Defining a Language and Early Literacy Domain for Assessment of Three-Year-Olds: Phonological Awareness

Technical Report #1

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Expanding Individual Growth & Development Indicators of Language and Early Literacy for Universal Screening in Multi-Tiered Systems of Support with Three-Year-Olds

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McConnell, Wackerle-Hollman and colleagues developed assessment tools and related resources known as *Individual Growth & Development Indicators,* described here. This intellectual property has been licensed by the Univesity of Minnesota to Early Learning Labs, Inc., and the authors and University have equity and/or royalty interests in ELL. These relationships have been reviewed and are being managed by the University of Minnesota in accordance with its conflict of interest policies.

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Abstract

This document presents results of that systematic review and proposed construct definition for one domain of interest – phonological awareness. This review of published and academic thesis research yielded 12 studies and 6 foundational articles with 22 empirical evaluations of PA performance in children under age 4. In general, these findings support and extend assumptions made prior to our detailed review: 3-year-old children can, with marked variability, perform PA tasks; onset of performance of these tasks generally emerges sequentially across rhyming, blending, alliteration, elision, and segmenting; performance within any "subarea" is evident in receptive tasks before expressive ones; and performance seems to move from analysis of larger units of words (e.g., compound words and syllables) to smaller units (e.g., phonemes). These findings suggest the likely utility of: a) more receptive than expressive tasks, although the latter may offer more "ceiling" in assessment; b) perhaps more emphasis on rhyming, blending, and alliteration for assessment of all children; and c) little evidence refuting, at least practically, "heterotypic" development and the overlapping performance of topographically distinct tasks.

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Project Introduction

This document has been developed as part of a four year (2016 – 2020) research and development project funded by the Institute of Education Sciences, *Expanding Individual Growth & Development Indicators of Language and Early Literacy for Universal Screening in Multi-Tiered Systems of Support with 3-Year-Olds*. The overarching purpose of this project is to is to extend the practical array of Individual Growth and Development Indicators for assessing language and early literacy development to 3-year-old preschool children in ways that inform and enhance multi-tiered systems of support, and to enrich current knowledge of the developmental course of language and early literacy development in this early preschool age group. Over the course of this project, we will develop and evaluate measures appropriate for 3-year-old children[1] in areas of oral language, phonological awareness, and alphabet knowledge, assess the psychometric characteristics of these measures (including their classification accuracy for identifying candidates for more intensive intervention) and use these measures to describe growth across time in PK3 and PK4 in ways that help describe the broader domain of language and early literacy development, and that note relations

[1] While we refer to 3-year-old children throughout this report, IGDIs are *not* age-normed nor intended to support inferences of age-based development. Rather, the focus here is development and evaluation of measures and data utilization tools that support assessment of language and early literacy skills that precede, developmentally, those measured by current IGDIs – and that, in broad terms, are likely to be developed by children more than one and less than two years prior to kindergarten entry – a "grade" we reference as PK3.

between achievement in this area and characteristics of services children receive in early childhood classrooms.

As a foundational step in preparing new items and measures for 3-year-olds in each domain, we will review existing construct definitions and confirm "construct maps" for later item writing, scaling, and validity testing. Construct maps are products of empirical research and theoretical analysis, and represent unidimensional latent variables, and the knowledge, skills, and abilities in concrete terms along this trait continuum (Messick, 1995; Wilson, 2005). IGDI developers have come to use these maps to provide *a priori* conceptual and semantic guidance to organize the selection, creation, and evaluation of individual measures (Wilson's "item response" and "outcome space") in ways that produce coherence (and, as a result, initial conditions for psychometric rigor) in resulting measures. In short, construct maps describe the behaviors to be sampled or the content to be assessed in a particular domain in ways that reflect theoretical and empirical foundations. To do this, construct maps are based on systematic review of theoretical, meta-analytic, and empirical work on one aspect of language and early literacy among young preschoolers.

Purpose of this Report

This document presents results of that systematic review and proposed construct definition for one domain of interest – phonological awareness. Phonological awareness (and related concepts) has been identified as a primary component of early literacy, encompassing a set of skills acquired before the onset of formal reading (i.e., the independent decoding, oral production, and comprehension of written text; National Early Literacy Panel [NELP], 2008).

While the intent of this review is to develop an operational definition of the construct of interest for 3-year-old children, in general terms phonological awareness (PA) can be described as an individual's ability to recognize, detect, and/or manipulate the sound structure of words independent of their meaning. In our earlier work (Wackerle-Hollman, Schmitt, Bradfield, Rodriguez, & McConnell, 2013), we adopted a definition of PA for preschoolers from Phillips, Clancy-Menchetti, & Lonigan (2008, p. 3): phonological awareness can be defined as "the ability to detect and manipulate the sound's structure of words independent from their meanings." In this review, we were interested in identifying those skills and competencies consistent with this general definition that particularly characterize the performance of children roughly 36 to 54 months of age.

Defining the scope of this review. Findings from research studies and reviews on phonological awareness development suggest both a distinction between "skills" and "abilities" in this area, and some characteristics of how development progresses. First, while some (Van Kleeck, Gillam, & McFadden, 1998) argue that phonological awareness is best conceptualized as a single or small set of abilities – stable cognitive characteristics that may or may not be affected by experience and learning – and others argue that these "constrained" skills are of little consequence instructionally (Paris, 2005), research in this area can be parsimoniously conceptualized as examination of specific behaviors that, at least on face, can be measured discretely and taught directly (e.g., alliteration, rhyming). As a result, phonological awareness can be – and in this paper is – conceptualized as a set of skills that, when used in combination with other language and early literacy skills, support early reading proficiency.

Similarly, a broad reading of research in this area suggests that these skills do not develop in a distinct, invariant sequence of discrete components. According to Chaney (1998), children are rapidly developing a structure for analyzing language structure starting as young as 3-years of age. A number of findings suggest that children acquire various phonological skills in overlapping stages rather than discrete stages (Anthony, Lonigan, Driscoll, Phillips, & Burgess, 2003; MacLean, Bryant, & Bradley, 1987; Cassano, 2013; Lonigan, Burgess, & Anthony, 2000).

In other words, development may be marked by gradual and overlapping acquisition of skills that are both topographically similar and dissimilar, rather than distinct onsets of ability. Anthony and colleagues (2003) have termed this “heterotypic development,” suggesting “quasi-parallel” progression of acquisition of skills that are empirically and functionally related to one another.

While the theoretical and empirical rationale for this heterotypic developmental model is still at preliminary level of development, its practical implications are clear. Over time and in ways that tend to be similar across individuals, children develop skills related to phonological awareness that precede more formal "reading," and assessment of these skills may in principle help describe a developmental path to reading that has instructional implications (McConnell & Wackerle-Hollman, 2016). Thus, the review presented here makes no effort to identify age-specific or theoretically distinct measures, but rather explores a broad range of child PA characteristics that develop in preschool, and that are expected to predict future reading performance.

Additionally, findings suggest that children become increasingly sensitive to smaller parts of words as they get older; for instance, children are able to detect syllables prior to detecting or manipulating onset rimes, and generally can perform tasks that

require discrimination and/or production of whole syllables and onset rimes both before they are able to manipulate individual phonemes (Anthony & Francis, 2005). Similar developmental patterns are observed in rhyming tasks—younger children are able to detect similar or dissimilar sounding words (e.g., does *cat* sound like *bat* or *tree*) whereas older children are able to produce similar sounding words (e.g., "bat, cat, that – what other words sound similar?"; Anthony & Francis, 2005). Additionally, Anthony and Francis (2005) found that children are able to blend phonological information (e.g., "what do the words "tooth," "brush" make if you put them together?") before they are able to segment or separate sounds (e.g., say the first sound in the word "pear"). As a result, we have organized our review to be attentive to variations in lexical complexity, or stimulus "size," as well as differences in reception and production and synthesis or analysis.

Also, existing studies indicate that detection of rhyme and alliteration are two of the earliest phonological awareness abilities to emerge, followed by blending of syllables and onset–rime, with segmentation skills emerging still later (Anthony & Francis, 2005; Anthony et al., 2003; Lonigan, Burgess, Anthony, & Barker, 1998; NELP, 2008). Our review will look to elaborate on, and possibly add some detail to, these earlier findings.

Finally, much of the PA literature published to date has included as participants children between the ages of four and six (e.g., Melby-Lervåg, Lyster, & Hulme, 2012). While some have argued that 3-year-olds' PA skills are not stable enough to act as a predictor of literacy success (Gillon, 2004), emerging evidence has provided contradictory evidence that PA develops gradually and is reliably discernible in children younger than 4 years (Anthony et al., 2003; Anthony & Francis, 2005). As a research team, the authors of this report are interested in identifying *as early as possible* children's skills that help direct intervention toward later successful reading; this interest must

support active exploration in areas that are still somewhat under-specified empirically. As a result, this technical report will report a review that includes participants as young as 2 years of age, and will selectively include samples of older children.

Method

A review of the literature and select graduate theses was conducted to include a search of references found in databases as well as selected focused searches. We searched an array of databases typically citing developmental and early education research, including Educational Resources Information Center (ERIC), PsycINFO, and Google Scholar. Further, searches of these databases were conducted using search terms compiled from relevant research (e.g., Lonigan et al., 1998; Anthony & Francis, 2005). In addition to searches of bibliographic databases, we completed select backward searches (i.e., ancestral searches of works cited within an article, and descendent searches of articles that have cited the articles) from Lonigan and colleagues (1998), and Anthony and Francis (2005), given the foundational character of these articles for research on young children's PA.

Search Procedures

When searching for literature, results were included that were (a) written in English; (b) scholarly, peer-reviewed empirical publications or theses; and (c) involving monolingual English speaking 3-year-old children with no identified disabilities. Bibliographic databases were queried using variants of 5 terms: *literacy, phonology, development, sensitivity,* and *awareness*; searches were also restricted to samples with 3-year-old children. Results were screened first by relevancy of the title by scanning the titles for combinations of identified keywords. Abstracts of selected articles were then reviewed for evidence of inclusion of 3-year-olds in study sample, and the discussion of

the development of PA. With the small pool of articles that were determined to be applicable through this process, the entire article was read and documented in a spreadsheet as relevant or not relevant.

Database searches were conducted on titles, abstracts, and full articles. Our initial search of PsychINFO and ERIC identified 23 articles meeting initial search criteria; only 1 of these articles was retained after reviewing abstracts more carefully. Searching these databases for "phonology* awareness and preschool or 3 year* old and English," yielded 151 results; 5 were retained after reviewing abstracts, and 2 of these were retained for review once the entire article was read. Searching for "phonolog* AND "three year olds" OR "3 year olds," produced 901 initial hits. Of these, 8 included relevant information in abstract, and only 1 was retained after reviewing the full text. In summary, search and review of electronic databases yielded 4 articles included in the current review.

Ancestral and descendent searches were performed for the identified foundational literature (i.e., Lonigan et al., 1998; Anthony & Francis, 2005). Additionally, backward searches were completed for all articles obtained during our search. Ancestral searches were completed by reviewing the references by title, abstract, and full text as necessary. Descendent searches were completed using the "cited by" function within Google Scholar. Of the 404 results found using Google Scholar "cited by", there were three articles that were cited in the Anthony and Francis article (2005) and 4 articles that cited the article that were examined based on the relevance of the title and abstract. Of these 7 articles, 3 were used based on the relative content. Three articles that were cited in the Lonigan et al. article (1998) and 8 that cited that article (of 32 with specifier "phonolog*") were examined. Of these 9 articles, 6 were included in this review.

Overall, this review includes information from 12 articles as found through this process and an additional 6 foundational articles: Anthony & Francis, 2005; Gillon, 2004; Lonigan et al., 1998; McConnell & Wackerle-Hollman, 2016; Phillips et al., 2008. See Table 1 for an overview of the articles included in the results and a summary of how PA was measured. In total, our search yielded 1,093 articles and publications in the initial pool. Screening of title and abstract for characteristics associated with our inclusionary criteria retained 30 of these references for further analysis. Closer analysis of content in full text of articles led to final retention of 19 published works or graduate theses. Ten of these articles measured PA through rhyming tasks, eight through alliteration, six through blending, five through elision, and four through segmenting (see Table 1). Of these articles, five reported results specific to 3-year-olds, while the remaining seven reported results for an age range that included 3-year-olds.

Results

This review is to identify research findings that illuminate the substantive features, skills, and measurement tasks that relate to PA for 3-year-old children. For initial screening, articles gathered from both the backward and database searches were reviewed first via title, then via abstract to determine inclusion status. Studies were reviewed in full text that either (a) discussed the development of PA; (b) discussed the relationship between PA and literacy development; or (c) involved the study of 3-year-olds' PA abilities. For a summary of obtained results across studies with 3-year-olds, including the behaviors measured see Table 1.

Our review suggests several broad themes that will be detailed in the sections that follow. Available research suggests that skills of 3-year-olds in phonological awareness “subareas” develop in overlapping fashion, with initial evidence of acquisition occurring

sequentially in rhyming, blending, alliteration, elision, and segmenting, (see Figure 1; MacLean et al., 1987; Cassano, 2013; Lonigan et al., 2000). These subareas of PA consistently reoccurred throughout the different articles identified as relevant. Further, children tend to develop the awareness of larger components (i.e., words) prior to understanding parts of words (i.e., syllables, followed by onset sounds/rimes, followed by phonemes) as shown in Figure 2 (Lonigan et al., 2000; Lonigan et al., 1998). Additionally, patterns with each of these skills became apparent—generally speaking, children were able to detect or complete receptive versions of tasks prior to developing the ability to express or produce responses (MacLean et al., 1987; Cassano, 2013).

With this in mind, we turn to review of observed child performance in each of 5 areas, including rhyming, alliteration and onset sounds, blending, elision, and segmenting. Studies reporting findings in each of these sections are summarized in Tables 2 through 6; studies that assessed more than one component of PA may be listed in multiple tables.

Rhyming

Our review identified seven published works and two unpublished theses that examined rhyming in 3-year-olds (see Table 2). These studies examined children's performance either *receptively* (e.g., presenting three words, *cat, hat, box*, and asking the child to identify the one that does not sound the same) and or *expressively* (e.g., presenting the child with a series of rhyming words, *cat, hat*, and *mat*, and asking the child to produce a word that "sounds the same").

Receptive rhyming. Across studies, relatively larger proportions of children were able to perform receptive rhyme or detection tasks. For instance, Cassano (2013) studied 20 three-year-old children from high socioeconomic backgrounds, asking participants

which word, given two options, rhymes with a stimulus word (e.g., "Does *nap* rhyme with *cap* or does *nap* rhyme with *bell*?"). Her investigation found 89% of the participants were able to complete at least one rhyme detection item, with an average accuracy rating of 4%. Lonigan and colleagues (2000) asked 3-year-olds to examine three named pictures and identify the one that did not rhyme; they found this to be the most reliable task for young children in their sample.

In comparison, Wackerle-Hollman, Schmitt, Bradfield, Rodriguez, and McConnell (2013) asked 47 children from economically diverse backgrounds between the ages of three years and five years eleven months to identify the picture, given three options, that sounds the same as four stimulus pictures. The paper reported 55% - 67% of children correctly completed at least one item across receptive rhyming tasks, although no information is available for 3-year-olds specifically (Wackerle-Hollman et al., 2013).

Average accuracy of receptive rhyming – variations on children identifying pictured words that rhyme, identifying one picture in an array that does not rhyme with others, or determining if words are rhymes or non-rhymes – has been reported between 31% to 61% across studies for children between the ages of two years and five years eleven months (see Table 2 for more information regarding the tasks and accuracy rates; Strang, & Piasta, 2016; Xu, Chin, Reed, & Hutchinson, 2014; Coursin, 2012; Chaney, 1998; Anthony et al., 2002). Lonigan and colleagues (1998) found that 14% of the 56 three-year-olds in their sample performed at a level above chance[2] when given three

[2] Several studies in our identified set report, on some measures, estimates of participants or responses that likely exceed chance responding. These are only calculated for receptive tasks where, typically, participants select one response from 2 or 3 provided responses. As a result, estimates of non-chance performance are interpreted here as evidence of skillful (versus random) responding by young children.

pictures and asked to identify the word that does not rhyme. Using the same type of task, MacLean and colleagues (1987) found that 21% of the 66 three-year-olds in their study responded at a rate higher than chance.

Expressive rhyming. Research results suggest that expressive rhyming (i.e., production of rhyming words) is less often performed successfully in younger samples. For instance, Cassano (2013) required participants to produce a word that rhymes with a stimulus word (e.g., "What rhymes with *cat*?"); she reported that none of the 3-year-olds in her study were able to correctly complete any expressive rhyming resulting in a mean accuracy rate of 0%. By contrast, MacLean and colleagues (1987) asked children to produce a word that rhymes with one stated by the researcher, and found that 41% of 3-year-olds were able to correctly complete at least one item out of 10 trials. We have limited information on the stimulus words provided by Cassano (2013) and MacLean and associates (1987), so no direct comparisons of these differing results can be offered. No studies to date have reported the accuracy or the percentage of 3-year-olds completing expressive rhymes at a level above chance.

A subset of studies used nursery rhyme awareness to assess expressive rhyming. According to MacLean and colleagues (1987), 97% of 3-year-olds knew at least part of nursery rhymes (i.e., "Humpty Dumpty," "Baa-baa Black Sheep," "Hickory Dickory Dock," "Jack and Jill," and "Twinkle Twinkle Little Star") when asked to recite each specific rhyme, with 1.5% of the 3-year-olds in their study knowing the entire rhyme. While not specific to 3-year-olds, average accuracy ratings for nursery rhyme awareness ranges between 47% and 69% for children between the ages of three and five years eleven months (see Table 2; Coursin, 2012; Xu et al., 2014). Again, no studies reported the percentage of responses at a level above chance.

Summary of rhyming studies. In summary, available investigations of rhyming in samples including children under the age of four indicate some evidence of receptive selection (or "detection") of rhyming words (Cassano, 2013; Wackerle-Hollman et al., 2013; Strang, & Piasta, 2016; Xu et al., 2014; Coursin, 2012; Chaney, 1998). Results are more inconsistent for children's production of rhymes given different prompts, with some more consistent results when young children are asked to produce parts of nursery rhymes (Cassano; MacLean et al., 1987; Coursin; Xu et al.).

Alliteration and Onset Sounds

Alliteration, or detection and operation of onset sounds in words, is typically assessed by asking children to detect or produce words with the same onset sound. Our review identified six published works and one unpublished thesis that examined alliteration performance or onset sound identification in 3-year-olds (see Table 3). These studies examined children's performance of alliteration in multiple ways: receptive alliteration tasks (e.g., presenting three words, *cat, car, ball*, and asking the child to identify the two that start with the same sound) and expressive alliteration (e.g., presenting the child with a series of words with the same onset sound, and asking the child to produce a word that starts the same way).

Receptive alliteration. Similar to rhyming, research evidence suggests some variability, but nonetheless evidence that 3-year-olds can identify under some conditions alliteration or similarities in onset sounds both receptively and expressively. Lonigan and colleagues (2000) asked 3-year-olds to identify a single word, out of three presented, that started with a different sound. They reported relatively strong performance, compared to other PA tasks, for young children in their sample. Wackerle-Hollman and colleagues (2013) presented and labeled photographs of one target word (e.g., "fish") and three

choices (e.g., “truck,” “dog,” “fire”), then asked the child to identify the single choice that started with the same onset rime as the target word. Results indicated that 53% - 58% of the participants across the age range studied were able to complete at least one receptive alliteration item.

MacLean and colleagues (1987) found that more than half of 3-year-olds in their study were able to respond accurately to at least one alliteration detection item given three pictures and asked to identify the word that does not start the same way, with 36% accurately detecting alliteration at a level above chance. By contrast, Lonigan and colleagues (1998) found that only 8.9% of 3-year-olds scored above chance when completing the same receptive alliteration task.

Average accuracy of receptive alliteration has been reported between 31% to 58% across studies for children between the ages of two years and five years eleven months (see Table 3 for more information regarding the tasks and accuracy rates; Strang, & Piasta, 2016; Xu et al., 2014; Coursin, 2012; Chaney, 1998).

Expressive alliteration. Research for expressive alliteration and 3-year-olds is limited; our search found only one study (MacLean et al., 1987) that evaluated production of alliterative words among young preschoolers. While evidence is scant, it appears that 3-year-olds do not commonly do this; when MacLean and colleagues asked children to say a word that started with the same sound as a verbal stimulus, there were not any 3-year-olds who could produce responses at a level above chance and only 35% of participants were able to produce acceptable alliterations for at least once.

Summary of alliteration assessments. Available investigations of alliteration in samples including children under the age of four indicate some evidence of receptive selection (or “detection”) of alliteration or onset sound awareness (Wackerle-Hollman et

al., 2013; Strang, & Piasta, 2016; Xu et al., 2014; Coursin, 2012; Chaney, 1998). Results are limited for children's rhyming production performance (MacLean et al., 1987).

Blending

Blending is the task of synthesizing phonological elements – words, syllables, or phonemes – into complete word units. Our review identified five published works and one unpublished thesis that examined blending performance in 3-year-olds (see Table 4). These studies examined the ability to combine word elements at the word level (e.g. presenting the words "cow" and "boy" and asking participants to say them together), syllable level (e.g. asking participants to blend the syllables "so" and "fa"), and phoneme level (e.g. presenting the phonemes /d/ and /go/ and asking participants to blend) . To date, all available studies assess blending expressively – that is, children are presented phonological elements and asked to "say the word the right way" (i.e., to combine word elements to form the target word). Across studies, results varied in the proportion of children who were able to complete tasks at the word, syllable, and phoneme level.

Three-year-olds were able to complete a higher proportion of tasks blending at the word level than at syllable or blending level (Anthony et al., 2002, 2003; Lonigan et al., 1998; Lonigan et al., 2000). The 1998 study by Lonigan and colleagues found that 39% of middle-income 3-year-olds and 25% of low-income 3-year-olds could accurately blend at the word level. Lonigan and colleagues (2000) found that the proportion of 3-year-olds who could complete blending tasks was highest for word-level blending, followed by syllable-level then phoneme-level blending. Anthony and colleagues (2003) found that 43% of 947 children between the ages of two and six years could blend non-pictured items at the word-level. In comparison, a study of 47 children from economically diverse backgrounds between the ages of three years and five years eleven months reported 43%

of children correctly completed at least one item across blending tasks at the word, syllable, and phoneme levels (Wackerle-Hollman et al., 2013).

While base rates of successful performance vary somewhat across available studies, findings generally suggest that blending at the syllable level is somewhat common in children as young as three, and that such blending is more likely when children are presented picture cues to scaffold their performance (e.g. "Point to the picture showing /flow/ /er/; Anthony et al., 2002; Lonigan et al., 1998; Lonigan et al., 2000). Similarly, reasonable proportions of young children (20 – 84% of 3-year-olds) complete blends of onset sounds and rimes (e.g. "point to the picture showing /f/ /ish/; Anthony et al., 2003; Cassano, 2013).

Across studies, blending at the phoneme-level is the most difficult (Lonigan et al., 1998; Lonigan et al., 2000; Anthony et al., 2003). Lonigan and colleagues (1998) found that 21% of middle-income 3-year-olds and 7% of low-income 3-year-olds could accurately blend at the phoneme level. Anthony and colleagues (2003) found an average accuracy rate of 8% when blending at the phoneme level for non-pictured items (i.e., the same task described above without pictures) for children between the ages of two and six years of age. In two studies, performance rates are somewhat higher: Anthony and colleagues (2002) found the mean percent correct of 34% when blending phonemes, and Cassano (2013) found that 37% of 3-year-olds could complete at least one phoneme blending item with an average accuracy rate of 24% *across all 3-year-old participants*.

These studies showed a mixed result of progression of blending skills. Lonigan and colleagues (1998; 2000) found that word-blending skills developed first, followed by syllables, and finally by phonemes. However, results from Anthony and colleagues (2002; 2003) reported that this might not be the case, and actually had word-blending as

the most difficult task in the 2002 study and syllables as the easiest in both the 2002 and 2003 studies. Blending tasks are presented both orally for production (e.g., “Say /cow/ /boy”) and with picture prompts (e.g., “Point to the picture of the /cow/ /boy”).

Elision

Elision tasks, or removing phonological elements of a word, measure the ability to detect or produce different levels of phonology. Our review identified five published works that examined elision performance in 3-year-olds (see Table 5). Studies examined children’s performance of elision at the word level (e.g., presenting the word "cowboy," and asking the participant to take away "boy"), at the syllable level (e.g., presenting the word "panda," and asking the participant to take away "da"), at the onset sound level (e.g., presenting the word "things," and asking the participant to say the word without "/th/"), and at the phoneme level (e.g., presenting the word "coat," and asking the participant to say it without the "/t/"). All available studies have measured elision productively; that is, children are presented a target word, an element to elide, and then asked to produce the resulting word or sound.

Word-level elision. A higher proportion of 3-year-olds were able to complete word-level elision tasks than those at a syllable level followed by phoneme level (Lonigan et al., 2000). Lonigan and colleagues (1998) found that 39% of middle income 3-year-olds and 42% of low income participants from their study could accurately complete word-level elision (with picture prompts – e.g., pictures of a cow and a boy) at levels above chance. Anthony and colleagues (2003) found that an average accuracy rate of 35% for non-pictured items (i.e., the same task described above without pictures) from the 947 children between the ages of two and six years of age in their sample. Using the

same word-level elision task, 109 children between the ages of two years three months and three years eleven months had an average accuracy of 12% (Anthony et al., 2002).

Syllable-level elision. Cassano (2013) found that 68% of 3-year-olds could complete at least one syllable-level elision task item, with an average accuracy rating across participants and items of 4%. Lonigan and colleagues (1998) found that 20% of middle income 3-year-olds and 4% of low income participants from their study could accurately complete syllable level elision items above chance. Anthony and colleagues (2003) found that an average accuracy rate of 75% using similar items, and 30% accuracy for non-pictured items (i.e., the same task described above without pictures) for children between the ages of two and six years of age. Using the same non-pictured syllable-level elision task, participants between the ages of two years three months and three years eleven months had an average accuracy of 25% (Anthony et al., 2002).

Onset-sound-level elision. Research on elision at the onset sound level is limited compared to elision at the word, syllable, or phoneme level. Anthony and colleagues (2003) found that an average accuracy rate of 58% using onset sound pictured elision items (e.g., children were shown three pictures and then asked to say /heat/ without the /h/), and 5% accuracy for non-pictured items for children between the ages of two and six years of age. Using the same non pictured onset sound level elision task, participants between the ages of two years three months and three years eleven months had an average accuracy of 28% (Anthony et al., 2002).

Phoneme-level elision. Cassano (2013) reported 42% of 3-year-olds could complete at least one phoneme-level elision item, with an average accuracy rate of 2%. Lonigan and colleagues (1998) found that 11% of middle-income 3-year-olds and 4% of

lower-income peers could perform elision tasks at the phoneme level above levels associated with chance responding.

Summary of elision assessments. In summary, when studying elision across children between the ages of two and six, children generally scored higher when given multiple-choice options as compared to tasks without pictures or options (e.g., Anthony et al., 2002). Additionally, children are able to elide most often at the word level, followed by elision of syllables, onset rimes, and individual phonemes (Anthony et al., 2003). However, when looking specifically at children between the ages of two and three, these results varied: scores were highest for elision of onset-rimes, followed by syllables, then phonemes, with words scoring the lowest (Anthony et al., 2002).

Segmenting

Segmenting tasks examine the ability to separate words into syllables or phonemes. Our review identified three published works and one thesis that examined segmenting performance in 3-year-olds (see Table 6). Studies examined children's performance of segmenting in multiple ways: segmenting at the word level (e.g., breaking sentences into words), segmenting at the syllable level (e.g., presenting the word "panda," and asking the participant to break into "pan" and "da"), and segmenting at the phoneme level (e.g., presenting the word "cat," and asking the participant to break it into "/k/," "/a/," and "/t/"). All available studies have measured segmenting productively; that is, children are presented a target word, a level to separate, and then asked to produce the resulting word or sound.

Sentence-level segmenting. In a study conducted by Fox and Routh (1975), three-year-olds were asked to repeat the first word of a sentence presented orally (i.e., "say the first word in the sentence "He fell."). While removing sounds aligns to elision as

operationally defined, it was presented as a segmenting task and therefore reported in the current section. Three-year-olds identified first words in sentences with 66% accuracy. MacLean and colleagues (1987) used the same task as Fox and Routh and found a mean accuracy of 38% at the word level for 3-year-olds.

Syllable-level segmenting. In the study conducted by Cassano (2013), children were asked to clap or count the syllables in words; about half of 3-year-olds were able to complete at least one syllable-level segmenting item, with an average accuracy rating of 1% across participants. In comparison, 62% of 3 to 5-year-olds were able to complete at least one syllable level segmenting item in a study conducted by Wackerle-Hollman and colleagues (2013). In this study, children were asked to correctly clap the syllable pattern of words that were presented verbally. Fox and Routh (1975) asked 3-year-olds had to say the first syllable of a word presented verbally. Across participants, children averaged 42% correct for segmenting at the syllable level. In comparison, MacLean and colleagues (1987) found an average accuracy of 16% using the same syllable level task.

Onset-sound and phoneme-level segmenting. Segmenting at the phoneme level, 3-year-olds had an average score of 25% correct when asked to say the first phoneme in a word (Fox & Routh; 1975). Using the same task, MacLean and colleagues (1987) reported a mean accuracy rate of 8% with 17% of 3-year-olds accurately responded to at least one phoneme-level task item. In comparison, Cassano (2013) found that none of the 3-year-olds were able to accurately complete any onset-sound or phoneme-level segmenting resulting in average accuracy ratings of 0% when asked to say sounds that make up specific words.

Segmenting summary. In summary, segmenting tasks reflect increased performance across lexical complexity throughout early childhood, allowing children to

identify or break down larger units (i.e., words in sentences) prior to smaller units (i.e., phonemes in words). Three-year-olds can successfully segment sentences into words at a level above chance (Fox & Routh, 1975). While results suggest that 3-year-olds are able to segment words into syllables on some occasions, it is not consistently at a level above chance (Cassano, 2013; Fox & Routh, 1975; MacLean et al., 1987; Wackerle-Holman et al., 2013). However, it appears that segmenting words to syllables develops rapidly across 3-year-olds, resulting in nearly 100% accuracy by 4 years of age (Fox & Routh, 1975). Findings were inconsistent for phoneme segmentation across studies for 3-year-olds; in general, findings suggest that 3-year-olds can segment words in sentences and syllables in words, but few can segment at the phoneme level regardless of the specific form of the phoneme segmentation task. Highest success rates were reported by Fox and Routh (1975)—it is possible that the sentence segmentation task primed children, better enabling them for further segmenting tasks.

Discussion

This review of published and academic thesis research yielded 12 studies and 6 foundational articles with 22 empirical evaluations of PA performance in children under age 4. In general, these findings support and extend assumptions made prior to our detailed review: Three-year-old children can, with marked variability, perform PA tasks; onset of performance of these tasks generally emerges sequentially across rhyming, blending, alliteration, elision, and segmenting; performance within any "subarea" is evident in receptive tasks before expressive ones; and performance seems to move from analysis of larger units of words (e.g., compound words and syllables) to smaller units (e.g., phonemes).

Figure 1 provides a heuristic representation of these effects. While typical ages of onset for performance in any one subarea are not known nor relevant to the current review, evidence that all five areas are performed (sometimes at low base rates) by 3-year-olds is noted. Further, evidence that receptive performance is evident before expressive performance, within and across tasks, is significant.

Given the plan to produce multi-item samples of child performance in the broad domain of PA for 3-year-olds, these findings suggest the likely utility of: a) more receptive than expressive tasks, although the latter may offer more "ceiling" in assessment; b) perhaps more emphasis on rhyming, blending, and alliteration for assessment of all children; and c) little evidence refuting, at least practically, "heterotypic" development and the overlapping performance of topographically distinct tasks.

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Figure 1. Pathway of PA skill acquisition. This figure shows the overlapping sequence of PA task development throughout early childhood.

Note. Arrows in this figure broadly describe the sequence with which performance of skills are demonstrated. Two sided arrow heads suggest development that occurs before and after depicted ranges, based on reviewed literature.

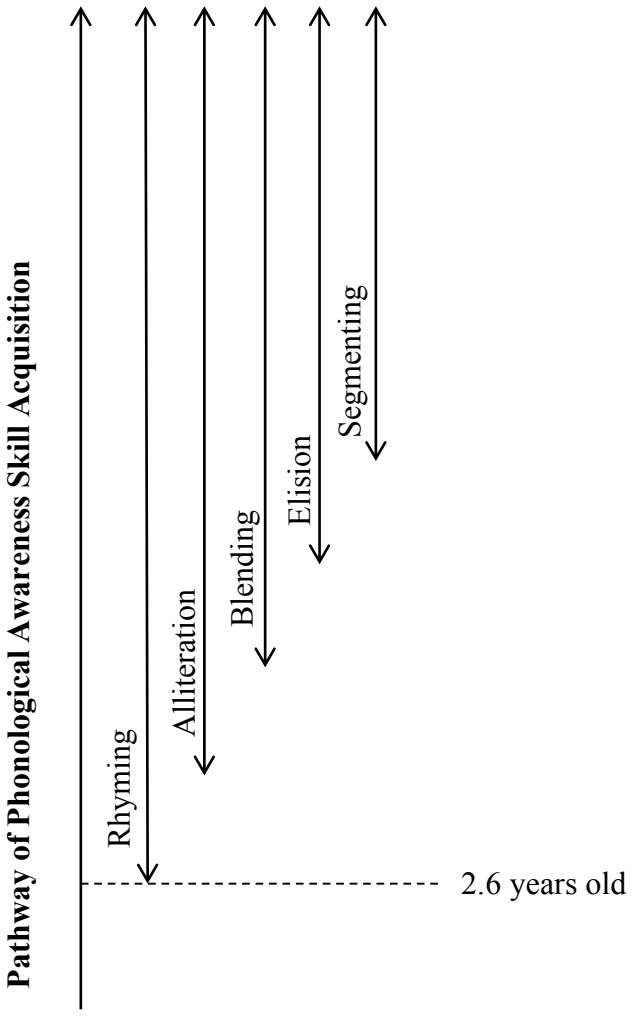

Figure 2. Pathway of lexical complexity. This figure shows the overlapping development of awareness of parts of words throughout early childhood, and describes patterns of acquisition in some PA skills – specifically, Blending, Elision, and Segmenting.

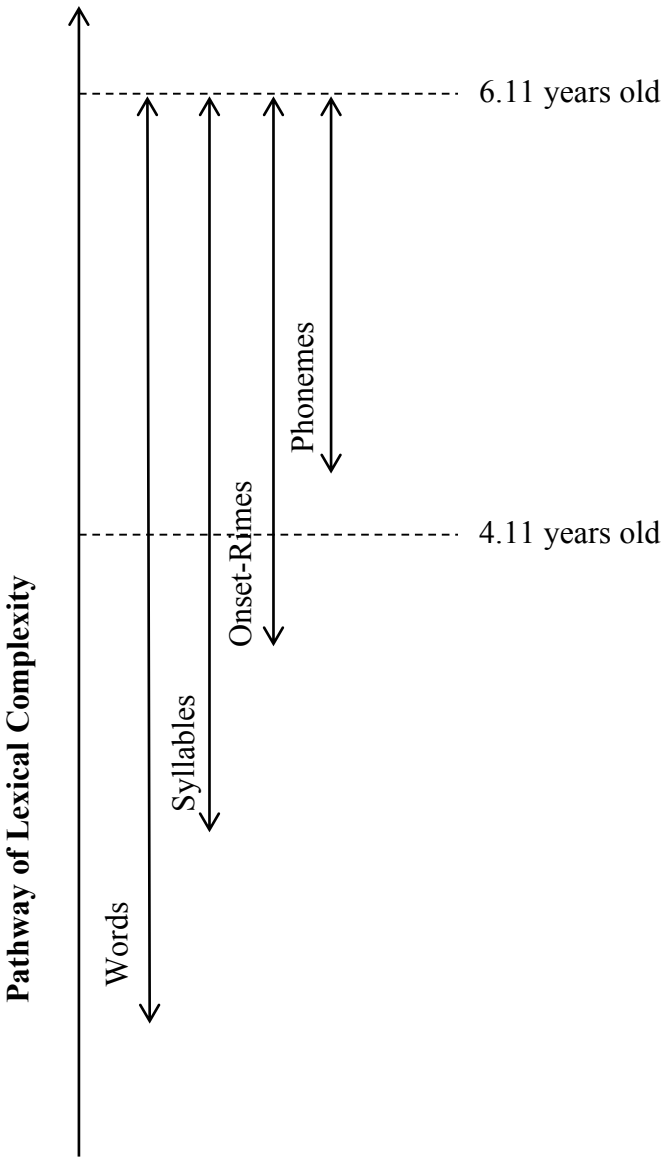

Table 1. Summary of literature involving the study of 3-year-olds' phonological awareness.

Source	Rhyming	Alliteration	Blending	Elision	Segmenting
Anthony, Lonigan, Burgess, Driscoll, Phillips, & Cantor (2002)	x	-	x	x	-
Anthony, Lonigan, Driscoll, Phillips, & Burgess (2003)	-	-	x	x	-
Cassano (2013)	x	-	x	x	x
Chaney (1998)	x	x	-	-	-
Coursin (2012)	x	x	-	-	-
Fox, & Routh (1975)	-	-	-	-	x
Lonigan, Burgess, Anthony, & Barker (1998)	x	x	x	x	-
Lonigan, Burgess, & Anthony (2000)	x	x	x	x	-
MacLean, Bryant, & Bradley (1987)	x	x	-	-	x
Strang, & Piasta (2016)	x	x	-	-	-
Wackerle-Holman, Schmitt, Bradfield, Rodriguez, & McConnell (2013)	x	x	x	-	x
Xu, Chin, Reed, & Hutchinson (2014)	x	x	-	-	-

Table 2. Summary of literature involving the study of 3-year-olds' rhyming.

Source	Age	Behaviors Measured	Corresponding Tasks	Results
Receptive Rhyming				
Anthony, Lonigan, Burgess, Driscoll, Phillips, & Cantor (2002)	2.3 – 3.11 year olds	Rhyme Oddity	Given 3 pictured words, the child is asked to pick out the word that does not rhyme	Average accuracy rating of 39%
		Rhyme Matching	Given 2 options, the child was asked which rhymed with the pictured stimulus word	Average accuracy rating of 53%
Cassano (2013)	3 year olds	Rhyme Detection	Given 2 options, the child was asked which rhymed with the stimulus word	Average accuracy rating of 4%
				89% gave at least one correct response
Chaney (1998)	3 year olds	Rhymes	Children were asked to judge words as rhymes or non-rhymes	Average accuracy rating of 61%
Coursin (2012)	2.10 – 4.11 year olds	Rhyme Awareness (PALS)	Given 3 pictured words, the child is asked to pick out the word that rhymes with the pictured stimulus	Average accuracy rating of 54%
Lonigan, Burgess, Anthony, & Barker (1998)	3 year olds	Rhyme Oddity Detection	Given 3 pictured words, the child is asked to pick out the word that does not rhyme	Middle-income: 14.3% above chance
				Lower-income: 13.3% above chance
Lonigan, Burgess, & Anthony (2000)	3 year olds	Rhyme Oddity Detection	Given 3 pictures, the child is asked to pick the word that does not rhyme	Strongest measure of PA based on the ratio of mean score to standard deviation
MacLean, Bryant, & Bradley (1987)	3 year olds	Detection of Rhyme	Given 3 pictures, the child is asked to pick out the word that does not rhyme	21% performed significantly above chance

		Forced-Choice Rhyme	Uses a puppet who likes words that sound the same as his name. Children were given two words and have to choose the word that sounds the same as the puppet's name	23% performed significantly above chance; Not a viable task for 3-year-olds
Strang, & Piasta (2016)	2.6 – 5.1 year olds	Rhyming	Given a stimulus word with corresponding picture, children were asked to identify the picture that sounded the same	Average accuracy rating of 31%
Wackerle-Holman, Schmitt, Bradfield, Rodriguez, & McConnell (2013)	3.0 – 5.11 year olds	Rhyming	Given three options, the child is asked to identify the picture that sounds the same as the four stimulus pictures	55% – 67% of children correctly completed at least one item
Xu, Chin, Reed, & Hutchinson (2014)	3 – 4 year olds	Rhyme Awareness (PALS)	Given 3 pictured words, the child is asked to pick out the word that rhymes with the pictured stimulus	Average accuracy rate of 46%
Expressive Rhyming				
Cassano (2013)	3 year olds	Rhyme Production	Asked children to produce a word that rhymes with a stimulus word	Average accuracy rating of 0%
				0% gave at least one correct response
Coursin (2012)	2.10 – 4.11 year olds	Nursery Rhyme Awareness (PALS)	After hearing a nursery rhyme, a child is asked to fill in missing words from the same rhyme	Average accuracy rating of 47%
MacLean, Bryant, & Bradley (1987)	3 year olds	Knowledge of Nursery Rhymes	"Can you say (e.g., Humpty-Dumpty)?"	1.5% knew none 97% knew some 1.5% knew all
		Rhyme production	Child asked to provide a word that rhymes with the word the experimenter said	42% gave at least one correct response
Xu, Chin, Reed, & Hutchinson (2014)	3 – 4 year olds	Nursery Rhyme Awareness (PALS)	After hearing a nursery rhyme, a child is asked to fill in missing words from the same rhyme	Average accuracy rating of 69%

Table 3. Summary of literature involving the study of 3-year-olds' alliteration.

Source	Age	Behaviors Measured	Corresponding Tasks	Results
Receptive Alliteration				
Chaney (1998)	3 year olds	Initial Sounds	Children were asked to judge words as having the same beginning sound or not	Average accuracy rating of 58%
Coursin (2012)	2.10 – 4.11 year olds	Beginning Sound Awareness (PALS)	Children are asked to say the beginning sound of pictured words and sort them based on their onset-sounds	Average accuracy rating of 44%
Lonigan, Burgess, Anthony, & Barker (1998)	3 year olds	Alliteration Oddity Detection	Given 3 pictures, the child is asked to pick the word that does not start the same way	Both middle- and lower-income samples had 9% score above chance
Lonigan, Burgess, & Anthony (2000)	3 year olds	Alliteration Oddity Detection	Given 3 pictures, the child is asked to pick out the word that does not start with the same sound	Second strongest measure of PA based on the ratio of mean score to standard deviation
MacLean, Bryant, & Bradley (1987)	3 year olds	Detection of Alliteration	Given 3 pictures, the child is asked to pick the word that does not start the same way	36% performed significantly above chance
Strang, & Piasta (2016)	2.6 – 5.1 year olds	Alliteration	Given a stimulus word with corresponding picture, children were asked to identify the picture that starts with the same sound	Average accuracy rating of 18%
Wackerle-Holman, Schmitt, Bradfield, Rodriguez, & McConnell (2013)	3.0 – 5.11 year olds	Alliteration	Given three options, the child is asked to identify the picture that starts the same as the stimulus picture	53% – 58% of children correctly completed at least one item
Xu, Chin, Reed, & Hutchinson (2014)	3 – 4 year olds	Beginning Sound Awareness (PALS)	Children are asked to say the beginning sound of pictured words and sort them based on their onset-sounds	Average accuracy rate of 50%

Expressive Alliteration				
MacLean, Bryant, & Bradley (1987)	3 year olds	Alliteration Production	Child asked to provide a word that starts with the same sound as one the experimenter said	35% gave at least one correct response

Table 4. Summary of literature involving the study of 3-year-olds' blending.

Source	Age	Behaviors Measured	Corresponding Tasks	Results
Word-Level Blending				
Anthony, Lonigan, Burgess, Driscoll, Phillips, & Cantor (2002)	2.3 – 3.11 year olds	Blending	Children were asked to combine single-syllable words to create compound words	Average accuracy rating of 23%
Anthony, Lonigan, Driscoll, Phillips, & Burgess (2003)	2.0 – 6.0 year olds	Blending Non-Pictured Words	Using a puppet, the child hears sounds of a word and is asked to say what the puppet is trying to say	Average accuracy rating of 43%
Lonigan, Burgess, Anthony, & Barker (1998)	3 year olds	Blending	Children were asked to combine word elements to form new word given pictures, then repeated with and without pictures for blending syllables and phonemes	39% of middle-income students scored above chance
				24% of lower-income students scored above chance
Lonigan, Burgess, & Anthony (2000)	3 year olds	Blending	Given 2 or more sounds, the child is asked to say the full word that is made up of those sounds	Second weakest measure of PA based on the ratio of mean score to standard deviation
Wackerle-Holman, Schmitt, Bradfield, Rodriguez, & McConnell (2013)	3.0 – 5.11 year olds	Blending	Children were asked to blend word segments at a word, syllable, and phoneme level	43% of children correctly completed at least one item
Syllable-Level Blending				
Anthony, Lonigan, Burgess, Driscoll, Phillips, & Cantor (2002)	2.3 – 3.11 year olds	Blending	Using a puppet, the child hears sounds of a word and is asked to say what the puppet is trying to say	Average accuracy rating of 56%
Anthony, Lonigan, Driscoll, Phillips, & Burgess (2003)	2.0 – 6.0 year olds	Blending Non-Pictured Words	Using a puppet, the child hears sounds of a word and is asked to say what the puppet is trying to say	Average accuracy rating of 53%
		Blending Multiple Choice	The child is asked to point to the picture showing the word that represents the sounds being said	Average accuracy rating of 88%

Source	Age	Behaviors Measured	Corresponding Tasks	Results
Cassano (2013)	3 year olds	Blending	Not detailed in text	Average accuracy rating of 13%
				100% gave at least one correct response
Lonigan, Burgess, Anthony, & Barker (1998)	3 year olds	Blending	Children were asked to combine word elements to form new word given pictures, then repeated with and without pictures for blending syllables and phonemes	25% of middle-income students scored above chance
				7% of lower-income students scored above chance
Onset-Rime-Level Blending				
Anthony, Lonigan, Driscoll, Phillips, & Burgess (2003)	2.0 – 6.0 year olds	Blending Multiple Choice	The child is asked to point to the picture showing the word that represents the sounds being said	Average accuracy rating of 20%
Cassano (2013)	3 year olds	Blending	Not detailed in text	Average accuracy rating of 15%
				84% gave at least one correct response
Phoneme-Level Blending				
Anthony, Lonigan, Burgess, Driscoll, Phillips, & Cantor (2002)	2.3 – 3.11 year olds	Blending	Using a puppet, the child hears sounds of a word and is asked to say what the puppet is trying to say	Average accuracy rating of 34%
Anthony, Lonigan, Driscoll, Phillips, & Burgess (2003)	2.0 – 6.0 year olds	Blending Non-Pictured Words	Using a puppet, the child hears sounds of a word and is asked to say what the puppet is trying to say	Average accuracy rating of 8%
Cassano (2013)	3 year olds	Blending	Not detailed in text	Average accuracy rating of 24%
				37% gave at least one correct response
Lonigan, Burgess, Anthony, & Barker (1998)	3 year olds	Blending	Children were asked to combine word elements to form new word given pictures, then repeated with and without pictures for blending syllables and phonemes	21% of middle-income students scored above chance
				7% of lower-income students

Source	Age	Behaviors Measured	Corresponding Tasks	Results
				scored above chance

Table 5. Summary of literature involving the study of 3-year-olds' elision.

Source	Age	Behaviors Measured	Corresponding Tasks	Results
Word-Level Elision				
Anthony, Lonigan, Burgess, Driscoll, Phillips, & Cantor (2002)	2.3 – 3.11 year olds	Elision	Without using a pictures, the child is asked to say part of a word	Average accuracy rating of 12%
Anthony, Lonigan, Driscoll, Phillips, & Burgess (2003)	2.0 – 6.0 year olds	Elision Non-Pictured Words	Without using a pictures, the child is asked to say part of a word	Average accuracy rating of 35%
Lonigan, Burgess, Anthony, & Barker (1998)	3 year olds	Elision	Children were asked to say a word minus a specific sound using pictures	39% of middle-income students scored above chance
				42% of lower-income students scored above chance
Lonigan, Burgess, & Anthony (2000)	3 year olds	Elision	Children are asked to say a word without a specific sound with and without pictures	Weakest measure of PA based on the ratio of mean score to standard deviation
Syllable-Level Elision				
Anthony, Lonigan, Burgess, Driscoll, Phillips, & Cantor (2002)	2.3 – 3.11 year olds	Elision	Without using a pictures, the child is asked to say part of a word	Average accuracy rating of 25%
Anthony, Lonigan, Driscoll, Phillips, & Burgess (2003)	2.0 – 6.0 year olds	Elision Non-Pictured Words	Without using a pictures, the child is asked to say part of a word	Average accuracy rating of 30%
		Elision Multiple Choice	The child is asked to point to the picture showing a specified part of a stimulus word using pictures	Average accuracy rating of 75%
Cassano (2013)	3 year olds	Elision	Not detailed in text	Average accuracy rating of 4%
				68% gave at least one correct response
Lonigan, Burgess, Anthony, & Barker (1998)	3 year olds	Elision	Children were asked to say a word minus a	20% of middle-income students scored above chance

			specific sound using pictures	4% of lower-income students scored above chance
Onset-Rime-Level Elision				
Anthony, Lonigan, Burgess, Driscoll, Phillips, & Cantor (2002)	2.3 – 3.11 year olds	Elision	Without using a pictures, the child is asked to say part of a word	Average accuracy rating of 28%
Anthony, Lonigan, Driscoll, Phillips, & Burgess (2003)	2.0 – 6.0 year olds	Elision Non-Pictured Words	Without using a pictures, the child is asked to say part of a word	Average accuracy rating of 5%
		Elision Multiple Choice	The child is asked to point to the picture showing a specified part of a stimulus word using pictures	Average accuracy rating of 58%
Phoneme-Level Elision				
Anthony, Lonigan, Burgess, Driscoll, Phillips, & Cantor (2002)	2.3 – 3.11 year olds	Elision	Without using a pictures, the child is asked to say part of a word	Average accuracy rating of 20%
Anthony, Lonigan, Driscoll, Phillips, & Burgess (2003)	2.0 – 6.0 year olds	Elision Non-Pictured Words	Without using a pictures, the child is asked to say part of a word	Average accuracy rating of 13%
		Elision Multiple Choice	The child is asked to point to the picture showing a specified part of a stimulus word using pictures	Average accuracy rating of 37%
Cassano (2013)	3 year olds	Elision	Not detailed in text	Average accuracy rating of 2%
				42% gave at least one correct response
Lonigan, Burgess, Anthony, & Barker (1998)	3 year olds	Elision	Children were asked to say a word minus a specific sound using pictures	11% of middle-income students scored above chance
				4% of lower-income students scored above chance

Table 6. Summary of literature involving the study of 3-year-olds' segmenting.

Source	Age	Behaviors Measured	Corresponding Tasks	Results
Sentence-Level Segmenting				
Fox, & Routh (1975)	3 year olds	Segmenting	Children were asked to say the first word of a sentence	Average accuracy rating of 66%
MacLean, Bryant, & Bradley (1987)	3 year olds	Segmenting	Children were asked to say the first word of a sentence	Average accuracy rating of 38%
Syllable-Level Segmenting				
Cassano (2013)	3 year olds	Segmenting	Children were asked to clap or count syllables in words	Average accuracy rating of 1% 47% gave at least one correct response
Fox, & Routh (1975)	3 year olds	Segmenting	Children were asked to say the first syllable of a word	Average accuracy rating of 42%
MacLean, Bryant, & Bradley (1987)	3 year olds	Segmenting	Children were asked to say the first syllable of a word	Average accuracy rating of 16%
Wackerle-Holman, Schmitt, Bradfield, Rodriguez, & McConnell (2013)	3.0 – 5.11 year olds	Segmenting	Children were asked to clap the syllable pattern of words that were presented verbally.	62% of children correctly completed at least one item
Onset-Rime-Level Segmenting				
Cassano (2013)	3 year olds	Segmenting	Verbally say parts of words (as broken into onset sound and end rimes)	Average accuracy rating of 0% 0% gave at least one correct response
Phoneme-Level Segmenting				
Cassano (2013)	3 year olds	Segmenting	Verbally say parts of words (as broken into phonemes)	Average accuracy rating of 0% 0% gave at least one correct response
Fox, & Routh (1975)	3 year olds	Segmenting	Children were asked to say the first phoneme of a word	Average accuracy rating of 25%
MacLean, Bryant, & Bradley (1987)	3 year olds	Segmenting	Children were asked to say the first phoneme of a word	Average accuracy rating of 8% 17% gave at least one correct response