J., Nittrouer, S., Simpson, J., Chapman, K.L., Honaker, J., Koehnke, J., McNeil, M., Rogers, M., Cone, B., & Robinson, S. (2015). *Final report: The role of undergraduate education in communication sciences and disorders*. [PDF]. <https://www.asha.org/siteassets/reports/aab-report-role-undergrad-ed-csd.pdf>
- Hall-Mills, S., & Bourgeois, M. (2008, November). *Challenges in teaching and learning phonetics: Implications for instruction*. Paper presented at the annual convention of the American Speech-Language-Hearing Association. Chicago, IL.

- Henbest, V.S., Fitton, L., Werfel, K.L., & Apel, K. (2020). The relation between linguistic awareness skills and spelling in adults: A comparison among scoring procedures. *Journal of Speech, Language, and Hearing Research, 63*, 1240-1253.
https://doi.org/10.1044/2020_JSLHR-19-00120
- Hillenbrand, J.M. (2017). Some thoughts on teaching and learning phonetic transcription. *The Journal of the Acoustical Society of America, 142*(4, part 2), 2617.
<https://doi.org/10.1121/1.5014582>
- IBM Corporation. (2020). IBM SPSS Statistics for Macintosh, Version 27.0. IBM Corporation.
- Kamhi, A., & Catts, H.W. (2001). The role of the speech-language pathologist in improving decoding skills. *Seminars in Speech and Language, 22*(3), 175-184.
<https://doi.org/10.1055/s-2001-16144>
- Krimm, H., Schuele, M.C., & Brame, C. (2017). Viability of online learning for ensuring basic skills in speech-language pathology. *Perspectives of the ASHA Special Interest Groups SIG 10, 2*(Part 1), 49-58. <https://doi.org/10.1044/persp2.SIG10.49>
- McBride-Chang, C. (1995). What is phonological awareness? *Journal of Educational Psychology, 87*(2), 179-192.
- Messier, J., & Jackson, C.W. (2014). A comparison of phonemic and phonological awareness in educators working with children who are d/Deaf or hard of hearing. *American Annals of the Deaf, 158*(5), 522-538.
- Moran, M.J., & Fitch, J.L. (2001). Phonological awareness skills of university students: Implications for teaching phonetics. *Contemporary Issues in Communication Science and Disorders, 28*, 85-90. <https://doi.org/1092-5171/01/2802-0085>

- Newcomer, P.L., & Hammill, D.D. (2019). *Test of language development: Primary (5th ed.)*. [TOLD:P-5]. Pro-Ed.
- Robertson, C., & Salter, W. (2018). *Phonological awareness test (2nd ed.): Normative Update. [PAT-2:NU]*. Pro-Ed.
- Robinson, G.C., Mahurin, S.L., & Justus, B. (2011). Predicting difficulties in learning phonetic transcription: Phonemic awareness screening for beginning speech-language pathology students. *Contemporary Issues in Communication Science and Disorders*, 38, 87-95.
<https://doi.org/1092-5171/11/3801-0087>
- Scarborough, H.S., Ehri, L.C., Olson, R.K., & Fowler, A.E. (1998). The fate of phonemic awareness beyond the elementary school years. *Scientific Studies of Reading*, 2(2), 115-142. https://doi.org.10/1207/s1543799xssr0202_2
- Schuele, C.M., & Boudreau, D. (2008). Phonological awareness intervention: Beyond the basics. *Language, Speech, and Hearing Services in Schools*, 39, 3-20.
[https://doi:10.1044/0161-1461\(2008-002\)](https://doi:10.1044/0161-1461(2008-002))
- Small, L.H. (2020). *Fundamentals of phonetics: A practical guide for students (5th ed.)*. Pearson.
- Spencer, E.J., Schuele, C.M., Guillot, K.M, & Lee, M.W. (2008). Phonemic awareness skill of speech-language pathologists and other educators. *Language, Speech, and Hearing Services in Schools*, 39, 512-520.
- Spencer, E.J., Schuele, C.M., Guillot, K.M, & Lee, M.W. (2011). Phonemic awareness skill of undergraduate and graduate students relative to speech-language pathologists and other educators. *Contemporary Issues in Communication Sciences and Disorders*, 38, 109-118.

Tessel, C.A., & Grover, V. (2020). Graduate student retention of prerequisite course content.

Teaching and Learning in Communication Sciences & Disorders, 4(1), Article 1.

<https://doi.org/10.30707/TLCSD4.1/ULMQ3912>

Tolman, C. (2005). Working smarter, no harder: What teachers of reading need to know and be

able to teach. *Perspectives of the International Dyslexia Association*, 31(4), 15-23.

Wagner, R.K., Torgesen, J.K., & Rashotte, C.A. (1999). *Comprehensive test of*

phonological processing. Pro-Ed.

Werfel, K.L. (2017). Phonetic transcription training improves adults' explicit phonemic

awareness: Evidence from undergraduate students. *Communication Disorders Quarterly*,

39(1), 281-287. <https://doi.org/10.1177/1525740117702456>

Chapter 4

Does Direct Phonological Awareness Intervention Improve SLP Student Outcomes with Phonetic Transcription?

Students pursuing a degree in speech-language pathology (SLP) take a foundational course in phonetics, wherein they learn about the differences between alphabetic letters (graphemes), and speech sounds (phonemes) and develop the skill of phonetic transcription (Crais et al., 2015; Small, 2020). Students learn to use the International Phonetic Alphabet (IPA) to transcribe words and phrases on the basis of phonemes versus spelling. While the English alphabet contains 26 graphemes, there are approximately 42 Standard American English phonemes, which requires students to ignore prior learning of spelling in favor of employing awareness of the phonemes they hear. In addition, students are trained to recognize syllable segments and syllable stress in order to accurately document and transcribe speech (Small, 2020).

In developing the skill of phonetic transcription, students must utilize phonological awareness (PA), which is the recognition of the auditory components of words and sentences, such as identifying syllables, creating rhyming words, and counting phonemes in a word (McLeod & Baker, 2017). PA is one component of phonological processing, which includes three components: PA, phonological memory, and phonological retrieval (ASHA, n.d.). PA is an umbrella term that includes three primary categories: word/syllable awareness, onset-rime awareness, and phonemic awareness. Phonemic awareness is a secondary umbrella term that includes a variety of tasks related to phonemes, such as isolation of phonemes, manipulation of phonemes, and counting phonemes (Bauman-Waengler & Garcia, 2020). PA skills are typically addressed with emerging readers in early elementary years and are important for development of

reading and writing skills (McLeod & Baker, 2017). While it would seem that proficient adult readers would have these skills fully developed, it appears that the PA skills of adults may be quite varied (Scarborough, 1998).

Several researchers have explored this interconnected relationship between PA skills and phonetic transcription learning with undergraduate SLP students. According to Robinson et al. (2011), learning phonetic transcription can be frustrating for some students, which may lead students to question their desire to pursue the SLP major. SLP students who have lower PA skills may have more difficulty with learning phonetic transcription (Moran & Fitch, 2001; Robinson et al., 2011; Hall-Mills et al., 2007, as cited in Hall-Mills & Bourgeois, 2008, Hillenbrand, 2017). Thus, it has been suggested that direct training in PA may be an effective strategy to support student learning, improve student outcomes, and decrease frustration while taking a phonetics course (Randolph, 2015). In consideration of the learning theories of cognitivism (Bates, 2016; Lattuca & Stark, 2009), it is possible that students have a higher cognitive load with learning phonetics than might be anticipated. Thus, students may benefit from having scaffolding of information, particularly with PA skills, that is currently not being offered within the current phonetics coursework. Scaffolding provides the necessary foundations that then allow students to learn more deeply and effectively in problem-based learning (Austin, 2013). According to Austin (2013), scaffolding is particularly important for training student clinicians who will need to engage in problem-based learning for clinical application.

A secondary importance of PA for SLP majors is that PA is within their scope of practice for assessment, treatment, and collaboration with other professionals (ASHA, n.d.; Powell, 2018). Interestingly, it appears that practicing SLPs, as well as SLP students, may have phonemic awareness skills that exceed those of educators (Messier & Jackson, 2014; Spencer et

al., 2008; Spencer et al., 2011). It has been suggested that the training students receive in phonetic transcription may be a reason for these increased skills (Spencer et al., 2011; Werfel, 2017). Despite this, it appears that SLPs and educators have “gaps in PA knowledge and skills” (Messier & Jackson, 2014, p. 522). Spencer et al. (2011) found that when asked to count the number of phonemes in words that are more challenging due to less phoneme to grapheme correspondence, students with phonetics training and SLPs still averaged only around 50% accuracy. Therefore, it appears that taking a phonetics course alone may not provide adequate PA support that is needed for the professional roles of an SLP. Spencer et al. (2011) suggested that there should be more direct phonemic awareness training provided while students are learning phonetic transcription.

Direct PA intervention was implemented by Hall-Mills and Bourgeois (2008), wherein phonetics students were offered 10-minute sessions to address a variety of PA tasks as well as related phonetic transcription practice. Of their 55 participants, 47 attended less than 3 of these sessions, while 8 attended at least three or more sessions. They found that there was a significant difference in their phonetic transcription quiz score between those who attended three or more sessions versus those who attended fewer. They learned that direct instruction in PA could help improve students’ PA skills, as well as provide improved outcomes with phonetic transcription (Hall-Mills & Bourgeois, 2008). These findings provide encouraging solutions to address the challenges that students experience in learning phonetic transcription.

Purpose of the Study

It is vital that SLPs have strong transcription skills in order to correctly assess and treat clients with speech sound disorders (Bauman-Waengler, 2020). If an SLP incorrectly uses these skills, it could result in misdiagnosis, inaccurate therapy planning, or progress tracking.

Therefore, it is important to determine new ways that instructors can provide better support that will result in strong student outcomes with phonetic transcription. The purpose of this study is to expand upon the work of Hall-Mills and Bourgeois (2008) by piloting the implementation of a full-semester course offering direct PA training in conjunction with a phonetics course in order to determine if this addition supports student outcomes with phonetic transcription. The components of such a course included direct practice and training of the various skills under the PA umbrella, connection with those PA skills to phonetic transcription, learning about the collaborative role of the SLP in regard to PA, and understanding the underlying ethical issues related to accurate transcription. We hypothesized that students taking Phonetics Lab concurrently with Phonetics would outperform students only taking Phonetics in a measure of phonetic transcription accuracy.

Methods

Study Design

In order to answer the research question, *Does the implementation of direct phonological awareness training (through Phonetics Lab) improve phonetic transcription skills in SLP undergraduate students?*, a pre-experimental design of static group comparison was utilized. The full semester offering of Phonetics Lab provided intervention of direct PA training. A post-course score of a phonetic transcription assessment provided a comparison measure of phonetic transcription skills for those who took Phonetics Lab while also taking phonetics versus those who only took phonetics.

Participants

Students enrolling for either the fall or spring semester phonetics course were offered the option to sign up for a phonetics lab course as a one-hour supplemental course. The course was

offered one time per week for one hour with only a few out-of-class expectations for assignments throughout the semester. It was explained that this course would not be tutoring or transcription practice, but rather would be supplemental information to support underlying aspects of phonetic transcription, with hands-on learning. Of the 26 students who enrolled in the phonetics course, 22 of those students opted to sign up for Phonetics Lab, resulting in 4 students who could serve as controls of taking only a traditional phonetics course. Students were provided with and signed informed consent to participate in the study, with all research procedures and assessments being approved by the Institutional Review Board (IRB) at the University of South Dakota, with an affiliation agreement made with the students' university IRB.

Procedures

Students attended a one-hour course for a full semester, which was entitled Phonetics Lab. Students enrolled in this course engaged in hands-on learning with peer-to-peer interaction to practice individual aspects of the PA umbrella and with various strategies of how to implement them with a client as well as when working on phonetics assignments. Students engaged in two interprofessional activities during the course: observing PA activities in a kindergarten classroom and collaborating with a graduate SLP student on the development of PA activities for a client. At the end of the semester, students engaged in application of the course concepts through an interprofessional service learning assignment of creating PA activities for the kindergarten classes that they observed. Students additionally engaged in course discussions and reflection assignments regarding the American Speech-Language Hearing Association (ASHA) Code of Ethics and the relationship between accurate transcription and ethical service delivery. They were also asked to make connections through assignments and discussions regarding the connection between specific areas of the PA umbrella and phonetics assignments.

(For example, when students are asked to create a minimal pair word, it was identified that this requires phoneme isolation and phoneme manipulation.) In the event that a student was absent from class, they attended a one-on-one tutoring session with a trained graduate assistant, who provided them with a similar experience to the class that had been missed.

At the end of the semester, all students in the phonetics course were administered a phonetics transcription assessment, using the words from the Bankson-Bernthal Test of Phonology, 2nd Edition (BBTOP-2; Bankson & Bernthal, 2020). This tool was selected to provide a wide range of commonly transcribed words which are clinically relevant and were not instructor created. A similar measure of transcription was used by Robinson et al. (2011) who opted to use a standardized articulation assessment tool for their measure of transcription skills.

Words were pre-recorded in a sound-proof audio booth and played via a Bluetooth speaker. The recorded words were repeated as requested by the students. A total of 80 words were elicited, and students' accuracy was scored. Two trained graduate students and the instructor graded the assessments and discussed variations in scoring between graders. It was determined that some allowable variations would be accepted as correct, based upon professional opinion. Students obtained a total transcription score out of 80, and then scores were further analyzed for the number of errors that were made based on whether they were related to vowel or consonant transcription errors.

Analysis and Results

To answer the research question, *Does the implementation of direct phonological awareness training (through Phonetics Lab) improve phonetic transcription skills in SLP undergraduate students?*, transcription scores taken at the end of the semester, using words from the *BBTOP-2*, were compared between the intervention group (n=22) and control group (n=4).

The results of the transcription score were analyzed using SPSS Version 27 (IBM Corporation, 2020). Due to the fact that the data had a great deal of negative skew, it failed parametric assumptions. With the small number of participants in the control group, a nonparametric Chi Square analysis was used, utilizing a median split for comparison of transcription scores between those who were in Phonetics Lab (intervention group) versus those who were not (control group). The overall median score for all participants of 76.50 was utilized as a median split of “high” versus “low” for the Chi Square analysis. The results of this analysis found a statistically significant difference ($\chi^2(1) = 4.727, p = .030$) between the two groups, with 100% of the control group falling below the median score for transcription, while only 41% of the intervention group fell below the median score for transcription (see Table 1).

Table 4.1

Chi Square

Transcription Score	Participated in Phonetics Lab	Did Not Participate in Phonetics Lab	Total
Below Median Split (<i>n</i>)	9	4	13
Above Median Split (<i>n</i>)	13	0	13

A secondary analysis of the data was to determine whether errors made on the transcription assessment were related more to vowels or consonants. In comparison to orthographic English, consonants tend to be more comparable, whereas vowels require strong phonemic isolation skills and recall of the IPA symbol. While in English, five vowel graphemes are utilized (a, e, i, o, u), there are 15 separate vowel transcriptions to represent the actual English vowel speech productions. A comparison of the vowel versus consonant errors found that out of the 80 words that students transcribed, students had a mean score of 4 words with incorrect transcription related to a vowel (max = 16, min = 0), whereas they had a mean score of

2 words with incorrect transcription related to a consonant (max = 11, min = 0). There was not a statistically significant difference between groups related to this comparison.

At the end of the course, students were asked to reflect on their learning from the course, particularly in relation to their phonetics development. Students provided encouraging feedback regarding the experience of the Phonetics Lab. Several students commented that prior to taking the lab they were unfamiliar with the term PA and were unaware of the underlying skills. Several students commented on how the concepts from the lab helped them increase their accuracy and comfort level with transcription. One student commented: “Through practicing the basic phonological awareness skills in lab, they enabled me to transcribe with less thought and with ease.” Another student wrote: “My auditory skills have enhanced because of all the practice with multiple forms of phonemes presented in our Phonetics Lab.” Finally, several students commented on the lab providing more confidence in transcribing, with one student stating: “I found transcription fairly easy, and I believe that could be attributed to the phonological awareness activities we did in the phonetics lab,” and yet another stating “By learning about all the different phonological awareness tasks, I am no longer feeling intimidated.”

Limitations

An important limitation of this study is the small control group for comparison. This was a variable that was challenging, as the Phonetics Lab course was offered to all students who were taking the phonetics course, and a large percentage of those students opted to take this course. It would not have been ethical to prohibit a certain number of students to enroll in the course simply to obtain a larger control group, and thus the control group numbers are low. A second limitation of this study is related to the fact that many of the classes were conducted under COVID-19 protocols with masking and social distancing in place for students and the instructor

at various times during the school year. This is not typical for delivery of face-to-face courses; however, the student outcomes do not appear to have been negatively impacted by this factor. When possible, the instructor introduced an option of wearing clear masks during activities, and at some points during the school year, students had the option of not masking or distancing.

Discussion

This study represents a pilot of implementing a full-semester course in addition to a traditional phonetics course in an attempt to learn more about whether or not it supported student learning outcomes. Based upon the findings of this study, it appears that direct PA instruction through the semester-long one hour course provided beneficial outcomes with phonetic transcription accuracy. Students' reflections on the experience and impact of taking Phonetics Lab, though, may be even more reflective of the impact such intervention had on their learning and reduction of cognitive load. The students' reflections indicated that by providing direct PA instruction, they had a stronger foundation and understanding of how to accurately transcribe speech, which made transcription easier for them. Thus, it appears Phonetics Lab accomplished reduction cognitive loads and provision of appropriate scaffolding for learning (Austin, 2013; Bates, 2016; Taylor & Hamdy, 2013). Further, students' reflections indicated that they had a lack of familiarity with PA concepts prior to taking Phonetics Lab. Given that PA is within the scope of practice for SLPs, and that discussion of PA in traditional undergraduate courses is typically relatively brief, these comments highlight the importance of this direct instruction.

While there is more exploration needed regarding the utility of incorporating a companion course to help further develop students' PA skills in order to support phonetic transcription outcomes, this study represents an important pilot of the effectiveness of such a model. Future studies should explore the delivery with a larger number of participants, as well as

to follow students longitudinally through their undergraduate training to see if the effects of this additional PA course can help support retention of phonetic transcription skills into graduate school. There appears to be some attrition of transcription skills from undergraduate school to graduate school, so exploring whether or not this early PA intervention helps reduce this issue would be valuable (Krimm et al., 2017; Tessel & Grover, 2020). Finally, as some students commented on how the PA lab supported an increased comfort level with transcription, another area of exploration may be to incorporate a mixed methods model so that more can be explored regarding student perceptions and experiences of the phonetics course learning process with and without the support of a Phonetics Lab. Regardless, the results of this study are encouraging in providing some effective solutions to support students' success with learning phonetic transcription.

Conclusion

This study is the first of its kind to pilot a semester-long course providing direct PA intervention concurrent with a traditional phonetics course. While the participant numbers were small, it provides encouraging results that such an intervention may benefit students with overall outcomes in phonetic transcription. Further, based upon student feedback, it appears that the course was successful in providing underlying understanding and application of PA that students were able to apply and utilize when completing phonetic transcription tasks. Therefore, this pilot has successfully offered a potential model for how SLP programs can address the challenges associated with teaching phonetic transcription, while also providing valuable content that students will need for professional practice.

References

- American Speech-Language-Hearing Association (ASHA). (n.d.). *Phonological Processing*.
<https://www.asha.org/practice-portal/clinical-topics/written-language-disorders/phonological-processing/>
- Austin, L. (2013). Scaffolding early clinical learning for students in communication sciences and disorders. *ASHA Perspectives on Administration and Supervision*, 23(3), 86-91.
<https://doi.org/10.1044/aas23.3.86>
- Bankson, N.W., & Bernthal, J.E. (2020). *Bankson-Bernthal test of phonology (2nd ed.)*. [BBTOP-2]. Pro-Ed.
- Bates, B. (2016). *Learning theories simplified...and how to apply them to teaching*. Sage Publications.
- Bauman-Waengler, J. (2020). *Articulation & phonology in speech sound disorders: A clinical focus*. (6th ed.). Pearson.
- Bauman-Waengler, J., & Garcia, D. (2020). *Phonological treatment of speech sound disorders in children: A practical guide*. Plural Publishing.
- Crais, E., Nunez, L., Bentler, R., DiLollo, A., Folsom, R., Gillam, R., Hewitt, L., Lister, J., Nittrouer, S., Simpson, J., Chapman, K.L., Honaker, J., Koehnke, J., McNeil, M., Rogers, M., Cone, B., & Robinson, S. (2015). *Final report: The role of undergraduate education in communication sciences and disorders*. [PDF].
<https://www.asha.org/siteassets/reports/aab-report-role-undergrad-ed-csd.pdf>
- Hall-Mills, S., & Bourgeois, M. (2008). *Challenges in teaching and learning phonetics: Implications for instruction*. Paper presented at the annual convention of the American Speech-Language-Hearing Association. Chicago, IL.

- Hillenbrand, J.M. (2017). Some thoughts on teaching and learning phonetic transcription. *The Journal of the Acoustical Society of America*, 142(4, part 2), 2617.
<https://doi.org/10.1121/1.5014582>
- IBM Corporation. (2020). IBM SPSS Statistics for Macintosh, Version 27.0. IBM Corporation.
- Krimm, H., Schuele, M.C., & Brame, C. (2017). Viability of online learning for ensuring basic skills in speech-language pathology. *Perspectives of the ASHA Special Interest Groups SIG 10*, 2(Part 1), 49-58. <https://doi.org/10.1044/persp2.SIG10.49>
- Lattuca, L.R., & Stark, J.S. (2009). *Shaping the college curriculum: Academic plans in context* (2nd ed.). Jossey-Bass.
- McLeod, S., & Baker, E. (2017). *Children's speech: An evidence-based approach to assessment and intervention*. Pearson.
- Messier, J., & Jackson, C.W. (2014). A comparison of phonemic and phonological awareness in educators working with children who are d/Deaf or hard of hearing. *American Annals of the Deaf*, 158(5), 522-538.
- Moran, M.J., & Fitch, J.L. (2001). Phonological awareness skills of university students: Implications for teaching phonetics. *Contemporary Issues in Communication Science and Disorders*, 28, 85-90. <https://doi.org/1092-5171/01/2802-0085>
- Powell, R.K. (2018). Unique contributors to the curriculum: From research to practice for speech-language pathologists in schools. *Language, Speech, and Hearing Services in Schools*, 49, 14-147. https://doi.org/10.1044/2017_LSHSS-17-0059
- Randolph, C. (2015). The “state” of phonetic transcription in the field of communication sciences and disorders. *Journal of Phonetics and Audiology*, 1, e102.
<https://doi:10.4172/jpay.1000e102>

- Robinson, G.C., Mahurin, S.L., & Justus, B. (2011). Predicting difficulties in learning phonetic transcription: Phonemic awareness screening for beginning speech-language pathology students. *Contemporary Issues in Communication Science and Disorders*, 38, 87-95. <https://doi.org/1092-5171/11/3801-0087>
- Scarborough, H.S., Ehri, L.C., Olson, R.K., & Fowler, A.E. (1998). The fate of phonemic awareness beyond the elementary school years. *Scientific Studies of Reading*, 2(2), 115-142. https://doi.org.10/1207/s1543799xssr0202_2
- Spencer, E.J., Schuele, C.M., Guillot, K.M, & Lee, M.W. (2008). Phonemic awareness skill of speech-language pathologists and other educators. *Language, Speech, and Hearing Services in Schools*, 39, 512-520.
- Spencer, E.J., Schuele, C.M., Guillot, K.M, & Lee, M.W. (2011). Phonemic awareness skill of undergraduate and graduate students relative to speech-language pathologists and other educators. *Contemporary Issues in Communication Sciences and Disorders*, 38, 109-118.
- Small, L.H. (2020). *Fundamentals of phonetics: A practical guide for students (5th ed.)*. Pearson.
- Taylor, D.C.M., & Hamdy, H. (2013). Adult learning theories: Implications for learning and teaching in medical education: AMEE Guide No. 83. *Medical Teacher*, 25(11), e1561-e1572. doi: 10.3109/0142159X.2013.828153
- Tessel, C.A., & Grover, V. (2020). Graduate student retention of prerequisite course content. *Teaching and Learning in Communication Sciences & Disorders*, 4(1), Article 1. <https://doi.org/10.30707/TLCSD4.1/ULMQ3912>
- Werfel, K.L. (2017). Phonetic transcription training improves adults' explicit phonemic awareness: Evidence from undergraduate students. *Communication Disorders Quarterly*, 39(1), 281-287. <https://doi.org/10.1177/1525740117702456>

Chapter 5

General Conclusion and Discussion

The purpose of this dissertation was to explore the relationship between PA and phonetic transcription in order to better inform course development for undergraduate speech-language pathology students. A review of the literature revealed that there were gaps in knowledge as well as unanswered questions regarding PA. Three studies were conducted in order to address three major areas of exploration and to add to the available literature. These three areas focused on learning about the PA skills of undergraduate students, gaining insight into what areas of PA are developed through coursework, and piloting a new course to directly teach PA while connecting this with concepts of phonetic transcription.

The first study explored the baseline PA skills of undergraduate college students, as there was little available literature in this regard. Robinson et al. (2011); earned their SLP students had some PA scores higher and lower than what would have been predicted for a normal distribution. Upon examination of the literature, it became clear that there was little known about the expected PA skills of undergraduate students. I hypothesized that students who were in majors related to PA, SLP and education, would have different baseline PA skills compared to similarly aged undergraduate peers who were in unrelated majors (e.g.: business, biology, marketing). It was important to learn more about the baseline skills of undergraduate students, particularly SLP majors, to help instructors determine what areas of PA may need explicit instruction. To assess PA, a unique tool was created by combining several pre-existing tools so that the entire umbrella of PA skills was represented in a single assessment (Binkley, 2021c; see Appendix D).

Using an exploratory/comparative design, the following three groups' scores on the PA Assessment Tool were evaluated: SLP majors, education majors, and other majors (e.g.: biology,

business, kinesiology). This study found that SLP majors outperformed undergraduate students in some areas of PA when compared to both education majors and students in other majors unrelated to PA. The specific areas of syllable awareness, counting the number of words in a sentence, identifying the first phoneme in a word, and the overall ability to identify a phoneme sound in word were identified as areas of strength of the SLP majors when compared to other undergraduate students. Learning about the differences in ability to count the number of words in sentences, which ultimately impacted the syllable awareness score, was interesting as this specific task was not assessed in any of the other published literature with undergraduate students. Although this is considered the least complex PA task, not all undergraduate students were fully competent in this area of the assessment, as indicated by the range of scores on this subtest (3-10). During administration of this item, some students indicated that they were unsure of how to count words in sentences in the context of contractions and possessive nouns.

The second study explored changes in PA as the result of taking a phonetics course. Findings by Werfel (2017) suggested this connection, but with only one measured component of PA, phoneme counting, it is hard to draw conclusions. To expand upon those findings, I wanted to answer this question with the full range of PA skills assessed, including the same measure used by Werfel. This knowledge would help increase understanding of what components are developed through the coursework, and to what extent, as well as to provide better understanding of what PA areas might need further intervention. This study used a pretest-posttest design and measured the changes in students' PA abilities over the course of the semester. I compared undergraduate SLP students enrolled in a phonetics course to undergraduate SLP students enrolled in an introductory course, who served as a control group. I hypothesized that taking a

phonetics course would result in an increase in at least some areas of PA that would not be seen in the control group.

This second study revealed a number of changes, specifically in areas of phonemic awareness, that occurred as the result of taking a phonetics course. The areas that were identified as between group differences were as follows: Overall Phonological Awareness Score, Overall Phonemic Awareness Score, Counting Phonemes in Words, and Vowel Matching. In looking at within group differences for the control group, there were significant changes from pretest to posttest in the following: Overall Phonological Awareness Score and the Overall Phonemic Awareness Score. However, in looking at within group differences for the intervention group, there were significant changes in the following: Overall Phonological Awareness, Overall Phonemic Awareness, Counting Phonemes in Words, Phoneme Segmentation, Phoneme Isolation (Final Phoneme), Phoneme Isolation (Medial Phoneme), Overall Phoneme Isolation Score, Vowel Matching, and the Phoneme Reversal Task. Thus, there were changes during the semester for both groups, but there were more changes in the students taking Phonetics compared to the students taking an introductory course.

A secondary research question for this study was whether or not the sequence of coursework for the introduction course and the phonetics course resulted in different outcomes with either PA skill development or transcription score. As this is relevant to advising students on course sequence, this question served to provide additional insight as to whether the classes provided a degree of sequential support or if they stood alone. By comparing students who took the introductory course simultaneously with the phonetics course to those who took the introductory course prior to the phonetics course, and to those who took the introductory course after the phonetics course, no significant differences were found between these three groups. It

was concluded that the sequence of coursework between these two courses does not impact development of PA skills nor transcription accuracy.

The third component of this research was to pilot a full-semester course, called Phonetics Lab, wherein students were given direct PA instruction and practice through experiential learning. Hall-Mills and Bourgeois (2008) had demonstrated the potential for direct PA intervention with SLP students taking a phonetics course to result in improved outcomes, and I expanded upon this finding by piloting a semester-long course. Based upon cognitive learning theories, I wanted to provide additional scaffolding in the area of PA to help support students' learning of phonetic transcription (Austin, 2013, Bates, 2016; Lattuca & Stark, 2009). I hypothesized that by implementing this additional instruction, students would have improved outcomes with phonetic transcription. Utilizing a pre-experimental design of static group comparison, I compared transcription scores between the intervention group and a control group of students who were in the Phonetics course but not in Phonetics Lab. After scoring the phonetic transcription accuracy of 80 words, the use of a median split with a Chi Square analysis revealed that 100% of the students who were only in Phonetics (control group) were below the median, while only 41% of those who were in the Phonetics Lab (intervention group) scored below the median. Further, students' feedback regarding the course provided anecdotal evidence that the course content provided them with support that made learning phonetic transcription easier.

Discussion

The overarching goal of this dissertation was to add to the existing literature regarding the relationship between PA and the learning of phonetic transcription with undergraduate SLP students. In order to answer important gaps in the literature, I developed three separate studies to

answer three main research questions. I wanted to learn more about how undergraduate SLP compared to their peers in regard to PA skills, to learn what areas of PA are developed through PA coursework, and to see if a course providing direct PA instruction could support student learning and outcomes in phonetic transcription. The results of these three studies provide new insight into the relationship between PA and undergraduate SLP students that can serve to assist with future course development.

By discovering that SLP students have underlying strengths compared to their peers in the areas of phoneme isolation and syllable awareness, there is a potential to use these underlying strengths as a foundation for further learning in PA. This suggests that they already have an ability to isolate and segment some elements of speech, and helping them connect that ability to different, new isolation and segmentation tasks may result in improved course outcomes and decreased frustration during the learning process. Helping students recognize their underlying areas of strength can also help improve their self-perceptions of their abilities.

The exploration of what PA skills develop as the result of taking a phonetics course revealed an increase in a number of phonemic awareness tasks. This result is not completely surprising since students must use a variety of phonemic awareness tasks to successfully transcribe. However, students were still not 100% accurate with the phonemic awareness tasks at posttest. Although students made significant gains in these areas, there is still room for improvement in phonemic awareness, such as with Phoneme Counting and Vowel Matching. Students who cannot complete those tasks with 100% accuracy are unlikely to be consistently accurate with phonetic transcription, as they may not recognize the correct phonemes to be transcribed. In the context of transcribing a word that is produced in a disordered way, such as when assessing a client for a speech sound disorder, this accuracy is increasingly important.

Should the SLP not accurately perceive a phoneme, the transcription could over or under identify a child's speech in the assessment process. There was also room for improvement in the area of overall syllable awareness. While SLP students outperformed their peers in this measure, the results of this study indicated that their scores for this area were not improved as the result of taking a phonetics course; students in the phonetics course had no change in the median score from pretest to posttest for the Overall Syllable Awareness score. It appears that more direct instruction and practice in the area of syllable awareness may be warranted. Clinically, SLPs must be able to recognize syllable breaks in words and to determine when clients are not producing these accurately. They also must have knowledge of where syllable breaks occur in words in order to accurately identify consonant cluster presence. Furthermore, if SLPs are to assess and treat PA, they should be independently accurate with all areas of PA themselves. Based upon the posttest scores for students following a phonetics course, it appears that there is continued need for growth in PA in order to properly prepare them for clinical practice.

The pilot of a full-semester course for direct PA intervention was the first of its kind, and it provided encouraging results regarding the potential for such a course to address a variety of identified student needs. First, it provided an opportunity for experiential learning, interprofessional education, and explicit connections between PA and phonetic transcription that are not currently offered in a traditional phonetics course. Students' reflections on the course revealed that these components not only introduced them to PA, but also provided them with skills that eased the learning of phonetic transcription. Second, it revealed the ability to improve outcomes with accuracy of phonetic transcription. In order to provide appropriate diagnoses and treatment plans, an SLP will need to be extremely proficient in transcription. Therefore,

equipping students to have greater accuracy outcomes with phonetic transcription is an important aspect of clinical skill development.

The results of the three studies conducted revealed that undergraduate college students are not fully competent in all areas of PA, despite the fact that they had the basic literacy skills needed to be accepted to a higher education institution. This is important knowledge for SLP instructors, as it suggests that PA skills cannot be assumed and rather should be directly instructed. The study also revealed that undergraduate students have the capacity to grow in their PA skills as the result of coursework. While some students have continued room for growth in PA following coursework, establishing the fact that PA skills can be further developed is important for SLP course development. It also appears that by providing explicit PA instruction, and by offering hands-on learning with PA, students were able to connect PA with phonetic transcription, resulting in greater accuracy.

Limitations and Future Directions

While these three studies provided new information regarding the relationship between PA and the training of phonetic transcription skills in undergraduate SLP students, there is room for further exploration. Because the participants in these studies are from a single university, the results are not generalizable to all undergraduate college students. Additionally, the participant numbers for SLP students, and particularly for controls, was limited by availability of course enrollment. Therefore, future exploration of PA skills with a larger sample, including participants from a variety of universities throughout the United States, is warranted.

The studies also did not provide a longitudinal view of PA skills for undergraduate SLP students. More research is warranted, particularly in maintenance of transcription skills and PA skills. It has been reported that incoming SLP graduate students struggle with phonetic

transcription (Tessel & Groven, 2020), so learning more about whether or not students were able to maintain or even increase their skills would be valuable. However, the present studies provided data regarding the baseline and growth in PA that SLP students have following their preliminary coursework.

Conclusions

This dissertation study was designed and implemented to further explore the relationship between PA and the training of phonetic transcription in undergraduate SLP students. A review of the literature provided better understanding of what has already been explored and also provided clarity on gaps in knowledge. The dissertation study was designed to answer three main research questions so that some of those gaps could be addressed. A unique component of this dissertation was the development of an assessment tool for PA that assessed the full range of the umbrella of skills and also was presented in an auditory manner, so as to be consistent with how the skill is practiced and measured. The results of the three research studies add to the existing body of literature and provide information that can help inform SLP programs that desire to redesign current delivery of phonetics coursework and improve student outcomes with phonetic transcription. With the great importance of preparing future clinicians to serve clients, learning more about students' learning needs and strategies to improve student outcomes can have an important impact on numerous individuals with speech and language impairments.

References

- Adams, M.J. (1990). *Beginning to read: Thinking and learning about print*. The MIT Press.
- American Speech-Language-Hearing Association (ASHA). (2010). *Roles and responsibilities of speech-language pathologists in schools* [Professional Issues Statement]. www.asha.org/policy/.
- American Speech-Language-Hearing Association (ASHA). (2016). *Scope of practice in speech-language pathology* [Scope of Practice]. <https://www.asha.org/policy/sp2016-00343/>
- American Speech-Language Hearing Association (ASHA). (2020). *2020 standards and implementation procedures for the certificate of clinical competence in speech-language pathology*. <https://www.asha.org/Certification/2020-SLP-Certification-Standards/>
- American Speech-Language-Hearing Association (ASHA). (n.d.-a) *Phonological Processing*. <https://www.asha.org/practice-portal/clinical-topics/written-language-disorders/phonological-processing/>
- American Speech-Language-Hearing Association (ASHA). (n.d.-b). *Speech sound disorders: Articulation and phonology*. https://www.asha.org/practice-portal/clinical-topics/articulation-and-phonology/#collapse_5
- Anthony, J.L., & Lonigan, C.J. (2004). The nature of phonological awareness: Converging evidence from four studies of preschool and early grade school children. *Journal of Educational Psychology*, 96(1), 43-55. <http://doi.10.1037/0022-0663.96.1.43>
- Austin, L. (2013). Scaffolding early clinical learning for students in communication sciences and disorders. *ASHA Perspectives on Administration and Supervision*, 23(3), 86-91. <https://doi.org/10.1044/aas23.3.86>

- Bankson, N.W., & Bernthal, J.E. (2020). *Bankson-Bernthal test of phonology (2nd ed.)*. [BBTOP-2]. Pro-Ed.
- Bates, B. (2016). *Learning theories simplified...and how to apply them to teaching*. Sage Publications.
- Bauman-Waengler, J. (2020). *Articulation & phonology in speech sound disorders: A clinical focus*. (6th ed.). Pearson.
- Bauman-Waengler, J., & Garcia, D. (2020). *Phonological treatment of speech sound disorders in children: A practical guide*. Plural Publishing.
- Binkley, J. (2021a, April 15). *Literature Review*. [Assignment completed for HSC 890 Seminar 3]. University of South Dakota.
- Binkley, J. (2021b, April 23). *PhD in Health Sciences Comprehensive Exam*. [Submission to dissertation committee]. University of South Dakota.
- Binkley, J. (2021c, September 20). *PhD in Health Sciences Dissertation Proposal*. [Submission to dissertation committee]. University of South Dakota.
- Carroll, J., Gillon, G., & McNeill, B. (2012). Explicit phonological knowledge of educational professionals. *Asia Pacific Journal of Speech, Language and Hearing*, 15(4), 231-244. <https://doi.10.1179/136132812804731820>
- Cerbin, W. (2018). Improving student learning from lectures. *Scholarship of Teaching and Learning in Psychology*, 4(3), 151-163. <http://dx.doi.org/10.1037/stl0000113>

- Crais, E., Nunez, L., Bentler, R., DiLollo, A., Folsom, R., Gillam, R., Hewitt, L., Lister, J., Nittrouer, S., Simpson, J., Chapman, K.L., Honaker, J., Koehnke, J., McNeil, M., Rogers, M., Cone, B., & Robinson, S. (2015). *Final report: The role of undergraduate education in communication sciences and disorders*. [PDF].
<https://www.asha.org/siteassets/reports/aab-report-role-undergrad-ed-csd.pdf>
- Fink, L.D. (2013). *Creating significant learning experiences: An integrated approach to designing college courses* (2nd ed.). Jossey-Bass.
- Hall-Mills, S., & Bourgeois, M. (2008, November). *Challenges in teaching and learning phonetics: Implications for instruction*. Paper presented at the annual convention of the American Speech-Language-Hearing Association. Chicago, IL.
- Hillenbrand, J.M. (2017). Some thoughts on teaching and learning phonetic transcription. *The Journal of the Acoustical Society of America*, 142(4, part 2), 2617.
<https://doi.org/10.1121/1.5014582>
- Hurford, D.P., Fender, A.C., Swigart, C.C., Hurford, T.E., Hoover, B.B., Butts, S.R., Cullers, K.R., Boux, J.L., Wehner, S.J., Hevel, J.K., Renner, L.P., Overton, K.B., Dumler, J.D., & Wilber, L.M. (2016). Pre-service teachers are competent in phonological processing skills: How to teach the science of reading. *Reading Psychology*, 37, 885-916.
<https://doi:10.1080/02702711.2015.1133464>
- Kamhi, A., & Catts, H.W. (2001). The role of the speech-language pathologist in improving decoding skills. *Seminars in Speech and Language*, 22(3), 175-184.
<https://doi.org/10.1055/s-2001-16144>

- Katz, J., & Moore, M.W. (2021). Phonetic effects in child and adult word segmentation. *Journal of Speech, Language, and Hearing Research*, 64, 854–869.
https://doi.org/10.1044/2020_JSLHR-19-00275
- Kennedy, M.J., Driver, M.K., Pullen, P.C., Ely, E., & Cole, M.T. (2013). Improving teacher candidates' knowledge of phonological awareness: A multimedia approach. *Computers & Education*, 64, 42-51. <http://dx.doi.org/10.1016/j.comp.edu.2013.01.010>
- Kilpatrick, D.A. (2016). *Equipped for reading success: A comprehensive, step-by-step program for developing phonemic awareness and fluent word recognition*. Casey & Kirsch Publishers.
- Kirschner, P.A., Sweller, J., & Clark, R.E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-Based, experiential, and inquiry-based teaching. *Educational Psychologist*, 41(2), 75-86,
doi:10.1207/s15326985ep4102_1
- Knight, R., Bandali, C., Woodhead, C., & Vansadia, P. (2018). Clinicians' views of the training, use and maintenance of phonetic transcription in speech language therapy. *International Journal of Language and Communication Disorders*, 53(4), 776-787.
[https://doi: 10.1111/1460-6984.12381](https://doi:10.1111/1460-6984.12381)
- Krimm, H., & Schuele, M.C. (2017). Viability of online learning for ensuring basic skills in speech-language pathology. *Perspectives of the ASHA Special Interest Groups SIG 10*, 2(Part 1), 49-58. <https://doi.org/10.1044/persp2.SIG10.49>
- Lattuca, L.R., & Stark, J.S. (2009). *Shaping the college curriculum: Academic plans in context* (2nd ed.). Jossey-Bass.

- Louko, L.J., & Edwards, M.L. (2001). Issues in collecting and transcribing speech samples. *Topics in Language Disorders, 21*(4), 1-11.
- Mackenzie Beck, J. (2003) Is it possible to predict students' ability to develop skills in practical phonetics? *Proceedings of the 15th International Congress of Phonetic Sciences. Universitat Autnoma de Barcelona, 2833 -2836.*
- McBride-Chang, C. (1995). What is phonological awareness? *Journal of Educational Psychology, 87*(2), 179-192.
- McKenna, M., Castillo, J., Dedrick, R.F., Cheng, K., & Goldstein, H. (2021). Speech-language pathologist involvement in multi-tiered system of supports questionnaire: Advances in Interprofessional Practice. *Language, Speech, and Hearing Services in Schools, 52*, 597-611. https://doi.org/10.1044/2020_LSHSS-20-00084
- McKinney, N.S., & Waite, R. (2016). Leadership development among a cohort of undergraduate interdisciplinary students in the health professions. *Journal of Leadership Education, 15*(3), 11-22. <https://doi.org/1012806/V15/I3/A2>
- McLeod, S., & Baker, E. (2017). *Children's speech: An evidence-based approach to assessment and intervention*. Pearson.
- Merriam, S.B., & Bierema, L.L. (2014). *Adult learning theory: Linking theory and practice*. San Francisco, CA: Jossey-Bass.
- Messier, J., & Jackson, C.W. (2014). A comparison of phonemic and phonological awareness in educators working with children who are d/Deaf or hard of hearing. *American Annals of the Deaf, 158*(5), 522-538.

- Moran, M.J., & Fitch, J.L. (2001). Phonological awareness skills of university students: Implications for teaching phonetics. *Contemporary Issues in Communication Science and Disorders*, 28, 85-90. <https://doi.org/1092-5171/01/2802-0085>
- Nelson, T.L., Mok, Z., & Eecen, K.T. (2020). Use of transcription when assessing children's speech: Australian speech-language pathologists' practices, challenges, and facilitators. *Folia Phoniatica et Logopadica*, 72, 131-142. <https://doi/10.1159/000503131>
- Newcomer, P.L., & Hammill, D.D. (2019). *Test of language development: Primary (5th ed.)*. [TOLD:P-5]. Pro-Ed.
- Portney, L.G. (2020). *Foundations of clinical research: Applications to evidence-based practice (4th ed.)*. F.A. Davis.
- Powell, R.K. (2018). Unique contributors to the curriculum: From research to practice for speech-language pathologists in schools. *Language, Speech, and Hearing Services in Schools*, 49, 14-147. https://doi.org/10.1044/2017_LSHSS-17-0059
- Randolph, C. (2015). The “state” of phonetic transcription in the field of communication sciences and disorders. *Journal of Phonetics and Audiology*, 1, e102. <https://doi:10.4172/jpay.1000e102>
- Robertson, C., & Salter, W. (2018). *Phonological awareness test (2nd ed.): Normative Update. [PAT-2:NU]*. Pro-Ed.
- Robinson, G.C., Mahurin, S.L., & Justus, B. (2011). Predicting difficulties in learning phonetic transcription: Phonemic awareness screening for beginning speech-language pathology students. *Contemporary Issues in Communication Science and Disorders*, 38, 87-95. <https://doi.org/1092-5171/11/3801-0087>

- Schatschneider, C., Francis, D.J., Foorman, B.R., Fletcher, J.M., & Mehta, P. (1999). The dimensionality of phonological awareness: An application of item response theory. *Journal of Educational Psychology, 91*(3),439-449.
- Schuele, C.M., & Boudreau, D. (2008). Phonological awareness intervention: Beyond the basics. *Language, Speech, and Hearing Services in Schools, 39*, 3-20.
[https://doi:10.1044/0161-1461\(2008-002\)](https://doi:10.1044/0161-1461(2008-002))
- Shaw, A., & Yanushevskaya, I. (2021). Students' views and experiences of the training and use of phonetic transcription in speech and language therapy—the Irish perspective. *Clinical Linguistics & Phonetics, 1*-16. <https://doi/0.1080/02699206.2021.1874055>
- Shriberg, L.D., Kent, R.D., McAllister, T., & Preston, J.L. (2019). *Clinical phonetics* (5th ed.). Pearson.
- Small, L.H. (2020). *Fundamentals of phonetics: A practical guide for students* (5th ed.). Pearson.
- Spencer, E.J., Schuele, C.M., Guillot, K.M, & Lee, M.W. (2008). Phonemic awareness skill of speech-language pathologists and other educators. *Language, Speech, and Hearing Services in Schools, 39*, 512-520.
- Spencer, E.J., Schuele, C.M., Guillot, K.M, & Lee, M.W. (2011). Phonemic awareness skill of undergraduate and graduate students relative to speech-language pathologists and other educators. *Contemporary Issues in Communication Sciences and Disorders, 38*, 109-118.
- Svinicki, M.D., McKeachie, W.J. (2014). *McKeachie's teaching tips: Strategies, research, and theory for college and university teachers* (14th ed.). Belmont, CA: Wadsworth.
- Taylor, D.C.M., & Hamdy, H. (2013). Adult learning theories: Implications for learning and teaching in medical education: AMEE Guide No. 83. *Medical Teacher, 25*(11), e1561-e1572. doi: 10.3109/0142159X.2013.828153

- Tessel, C.A., & Grover, V. (2020). Graduate student retention of prerequisite course content. *Teaching and Learning in Communication Sciences & Disorders*, 4(1).
<https://doi.org/10.30707/TLCSD4.1/ULMQ3912>
- Wagner, R.K., & Torgesen, J.K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin*, 101(2), 192-212.
- Wagner, R.K., Torgesen, J.K., Rashotte, C.A., & Pearson, N.A. (2013). *Comprehensive test of phonological processing*. (2nd ed.). Pro-Ed.
- Werfel, K.L. (2017). Phonetic transcription training improves adults' explicit phonemic awareness: Evidence from undergraduate students. *Communication Disorders Quarterly*, 39(1), 281-287. <https://doi.org/10.1177/1525740117702456>
- Westerveld, M.F., & Barton, G.M. (2016). The phonological awareness skills of education and speech pathology higher education students during their first semester of study. *Journal of Clinical Practice in Speech-Language Pathology*, 18(2), 84-88.
- World Health Organization. (2010). *Framework for action on interprofessional education and collaborative practice*.
https://apps.who.int/iris/bitstream/handle/10665/70185/WHO_HRH_HPN_10.3_eng.pdf

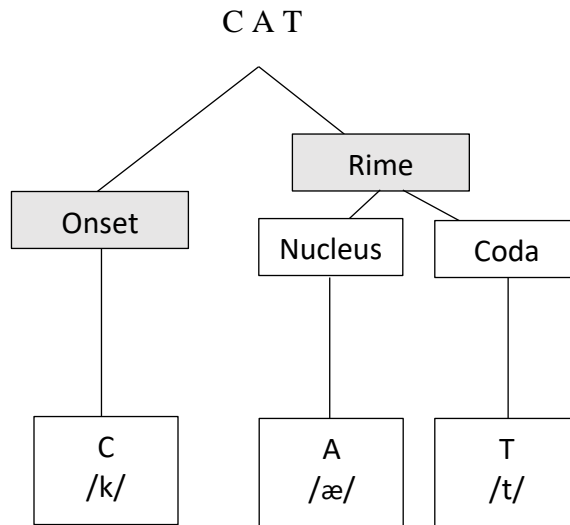
Appendix A

Examples of Spelling versus Phonetic Transcription

Example word	Phonetic Transcription	Comparison to Spelling
Cat	/kæt/	/k/ used for “c” to denote how the sound was produced 3 graphemes (letters), 3 phonemes (speech sounds)
City	/sɪti/	/s/ used for “c” to denote how sound was produced; /i/ used for “y” to denote how sound was produced 4 graphemes, 4 phonemes
Czar	/zɑr/	“c” not transcribed because no sound produced 4 graphemes, 3 phonemes
Trough	/traʊf/	/ɑ/ used to denote “ou”; /f/ used to denote “gh” 6 graphemes, 4 phonemes

Appendix B

The Syllable and Its Structure



Appendix C

Areas of PA Explored in the Literature with SLP Students

Phonological Awareness Task <small>(Bauman-Waengler & Garcia, 2020)</small>	Example <small>(Bauman-Waengler & Garcia, 2020)</small>	Name of Activity and Cited Study with SLP Undergraduate Participants
<i>Word/Syllable Segmenting</i>		
Segmenting words in sentences	How many words in sentence	
Syllable Awareness	How many syllables in word	<ul style="list-style-type: none"> • “judging number syllables in polysyllabic words”: Mackenzie Beck, 2003
Syllable Completion	Compound words—ask them to complete	
Syllable identification	Compound words—compare 2, which are the same (ex: football/baseball)	
Syllable Blending	Compound words/2 syllable—put two words together to make a word (win dow/window)	
Syllable Deletion	Compound words/two syllable words to create new (jellyfish/fish)	
<i>Onset-Rime Awareness and Production</i>		
Recognition of rhyming words	Do these two words rhyme?	
Recognition of onset-rime words that does not match	1 out of 3-4 words that does not rhyme	<ul style="list-style-type: none"> • “odd rhyme” with non-English words: Hillenbrand, 2017
Producing rhyming words	Real or non-word that rhymes with simple one-syllable word	
<i>Phonemic Awareness Tasks</i>		
<i>Identifying Phonemes</i>		
Phoneme detection, same v. different	Which of these words has a different first sound?	<ul style="list-style-type: none"> • “odd vowel, odd final, odd initial”: Hillenbrand, 2017
Phoneme matching the same	Which word begins with the same sound?	<ul style="list-style-type: none"> • “vowel matching”: Moran & Fitch, 2001 • “phoneme identification”: Spencer et al. 2008 • “phoneme identification”: Spencer et al. 2011

<i>Isolating phonemes/blending phonemes</i>		
Isolating initial phoneme then final phoneme	Which sound do you hear at the beginning of...at the end of...	<ul style="list-style-type: none"> • “phoneme isolation”: Spencer et al. 2008 • “phoneme isolation”: Spencer et al. 2011
Phoneme segmentation	How many sounds do you hear in this word/what sounds do you hear in this word?	<ul style="list-style-type: none"> • “phoneme counting”: Moran & Fitch, 2001 • “phoneme counting”: Hall-Mills 2007 • “Phoneme segmentation”: Robinson et al., 2011 • “phoneme segmentation”: Spencer et al. 2008 • “phoneme segmentation”: Spencer et al. 2011 • “phoneme segmentation”: Werfel, 2017 • “counting sounds”: Hillenbrand, 2017
Phoneme blending	Can you put these sounds together to make a word?	
<i>Manipulating phonemes</i>		
Phoneme deletion	What would the word “moon” be without “n”?	<ul style="list-style-type: none"> • “Elision/phoneme deletion”: Robinson et al., 2011
Phoneme manipulation	What would the word be if you changed the beginning and end sound around (cap/pack)	<ul style="list-style-type: none"> • “Phoneme switching”/“phoneme reversal”: Moran & Fitch, 2001 • “phoneme switching/phoneme reversal”: Hall-Mills 2007 • “phoneme reversal”: Hall-Mills 2008 • “Phoneme reversal”: Robinson et al., 2011 • “reversal, sound substitution”: Hillenbrand, 2017
Additional Tasks Assessed	Example	Studies
Spelling	Real word and not real word	<ul style="list-style-type: none"> • Hall-Mills 2008 • Hillenbrand, 2017
Spoonerism Repair	Undo a spoonerism (toin coss-coin toss)	<ul style="list-style-type: none"> • Hillenbrand, 2017
Odd Stress Pattern	“re-FER”	<ul style="list-style-type: none"> • Hillenbrand, 2017
Detect between 2 sounds in non-English words	Is there a /k/ in it?	<ul style="list-style-type: none"> • Hillenbrand, 2017 • Mackenzie Beck, 2003
Knowledge of tongue position for phoneme production	Ability to compare tongue position during production of pairs of sounds	<ul style="list-style-type: none"> • Mackenzie Beck, 2003

Appendix D

Phonological Awareness Assessment Tool (Binkley, 2021c)

Phonological Awareness Task (Bauman-Waengler & Garcia, 2020)	Example (Bauman-Waengler & Garcia, 2020)	Subtest Addressing Task/Original Source/Adaptations
Word/Syllable Awareness and Segmenting		
Segmenting words in sentences	How many words in sentence	PAT-2: segmentation of sentences* (ADAPT: oral presentation; student writes number on answer key)
Syllable Awareness	How many syllables in word	PAT-2: segmentation of syllables* (ADAPT: oral presentation; student writes number on answer key)
Syllable Blending	Compound words/2 syllable—put two words together to make a word (win dow/window)	PAT-2: syllable blending
Onset-Rime Awareness and Production		
Recognition of rhyming words	Do these two words rhyme?	PAT-2: rhyming discrimination* (ADAPT: oral presentation; student circles Y/N on answer key)
Producing rhyming words	Real or non-word that rhymes with simple one-syllable word	PAT-2: rhyming production
Phonemic Awareness Tasks		
Identifying Phonemes		
Phoneme detection, same v. different	Which of these words has a different first sound?	TOLD-P:5 word matching task* (ADAPT: student circles same/different; Reduced number of items to 20, with same proportion of foils. Removed 3 items that have less distinction due to southern dialect prior to selecting items randomly. Used app to randomly select items, keeping same ratio of foils.)
Phoneme matching the same	Which word begins with the same sound?	Moran & Fitch vowel matching task (ADAPT: individual administration--orally read with choice of 4 words on answer key to circle)

<i>Isolating phonemes/blending phonemes</i>		
Isolating initial phoneme then final phoneme	Which sound do you hear at the beginning of...at the end of...	PAT-2: isolation of initial, final, medial
Phoneme segmentation	How many sounds do you hear in this word/what sounds do you hear in this word?	Words from Spencer et al., 2008* (<i>ADAPT: oral presentation of words; have students write number on answer key; removed 3 items that are challenging for a trained SLP to accurately identify number of phonemes due to syllabic possibilities</i>) PAT-2: phoneme segmentation
Phoneme blending	Can you put these sounds together to make a word?	PAT-2: phoneme blending
<i>Manipulating phonemes</i>		
Phoneme deletion	What would the word “moon” be without “n”?	PAT-2: deletion of phonemes
Phoneme manipulation	What would the word be if you changed the beginning and end sound around (cap/pack)	Moran & Fitch: phonetic reversal task (<i>ADAPT: individual administration 10/20 items based upon frustration of participants of pilot administration—orally presented and respond orally</i>)
*indicates group administration is possible		

Appendix E

Phonological Awareness Tasks Assessed in the Literature

Phonological Awareness Task (Bauman-Waengler & Garcia, 2020)	Example of Task (Bauman-Waengler & Garcia, 2020)	Name of PA Activity and Cited Study	Delivery Method of PA Activity
<i>Word/Syllable Awareness and Segmenting</i>			
Segmenting words in sentences	How many words in sentence		
Syllable Awareness	How many syllables in word	<ul style="list-style-type: none"> • “indicate number of syllables in given words”; Messier & Jackson, 2014 • “Syllable Identification”; Carroll et al., 2012 • “Syllable Identification”; Westerveld et al., 2016; Westerveld & Barton, 2017 	<ul style="list-style-type: none"> • 5 items ranging from 1-5 syllables; on Survey Monkey • Spoken words, participants recorded answer on paper • Same as Carroll et al., 2012 but with multiple choice options
Syllable Completion	Compound words—ask them to complete		
Syllable identification	Compound words—compare 2, which are the same (ex: football/baseball)		
Syllable Blending	Compound words/2 syllable—put two words together to make a word (win dow/window)	<ul style="list-style-type: none"> • “Blending”; Del Tufo & Earle, 2020; Earle & Del Tufo, 2021; Hurford et al., 2016 	<ul style="list-style-type: none"> • CTOPP
Syllable Deletion	Compound words/two syllable words to create new (jellyfish/fish)	<ul style="list-style-type: none"> • “Elision”; Del Tufo & Earle, 2020, Earle & Del Tufo, 2021; Hurford et al., 2016; Robinson et al., 2011 	<ul style="list-style-type: none"> • CTOPP
<i>Onset-Rime Awareness and Production</i>			
Recognition of rhyming words	Do these two words rhyme?	<ul style="list-style-type: none"> • “rhyme matching”; Carroll et al., 2013; Westerveld & Barton, 2017 	<ul style="list-style-type: none"> • Read ten words and match four pairs of rhyming words
Recognition of onset-rime words that do not match	1 out of 3-4 words that do not rhyme	<ul style="list-style-type: none"> • “odd rhyme”; Hillenbrand, 2017 	<ul style="list-style-type: none"> • From 4 non-English words, find one that does not rhyme with others
Producing rhyming words	Real or non-word that rhymes with a word		

Phonemic Awareness Tasks	
Identifying Phonemes	
Phoneme detection, same v. different	<ul style="list-style-type: none"> • “alliteration awareness”; Carroll et al., 2012; Westerveld & Barton, 2017 • “odd vowel sound, odd final sound, odd initial sound”; Hillenbrand, 2017 • “similar word endings”; Kennedy et al., 2013
Phoneme matching the same	<ul style="list-style-type: none"> • “vowel matching”: Moran & Fitch, 2001 • “phoneme identification”: Spencer et al. 2008; Spencer et al., 2011 • “phoneme identification”; Messier & Jackson, 2014
Which of these words has a different first sound?	<ul style="list-style-type: none"> • Read 9 words and match those starting with same sound but different graphemes • Find odd vowel/final/initial sound in list of words • Find word in row that ends with same sound as presented word; paper task
Which word begins with the same sound?	<ul style="list-style-type: none"> • 20 sets of words; students listen to word and circle word from choice with same vowel sound • Pencil and paper task of matching a selected sound from a word with choice of 4 words • Similar to Spencer et al, 2008; on Survey Monkey
Isolating phonemes/blending phonemes	
Phoneme Isolation	<ul style="list-style-type: none"> • “phoneme isolation”: Spencer et al. 2008; Spencer et al. 2011 • “second sound identification”; Carroll et al., 2012 • “final sound identification”; Carroll et al., 2012 • “second sound identification, final sound identification”; Westerveld et al., 2016; Westerveld & Barton, 2017 • “detect k/s”; Hillenbrand, 2017
Which sound do you hear at the beginning of...at the end of...	<ul style="list-style-type: none"> • Pencil and paper task of giving letter from a word that represents the requested sound (i.e.: third speech sound) • Identification of second sound in six spoken words with written response for letter or combination of letters • Identification of last sound in six spoken words with written response for letter or combination of letters • Same as Carroll et al., 2012, but with multiple choice options • from phrase in unfamiliar language, detect k/s phoneme presence

		<ul style="list-style-type: none"> • “identification of phoneme”; Kennedy et al., 2013 	<ul style="list-style-type: none"> • Ex: what is the third phoneme in the word?; paper task
Phoneme segmentation	How many sounds do you hear in this word/what sounds do you hear in this word?	<ul style="list-style-type: none"> • “phoneme segmentation”; Spencer et al. 2008; Spencer et al. 2011; Werfel, 2017; Henbest et al., 2020 • “phoneme segmentation”; Messier & Jackson, 2014 • “Phonemic awareness task”; Henbest et al., 2020 • “phoneme counting”; Moran & Fitch, 2001; Hall-Mills et al., 2007 • “Segmenting Words”; Robinson et al., 2011; Hurford et al., 2017 • “phoneme identification”; Carroll et al., 2012 • “phoneme identification”; Westerveld et al., 2016; Westerveld & Barton, 2017 • “Counting”; Hillenbrand, 2017 • “number of phonemes”; Kennedy et al., 2013 • “Blending”; Del Tufo & Earle, 2020, Earle & Del Tufo, 2021; Hurford et al., 2016 	<ul style="list-style-type: none"> • 21 words presented on paper, separated by easy versus hard • 27 words similar to Spencer et al. 2008; on Survey Monkey • Phoneme identification task as created by Spencer et al. (2008) • List of 20 words written and heard on recording; count number of sounds and record on paper • CTOPP • Record number of sounds from 10 spoken words • Same as Carroll et al., 2012, but with multiple choice options • Count number of speech sounds in word • Identify number of phonemes in single syllable word; paper task • CTOPP
Phoneme blending	Can you put these sounds together to make a word?		
Manipulating phonemes			
Phoneme deletion	What would the word “moon” be without “n”?	<ul style="list-style-type: none"> • “Elision”; Del Tufo & Earle, 2020, Earle & Del Tufo, 2021; Hurford et al., 2016; Robinson et al., 2011 • “Phoneme Deletion Task”; Wilson & Lesaux, 2001 	<ul style="list-style-type: none"> • CTOPP • Task created by Snowling et al., 1997, as cited in Wilson & Lesaux, 2001

Phoneme manipulation	What would the word be if you changed the beginning and end sound around (cap/pack)	<ul style="list-style-type: none"> • “Phonetic Reversal”: Moran & Fitch, 2001; Hall-Mills et al., 2007; Hall-Mills & Bourgeois, 2008 • “Phoneme reversal”: Robinson et al., 2011; Hurford et al., 2016 • “reversal, sound substitution”: Hillenbrand, 2017 • “word reversal”; Kennedy et al., 2013 	<ul style="list-style-type: none"> • List of 20 written words; students write down word made by reversing the sounds • CTOPP • Reverse of first and last sounds of word; vowel sound presented, and then consonants instructed to add to word • Reverse the order of sounds in word; paper task
Additional Tasks Assessed	Example of Task	Studies Cited	Delivery Method
Spelling	Real word and not real word	<ul style="list-style-type: none"> • “spelling”; Hillenbrand, 2017 • “real world spelling, pseudoword spelling”; Hall-Mills et al., 2007, Hall-Mills & Bourgeois, 2008 	<ul style="list-style-type: none"> • 20 words that are commonly misspelled and challenging • Researcher-made tasks
Spoonerism Repair/Exchange	(toin coss-coin toss)	<ul style="list-style-type: none"> • “phoneme switching”; Moran & Fitch, 2001; Hall-Mills et al., 2007 • “Spoonerisms”; Wilson & Lesaux, 2001 • “Spoonerism Repair”; Hillenbrand, 2017 	<ul style="list-style-type: none"> • 20 two-word phrases, transposing first phoneme of each word; written response • Task created by Snowling et al., 1997, as cited in Wilson & Lesaux, 2001 • Listener fixes to intended utterance
Stress Pattern	“re-FER”	<ul style="list-style-type: none"> • “odd stress pattern”; Hillenbrand, 2017 	<ul style="list-style-type: none"> • From list, find different stress pattern
Grapheme to phoneme correspondence	Underline the sounds and count the number of sounds in a word Produce a sound(s) associated with the letter/letter combination	<ul style="list-style-type: none"> • “Graphophonemic segmentation task”; Scarborough et al, 1998 • “Phoneme-grapheme correspondence assessment”; Sayeski et al., 2017 	<ul style="list-style-type: none"> • Pencil and paper task created by researchers • Individual, oral assessment

Appendix F

Table 2.4

Comparisons of Students With and Without Reported Learning Disabilities

PA Assessment Category (possible total score)	Median Test (Significance)	Mann-Whitney U Test (Significance)
Overall Phonological Awareness (178)	.335	.407
Overall Syllable Awareness (30)	.845	1.000
Overall Onset-Rime Awareness (20)	*	.117
Overall Phonemic Awareness (128)	.219	.432
Number of Words in Sentence (10)	*	.921
Number of Syllables in Word (10)	*	.610
Identification of Rhyming Words (10)	*	.788
Counting Phonemes in Words (18)	.511	.233
Auditory Discrimination between Words (20)	.630	.745
Blending Syllables (10)	1.000	.810
Rhyming Production (10)	*	.096
Blending Phonemes (10)	*	.167
Phoneme Segmentation (10)	.861	.470
Phoneme Isolation (Beginning Phoneme) (10)	.456	.423
Phoneme Isolation (Final Phoneme) (10)	.653	.627
Phoneme Isolation (Medial Phoneme) (10)	*	.571
Overall Phoneme Isolation Score (30)	.062	.208
Vowel Matching (20)	.997	.614
Phoneme Deletion (10)	*	.209
Phoneme Reversal (10)	.563	.474

*SPSS unable to compute

Appendix G

Table 2.5

Median, Minimum, and Maximum Scores by Category and Group

PA Assessment Category (possible total score)	SLP Majors Median Score	Education Majors Median Score	Other Majors Median Score	SLP Majors Min-Max Score	Education Majors Min-Max Score	Other Majors Min-Max Score
Overall Phonological Awareness (178)	154	152	152	127-169	109-168	93-169
Overall Syllable Awareness (30)	29	29	29	24-30	25-30	21-30
Overall Onset-Rime Awareness (20)	20	19.50	20	18-20	17-20	17-20
Overall Phonic Awareness (128)	104	102	103	78-119	63-119	53-121
Number of Words in Sentence (10)	10	10	10	9-10	8-10	3-10
Number of Syllables in Word (10)	10	10	10	5-10	5-10	5-10
Identification of Rhyming Words (10)	10	10	10	10-10	9-10	9-10
Counting Phonemes in Words (18)	10	11	10	2-14	4-13	1-14
Auditory Discrimination between Words (20)	20	19	19	15-20	11-20	15-20
Blending Syllables (10)	10	10	9	9-10	9-10	9-10
Rhyming Production (10)	10	10	10	8-10	7-10	7-10
Blending Phonemes (10)	10	9.4	10	8-10	7-10	6-10
Phoneme Segmentation (10)	8	6	6	3-10	1-10	0-10
Phoneme Isolation (Beginning Phoneme) (10)	10	9	9	1-10	3-10	1-10
Phoneme Isolation (Final Phoneme) (10)	9	9	9	5-10	4-10	5-10
Phoneme Isolation (Medial Phoneme) (10)	10	10	10	3-10	2-10	2-10
Overall Phoneme Isolation Score (30)	29	28	28	17-30	12-30	10-30
Vowel Matching (20)	15	15.50	16	8-20	7-19	4-20
Phoneme Deletion (10)	10	10	10	5-10	8-10	4-10
Phoneme Reversal (10)	6	6	7	1-10	0-10	0-10

Appendix H

Table 3.1

Comparison of Students Taking Phonetics Lab and Phonetics Versus Taking Only Phonetics

PA Assessment Category	Difference from Pretest to Posttest Mann Whitney U Test (Significance)
Overall Phonological Awareness Score	.354
Overall Syllable Awareness Score	.922
Overall Onset-Rime Awareness Score	.083
Overall Phonemic Awareness Score	.354
Number of Words in Sentence	.118
Number of Syllables in Word	.115
Identification of Rhyming Words	1.000
Counting Phonemes in Words	.062
Auditory Discrimination between Words	.755
Blending Syllables	.505
Rhyming Production	.083
Blending Phonemes	.269
Phoneme Segmentation	.704
Phoneme Isolation (Beginning Phoneme)	.692
Phoneme Isolation (Final Phoneme)	.843
Phoneme Isolation (Medial Phoneme)	.922
Overall Phoneme Isolation Score	.924
Vowel Matching	.515
Phoneme Deletion	.441
Phoneme Reversal	1.000

Appendix I

Table 3.2

Results and Comparisons Between and Within Groups

PA Assessment Category (possible total score)	Pretest Median Score (Phonetics Course)	Posttest Median Score (Phonetics Course)	Wilcoxon Signed Rank Test for Pretest to Posttest for Phonetics Course (Significance)	Pretest Median Score (Introduction Course)	Posttest Median Score (Introduction Course)	Wilcoxon Signed Rank Test for Pretest to Posttest for Introduction Course (Significance)	Mann Whitney U Test \Differences Between Groups from Pretest to Posttest (Significance)
Overall Phonological Awareness (178)*	144	167	.002	159	163	.012	.000
Overall Syllable Awareness (30)**	29	29	1.00	30	29	.518	.695
Overall Onset-Rime Awareness (20)***	20	20	.317	19	20	.414	.651
Overall Phonemic Awareness (128)****	94.5	118	.002	110	113	.008	.000
Number of Words in Sentence (10)	10	10	1.00	10	10	.564	.740
Number of Syllables in Word (10)	10	10	.414	10	10	1.00	.740
Identification of Rhyming Words (10)	10	10	1.00	10	10	1.00	1.00
Counting Phonemes in Words (18)	9	15	.002	11	12	.297	.011
Auditory Discrimination between Words (20)	20	19.5	.408	20	20	.257	.880
Blending Syllables (10)	9.5	9	.317	10	10	.157	1.00
Rhyming Production (10)	10	10	.317	9	10	.414	.651
Blending Phonemes (10)	9.5	10	.083	10	10	.180	.316
Phoneme Segmentation (10)	6	10	.003	8	9	.120	.079
Phoneme Isolation (Beginning Phoneme) (10)	10	10	.167	10	10	.317	.134
Phoneme Isolation (Final Phoneme) (10)	9	10	.027	9	10	.180	.190
Phoneme Isolation (Medial Phoneme) (10)	9	10	.016	10	10	.785	.069
Overall Phoneme Isolation Score (30)*****	27	30	.018	29	29	.438	.091
Vowel Matching (20)	13.5	18	.004	15	17	.474	.007
Phoneme Deletion (10)	10	10	.144	9	9	.257	.880
Phoneme Reversal (10)	6	8.5	.006	6	6	.396	.069

*comprised of all subtests, totaled; **comprised of 3 subtests: number of words in sentence, number of syllables in word, blending syllables; *** comprised of two subtests: identification of rhyming words, rhyming production; **** comprised of 11 subtests: counting phonemes in words, auditory discrimination between words, blending phonemes, phoneme segmentation, phoneme isolation (beginning), phoneme isolation (final), phoneme isolation (medial), vowel matching, phoneme deletion, phoneme reversal; *****comprised of total of 3 phoneme isolation task scores

Appendix J

Table 3.3

Comparisons for Course Sequence (Simultaneous vs. Concurrent)

PA Assessment Category	Pretest Mann-Whitney U Test (significance)	Posttest Mann-Whitney U Test (significance)	Difference Pretest to Posttest Mann-Whitney U Test (significance)
Overall Phonological Awareness	.657	.545	1.000
Overall Syllable Awareness	.177	.351	.545
Overall Onset-Rime Awareness	.020	.657	1.000
Overall Phonemic Awareness	.657	.442	.778
Number of Words in Sentence	.904	.904	.238
Number of Syllables in Word	.545	1.000	.904
Identification of Rhyming Words	1.000	1.000	.075
Counting Phonemes in Words	.492	.545	.968
Auditory Discrimination between Words	.492	.600	.545
Blending Syllables	.238	.351	.351
Rhyming Production	.020	.657	.840
Blending Phonemes	.492	.545	.657
Phoneme Segmentation	.442	.778	.904
Phoneme Isolation (Beginning Phoneme)	.206	.545	.272
Phoneme Isolation (Final Phoneme)	.657	.840	.351
Phoneme Isolation (Medial Phoneme)	.657	1.000	.272
Overall Phoneme Isolation Score	.545	.600	.840
Vowel Matching	.351	.904	.545
Phoneme Deletion	.600	.351	.075
Phoneme Reversal	.717	.442	.840
Transcription Accuracy	Median Test (significance)		Mann Whitney U Test (significance)
Transcription Score (BBTOP-2 words)	.658		.395