Exploring Learning Potentials of Late Talking Children Through a Structured Dynamic Assessment

By

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Abstract

Late talking children have variable language trajectories. Some spontaneously "catch up" with their peers before early school age and some late talking children are later diagnosed with specific language impairments. Currently, there is no way to conclusively predict later language development. Since all of these children score low on static measures of expressive language, it is likely that a dynamic assessment can expose these children's learning potential, modifiability and readiness to learn. The goal of this research is to construct a preliminary dynamic assessment to identify cues that aid in word learning for late talking children and younger vocabulary-matched typically developing children.

Ten 12-18-month-old typically developing children and three 20-30-month-old late talking children who were receiving speech-language pathology services were included in this dynamic assessment. Children were taught four words that varied in phonotactic probability (i.e., the likelihood of occurrence of a sound sequence), neighborhood density (i.e., the number of similar sounding words), and receptive knowledge. Four levels of support were presented to the children (e.g., no support, auditory semantic and phonological cues, visual semantic and phonological cues, and naming/imitation). The children were tested and scored at the end of all the exposures to see if they could name the target object. It was found that both groups produced the same patterns of word learning when given the scaffold of supports. Furthermore, both groups needed more support for words they had no receptive knowledge of than words of which they had previous knowledge, especially for words with low phonotactic probability/neighborhood density. Lastly, auditory phonological and visual semantic cues were more effective than auditory semantic and visual phonological cues for both groups. Taken together, this

dynamic assessment shows promise in assessing word learning abilities of toddlers but requires further investigation to determine its effectiveness in differentiating toddlers who will continue to have language learning difficulties from those that will not.

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Contents

Introduction

Late talkers are characterized as children who are not producing at least 50 words or two-word combinations by 24 months of age without any other cognitive, hearing, social, and physical disorders. About 15% of toddlers have delayed expressive language development without other existing delays or disorders, classifying them as late talkers (Rescorla, 1989). Currently, research has shown that the trajectory of language development in this population is particularly variable. Some late talkers will ultimately "catch up" with their peers but continue to perform on the low-average level, whereas other late talkers will continue to have life-long learning disabilities. To illustrate, in a study done through the Australian Bureau of Statistics (2006) by Reilly et al. (2010), researchers followed the language trajectory of 215 late talkers from age 2 to 4-years-old. From the sample of 215 children characterized as late talkers, 37.7% of the children were identified as Specific Language Impairment (SLI) by age 4. Within this 37.7% there were variable diagnoses of SLI: 12.6% identified as having expressive SLI, 9.3% identified with receptive SLI and 15.8% identified with mixed expressive-receptive SLI. Of the sample 62.3% of the children resolved and had no evidence of SLI or any characteristic delays at 4 years of age. Due to the variability in outcome, it is important to be able to predict which children will improve and which will have continued language deficits. There are a variety of risk factors that may be useful in solving this clinical conundrum. Potential predictors include: genetic/familial risk, child's phonology, receptive word knowledge, gesture and word learning.

Outcome predictors for late talkers. Family history of language impairments is considered a contributing risk factor for this population. Zubrick et al. (2007) concluded

that the risk of later language impairment for children with family history of language impairment is two times greater than a child without any family history. Bishop et al. (2012) provided a non-word repetition assessment to parents of late talking children to see if the parental scores corresponded with the children who were later diagnosed with SLI or the children who later scored within normal limits for their age group. The parents' non-word repetition task scores significantly differentiated the children who had typically developing outcomes versus the children who had SLI outcomes at age 4. Considering current research, if there is a family history of language impairment the child is at greater risk for continued language impairment. If a child's phonology is poor they are at greater risk for continuing language impairment. Phonology is a useful predictor for lexical development due to an inherent link between phonology and the lexicon. In particular, complexity of babble is a significant predictor of lexical growth (Whitehurst et al., 1991). In addition, children who do not produce a variety of sounds are shown to produce fewer words later in development (Girolametto, Pearce, & Weitzman, 1997). Finally, Schwartz & Leonard (1981) showed experimentally that the sounds in a child's phonological repertoire impact word learning. Specifically, Schwartz and Leonard constructed novel words that were composed of sounds the child produced (i.e., IN sounds) or composed of sounds the child did not produce (i.e., OUT sounds). After teaching both sets of words, it was apparent that children could learn to comprehend either type of word but only learned to produce the words composed of IN sounds. Taken together, phonology appears to restrict the words that are produced throughout development. Thus, a late talking child with poor phonology is at higher risk for continued problems with word learning and language production than a late talking child with well developed phonology.

Another risk factor for this population is that poor comprehension leads to poorer language outcomes later in life. Late talking children vary in the level of receptive language abilities even when they show similar expressive language deficits (Paul, Looney, & Dahm, 1991). From previous investigations focusing on comprehension in the early developmental age-range, studies have found that the speed and accuracy of online speech processing increases as children get older (Fernald, Perfors, & Marchman, 2006). This finding is important because these children who followed a typical developmental pattern of increasing processing speed also had higher rates of vocabulary growth during the second year than the children who did not show an increase in processing speed. Therefore, better comprehension may lead to higher vocabulary growth for these late talking children. Another study concluded that comprehension in early development can predict later vocabulary growth between 18-30-months in typically developing children and late talking populations (Fernald & Marchman, 2012). Carson et al., (2003) also suspected that comprehension skills are a possible predictor of later language outcomes. Late talking children who are able to comprehend words quickly, in similar fashion to typically developing children, are predicted to have better language outcomes later in development (Weismer et al., 2013). Poor comprehension at this age may indicate a more severe deficit that is likely to continue rather than resolve later in development.

Gesture use has been linked to spoken language development in a variety of populations (Alibali, Bassok, Solomon, Syc & Meadow, 1999; Iverson & Goldin-Meadow, 2005). Gestures indicate emerging word knowledge for children in the early developmental range (Capone & McGregor, 2005). Thal and colleagues (1991) concluded that conventional gestures produced by 18 to 30-month-olds, in addition to vocabulary comprehension at

this age, provide important prognostic information. Late talking children who produce communicative gestures may have better outcomes than those who do not use communicative gestures.

Word learning is a factor known to predict later language outcome for late talking children. Since vocabulary deficits are a hallmark for late talking children (Weismer, et al., 2012), it is likely that this population learns and understands words more slowly. After children learn a word they add, or map, it into their mental lexicon. This mental lexicon is like a personal dictionary for all the words a person or child knows, understands and uses. Investigating fast mapping in late-talking toddlers provided insight into word learning. A fast mapping task is a controlled learning situation that exposes a child to a certain object and word multiple times in order for the child to learn the word quickly and efficiently. Weismer et al. (2012) conducted a study that investigated fast mapping in late talking children in relation to their developmental age-matched normal language peers. They found that fast mapping ability is dependent on a child's current language ability and correlates with later language outcomes.

Manipulating the fast mapping task may provide additional insights into word learning abilities. One factor that can increase word learning is the role of gestures in word learning. In one study targeting at-risk infants, words with associated gestures were learned and produced before words that were spoken without gestures (McGregor & Capone, 2004). When children were taught words with shape or function gestures, children mapped words with shape gestures more quickly than function or no gesture (Capone & McGregor, 2005). Capone and McGregor hypothesized that gestures provided toddlers with more information about the meaning of the word. By providing children with another

manner of semantic meaning, like shape or function gestures, it mediated the relation between the semantic meaning and the word. This allowed the children to better understand the word and thus, map the word quicker than words with no gestures. This suggests that adding a gesture to the fast mapping task can aid in the child's word learning, which will ultimately benefit building the child's vocabulary.

Speed of fast mapping also can be influenced by word characteristics. Two word characteristics that influence fast mapping are phonotactic probability (PP), the likelihood that the particular syllable structure will occur (by itself or with other words), and neighborhood density (ND), the number of words that sound similar to a given word. Toddlers with normal language showed an influence of PP/ND on their word learning abilities. Weismer et al. (2012) found that late talking children did not show the same sensitivity to PP/ND as their normal talking peers. In a study by MacRoy-Higgins et al. (2012), which explored the influence of late talking children's phonological representation on word learning, they found that in general, most late talkers do not take advantage of the PP/ND word properties, that their typically developing peers do at this age to enhance word learning. One study concluded, "low PP/ND is optimal to trigger word learning in young children" (Weismer, et al., pg 12). However, we know that late talking children can have an overall weak phonological representation that lacks the detail for high or low PP/ND to have any influence at all (Higgins, et al., 2012). This puts late talking children at a disadvantage to learn and/or produce novel words. At this stage of development, the way that children learn words and attend to word properties is indicative of future growth and development.

Even when considering these factors it is still difficult to predict outcomes (Thal et al., 1997; Dale et al., 2003). Dollaghan (2013) synthesized 42 measures from multiple investigations, including varying tests, outcome measures and ages. From the synthesis of evidence, Dollaghan concluded that the predictive accuracy from early status as a Late Talking toddler to a typically language developing toddler is quite poor. Since the clinical category of Late Talker is not a definitive diagnosis but rather a representation of the population at the lower end of the language continuum, it is hard to predict this population's language outcome even when multiple risk factors are taken into account. This indicates that there is a need to explore the possibility of different measures in order to increase better predictability for late talking toddlers.

Measures of language status. Current assessments used for this age group are categorized as static measures. Static assessments employ deficit-based approaches to emphasize what the child does not know or have the ability to do. Two static measures commonly used for this age group include the Preschool Language Scale, 5th Edition (PLS-5) and the MacArthur Bates Communicative Development Inventory: Words and Sentences (CDI). The PLS-5 is used to assess a child's current language comprehension and production. The CDI is a parent-report measure that evaluates a child's current lexical ability. Static assessments focuses on what the child has learned so far, which is a function of the child's exposure as well as the child's ability to learn on his or her own. Static assessments show the actual level of functioning by measuring current ability instead of the child's online learning in the moment. Many of the late talking children are fundamentally at floor on static assessment of expressive language. Therefore, since these children are all at floor, there is a need to construct a type of assessment that focuses on the

potential for learning instead of the current outcome of learning in order to differentiate these children who show similar scores on static assessments. An alternative way to measure the potential level of functioning of these children who otherwise show similar abilities is a dynamic assessment. There are no current dynamic assessments available for use with this population. However, there are certain dynamic procedures that can be implemented to provide a better measure of a child's current learning abilities. A few dynamic assessment procedures include non-word repetition tests and fast mapping tasks (Dollaghan & Campbell, 1998). Pena, Iglesias & Lidz (2001) found that there is more predictive validity in dynamic assessments than in static measures. A dynamic assessment can reveal the child's potential for learning by providing different supports to explore the child's potential abilities. Additionally, a dynamic assessment is advantageous for exploring the potential modification of the child's performance. This type of assessment has the ability to further look at children's current ability and how it can be changed or altered by varying support or input given to them. Olswang et al. (1986) implemented a dynamic assessment to examine the difficulty of stimulating production of a new behavior by measuring the types of cues and prompts used for successful outcomes in two late talking children with similar language profiles, according to static assessments. Cues and prompts elicited behavior that would be difficult to stimulate outside of the study since these behaviors were only achieved through the most structured and supportive cueing. The assessment consisted of three conditions: Model Only, Model and Obstacle, Model and Elicitation Question or Statement. In the Model Only condition the researcher said the single word while the child was playing with the object. This condition gave the child an opportunity to spontaneously imitate the word. In the Model and Obstacle condition the

researcher modeled the word while the object was out of reach of the child and the child was trying to reach it. This condition gave the opportunity for the child to request the object. In the Model and elicitation/statement condition the researcher let the child play with toy while the researcher tried to immediately elicit a verbal response from the child by asking questions and commenting. This condition provided an opportunity for the child to produce an answer. The dynamic assessments revealed different profiles for the two subjects. Subject 1 showed good potential for change and rapid learning. Specifically, this subject didn't need a high number of exposures or extensive practice in order to learn the test items. However, Subject 2 revealed little potential for change and slower transfer of learning. That is, this child needed more exposures and extensive practice for each item. Both subjects were given the treatment. The dynamic assessment's results were consistent with treatment outcomes. Subject 1, who showed the greatest potential for change, made the greatest gains in treatment. This child was highly stimulable and produced responses when given the opportunity. However, Subject 2, who showed the least potential for change, made more limited gains in treatment. This child was less successful and had very limited productions of responses. The dynamic measure held true for predicting which child would respond better to the treatment and learn more quickly (Olswang et al., 1986). Dynamic assessments have the ability to show the learning potential and readiness to learn that can help decipher language profiles of children that otherwise look similar through static assessments Although Olswang et al. (1986) show the potential of dynamic assessment, there are some limitations to the study. The researchers did not incorporate all levels of cueing. The child's performance was maximized due to the extensive cues that the child was given. Children may perform differently with minimal cueing techniques that are

similar to everyday language exposures. Additionally, this dynamic assessment did not take into account the child's current lexical repertoire. They did not explore the production of words that children already understand opposed to words that are not included in the subjects' receptive knowledge. A follow up may be necessary to create a more comprehensive dynamic assessment that considers both word difficulty and a variety of teaching techniques.

A new dynamic assessment. There are two areas to incorporate when determining the words used in a dynamic assessment with this population. First, the level of difficulty can be altered by manipulating the phonetic composition and receptive knowledge. This will allow for an appropriate target pool for the children. Next, the context for teaching the target words can be considered. In order to decipher the best level of support, three areas need to be addressed when constructing the teaching contexts: teaching semantic and phonological properties of the targets, auditory versus visual input, and implicit versus explicit teaching. All of these factors are necessary to conclude which cues and types of input are most advantageous for late talking children's word learning abilities.

Focusing on both phonetic composition and receptive knowledge will vary the level of difficulty of the target words to determine which is appropriate for the late talking population. It is important to emphasize the sounds in the child's phonological repertoire. Schwartz & Leonard (1981) showed that words that contain IN sounds, sounds that are consistent with the child's phonology, are more likely to be produced during this point in development. It likely that targeting words that have IN sounds in a child's phonological repertoire will have a positive outcome opposed to words that contain OUT sounds, sounds that are not yet in the child's repertoire. Additionally, varying the phonotactic probability

and neighborhood density of each word is important to utilize the child's word properties advantage, if any (MacRoy-Higgins et al., 2012). It is likely that the words with high PP/ND, or the more familiar words, will be easier for children to learn since these sound structures and words appear most often in the language. Furthermore, using words that the child currently understands could provide insight into the influences of word difficulty. Similar to the IN and OUT sounds by Schwartz & Leonard (1981), the child may be more likely to produce sounds of words of which he or she has previous receptive knowledge. By systematically altering the phonetic composition and receptive word knowledge of each target word, the different words will provide a range of targets with different levels of difficulty.

When determining the teaching context for the target words, semantic and phonological properties of the words are beneficial to learn the sounds and understand the meaning of the targeted word. Most late talking children have some receptive vocabulary, but all of the children have deficits in expressive language (Rescorla, 1989; Paul, Looney, & Dahm, 1991). Given this, it is likely that expressive phonological properties of words would be difficult for these children since all of them have expressive language delays. However, some may still have deficits in receptive language, which means it's possible for semantics to be problematic as well. When teaching words to late talking children, it would be beneficial to teach in ways that incorporates both phonological and semantic properties of words.

Additionally, giving the input both auditorally and visually within the teaching context will help determine what type of input is most beneficial for late talking toddlers. Auditory processing is a weakness in children with specific language impairment (Leonard,

2014). Since auditory processing is weaker in this population, it is likely that it may be weak in some late talking children due to the likelihood that some of these children will later by identified with specific language impairment. Therefore, it is likely that visual cues may be better for this population than auditory cues alone. If these late talking children cannot learn through auditory support, then visual support may be advantageous in teaching these children new words.

Finally, the purpose of a dynamic assessment is to provide different levels of support in order to see what cues and/or prompts are most effective, if any, and what are least effective. The least supportive teaching technique is implicit teaching, which is no support at all. This type of teaching support is similar to children's everyday exposure. A child hears a word in a sentence and is expected to extract all the word's phonological and semantic features. Since these children already have expressive delays it is likely that everyday exposure is not working for these children like it does for their typically developing peers. A more supportive teaching technique is teaching children words explicitly. Explicit teaching is clearly, unambiguously teaching the sounds and meaning of the targets. Explicit teaching is known to provide better quality instruction, which leads to better vocabulary learning (Marulis & Neuman, 2010). Some studies reveal that this holds true when teaching grammatical forms as well, showing that explicitly teaching language may be the best approach to language acquisition and development (Finestack & Fey, 2009). A more supportive teaching technique is providing explicit teaching instruction auditorially to late talking children. By explicitly telling the child the meaning or highlighting phonological properties of the words, it is no longer up the child to infer these characteristics of the words. This type of instruction may help the children who could not

extract this information on their own. As noted previously, weaknesses in auditory processing may hinder use of explicit teaching with auditory cues. Thus, explicit teaching with visual cues may be more effective in supporting word learning than other types of support/cues.

Purpose of the project. The purpose of this project is to construct an initial dynamic assessment that will be used to conclude which cues are helpful for late talking children and younger vocabulary-matched typically developing children to learn new words and how their current lexical abilities interact with their word learning skills. Exploring the learning potential of these children by introducing various levels of support and cues can lead to conclusions as to how these late talking children are acquiring new vocabulary and what environmental factors help facilitate the process. It will also allow identification of differences and similarities in vocabulary acquisition between late talking children and their younger vocabulary-matched counterparts. Furthermore, using their current knowledge of words in addition to sound properties of new words will provide insight into how these late talking children's current lexical ability influences their future vocabulary growth and how this is similar or different to their vocabulary-matched cohort. This dynamic assessment explored two questions.

Do late talking children and their younger vocabulary-matched peers learn to produce words that they have receptive knowledge of better than words in which they don't have receptive knowledge when given this dynamic assessment? Do phonological properties (PP/ND) of words have any influence on late talking children and their younger vocabulary-matched peers learning process?

One would believe that children would be more likely to learn to produce receptive knowledge words since they already have some semantic representation so they would only need to learn the expressive phonological properties of the word, versus both the semantic and phonological properties of a new word. Furthermore, it would be expected that late talking children produce high PP/ND words better because these words are heard more often in the language and thus are more familiar to the children.

What level of support is most beneficial to late talking children and their younger vocabulary-matched peers?

One would assume that this may vary in children considering the late talking profile varies across children, that is all late talking children have different levels of deficits. However, it is predicted that the more supportive levels (i.e., explicit instruction) will be more effective than less supportive levels (i.e., implicit instruction) and that visual cues may be more effective than auditory cues. It is unclear whether phonological and semantic cues will differ in effectiveness or be equally effective.

Methods

Participants

Late Talking Children: Three 2-year-old (M = 2 years; 5 months) late talking children participated. All children were monolingual native speakers of English who are currently receiving speech-language pathology services and have been previously identified with an

expressive language delay. Late talkers were identified through speech-language pathologists' caseloads in the Kansas City area. Late talkers were characterized as only having an expressive language delay with no other cognitive, hearing, social, or physical delays or disorders. The original criteria for late talkers consisted of scoring below the 16th percentile(1 standard deviation below the mean) for any measure of total productive vocabulary. As shown in Table 1, standardized clinical testing (Fenson, et al., 2007; Bayley, 2006; Zimmerman, et al., 2006) confirmed normal nonverbal IQ and receptive vocabulary. However, the standardized assessments did not show a previously identify expressive vocabulary delay. This suggests that the in progress speech therapy is positively impacting the child's vocabulary development.

Table 1: Standardized assessment scores for late talking toddlers

Participants	Standard Score Bayley Cognition Test	Standard Score PLS-5 Receptive Vocabulary Test	Standard Score PLS-5 Expressive Vocabulary Test	Percentile Score Mac-Arthur Bates Words & Gestures Parent Report
LT01	100	109	82	37
LT03	110	118	91	86
LT04	90	89	88	68
Mean	100	105	87	52.93
Standard Deviation	10	15	5	21
Range	90-110	89-118	82-88	37-86

Typically Developing Children: Ten 12- to 18-month-old typically developing children participated. These children were chosen because they are the younger, vocabulary-matched age group of the late talking children. CDI raw scores for typically developing children ranged from 0-149 and CDI raw scores for late taking children ranged from 11-141, categorizing the 12-18-month-olds as the vocabulary-matched cohort. All children were monolingual native speakers of English with no history of speech, language,

motor, cognitive, or health impairment by parent report. As shown in Table 2, standardized clinical testing (Fenson, et al., 2007; Bayley, 2006; Zimmerman, et al., 2006) confirmed normal nonverbal IQ (M = 111; SD = 15; Range = 100-130), receptive vocabulary (M = 126; SD = 15; Range = 108-147), and expressive vocabulary (M = 114.2; SD = 15; Range = 97-129).

Table 2: Standardized assessment scores for vocabulary-matched typically developing children

Participants	Standard Score Bayley Cognition Test	Standard Score PLS-5 Receptive Vocabulary Test	Standard Score PLS-5 Expressive Vocabulary Test	Percentile Score Mac-Arthur Bates Words & Gestures Parent Report
TD01	100	120	117	46
TD02	110	108	101	10
TD06	115	120	117	70
TD07	110	147	129	67
TD08	105	120	125	75
TD09	110	128	113	7
TD10	115	132	101	<1
TD11	110	136	121	96
TD12	130	124	97	35
TD13	100	120	121	42
Mean	111	126	114	45
Standard Deviation	15	15	15	32
Range	100-130	108-147	97-129	1-96

Stimuli

The stimuli used in the study were words that were cross-referenced with the CDI (i.e., eliminated all the items not on the CDI) so the CDI from parents could be referenced to choose the stimuli for comprehension. The stimuli pool was based on the CDI norms for these age groups. However specific words for each participant were chosen from the pool based on parents' reports of children's receptive knowledge. A small pool of 9 stimuli, shown in Table 3 below, was created for which four specific items were selected for each

participant. The stimuli were derived from the Behavioral Research Methods consonant-vowel-consonant (CVC) corpus (Storkel, 2013). The report included a large list of legal CVC structures, real words or nonwords, in American English that have the potential to be used as stimuli for further psycholinguistic research. The CVC structures were "coded based on child or adult usage, real words or nonwords and by consonant age of acquisition" (Storkel, 2013, p 1160). Four real words that were not yet produced by the child were chosen for each participant. Two were from the child's lexical repertoire that he or she currently understood and two new words that were developmentally appropriate but not yet understood by the child based on parent report. By using words that were in the child's lexicon, versus using all new words, we further evaluated the role that the child's current lexical repertoire played in language output. Based on the CDI norms, words that many children in the norming sample understood were the stimuli that were considered receptive knowledge. These words should have been easiest for children to learn to produce because they had a semantic foundation already in place. However, the words that had lower "likely receptive" knowledge based on the CDI norms, may need more support throughout the learning process for children to be able to learn to produce these words because they do not yet comprehend these words.

All of these words were composed of age-appropriate sounds. In the pool of stimuli, the items that were likely outside the phonological capabilities of toddlers were eliminated (I.e., eliminating all CVC with mid- or late-8 sounds) (Shriberg, Gruber, & Kwiatkowski, 1994). These sounds are known as mid- or late-8 sounds, which are sounds that are learned later in development. The sounds used to construct the stimuli in this study were classified as early-8 sounds, which are age-appropriate for this population. The early 8

sounds this study focused on for the construct of the stimuli included: /m/ /b/ /j/ /n/ /w/ /d/ /p/ and /h/. Previous research shows that there is evidence for the influence of selection and avoidance at early age for words in early production. Schwartz & Leonard (1981) proposed the evidence of early phonological representation and acquisition. In their study they found that children have the ability to imitate words that contain sounds outside of their current phonemic repertoire but children use certain word structures (CV, CVCV, CVC, etc.) and specific IN sounds to produce during early developmental stages. Therefore, by using the early-8 sounds we maintained the IN sounds produced at this early developmental age-range in order to use stimuli that fell in the early phonological abilities and acquisition of these children.

The two words in each category, comprehended versus new words, had high or low phonotactic probability (PP) and neighborhood density (ND). Words were characterized as high PP/ND and low PP/ND. High PP/ND were more familiar words and sound structures, which is predicted to be easier for typically developing children to learn to produce since they are heard more in the environment, whereas low PP/ND were more unique structures and words in the language. The computations of phonotactic probability and neighborhood density were taken from Storkel (2013). Phonotactic probability was computed by positional segment sum and biphone sum using the online calculator. Positional segment sum is computed by calculating the positional segment frequency for each sound and then adding the frequencies together for each complete CVC structure. The positional segment frequency is calculated by adding the log frequencies of all the words in the online dictionary that contain the target sound in the same word position and dividing the sum of the log frequencies of all the words that contain any sound in the same word position.

Biphone sum is calculated similarly to positional segment frequency but the calculation is based on the pair of adjacent sounds not just the single sound. The stimuli for this study were selected from the real-word CVC corpus of Storkel (2013) using the z-scores for positional segment sum and biphone sum. Neighborhood density was computed by counting the number of words appearing in the list that differed from the given CVC by a substitution of only one sound, a deletion, or an addition in any word position. This computation is based on the sounds, not spelling. Again, the z-score from Storkel (2013) was used. Words selected as low PP/ND had negative z-scores and words selected as high PP/ND had positive z-scores, the cut-off ranging from + or – 0.50. This manipulation allowed the exploration of the variability of late talking children's and younger typically developing children's attention to phonological word properties. By introducing words with both high and low PP/ND it was likely that the children who exhibited PP/ND advantage learned the high PP/ND more quickly than the low PP/ND since these words are more familiar to the children. Since there were limited words with low PP/ND to choose from, there were 50% of children who had a low PP/ND word classified as not receptive that the parent reported as understood on the CDI. In this case, the word that was least likely to be produced was chosen for the child.

MCDI Stimuli Words	Description of Object Used for Play	Phonotactic probability & Neighborhood Density	% Understands at 18-months-old (MCDI website)	% Produces at 18-months-old (MCDI website)	% of LTs who used this word in DA	% of TDs who used this word in DA

Bead	A large bead	High	20	9	100%	70%
Man	A male doll, possibly in a suit	High	27	9	0%	10%
Pen	Toy pen	High	73	24	33%	10%
Head	A Mr. Potato Head	High	77	26	0%	20%
Bed	A plastic, dollhouse bed	High	88	26	0%	30%
Dad (Daddy)	A male doll holding a baby	High	98	80	66%	60%
Home	A plastic house or dollhouse	Low	74	21	100%	90%
Bird	Toy bird	Low	91	58	66%	70%
Nap	A baby sleeping in a bed or crib	Low	91	30	33%	40%

Table 3: Pool of Stimuli

The stimuli were selected for a given child according to low and high PP/ND in addition to receptive knowledge versus no receptive knowledge. Two words that the parent reports in the CDI as understood by the child were chosen to serve as the comprehended words. One had high PP/ND and one had low PP/ND according to Storkel's (2013) computations. In the event that the child, according to the CDI, comprehended no words from the list, the stimuli chosen was the word with the higher 18-month-old comprehension percentage. This did not occur with the children in this sample. The other two stimuli were words that the parent reports are not understood by the child to use as the words that are not yet comprehended. These were chosen from the list with high PP/ND and low PP/ND taken into consideration for each stimulus. An example of the four stimuli that might be selected for a given child includes: *dad*, *bird*, *bead*, and *home*. *Dad* and *bird* are words in the child's current lexicon and exhibit high and low PP/ND, respectively.

Bead and *home* are words that the child has no receptive knowledge of and have high and low PP/ND, respectively.

Procedures

While choosing the stimuli according to the child's current receptive knowledge, a comprehension task was administered to verify the parent-reported CDI. The child was asked "Where is the [WORD]?" (E.g., *dad*) and was prompted to pick an object from a group of four total objects. Two of the objects were novel objects that the child would not be taught during the dynamic assessment, the 3rd object was another target object that was used during the dynamic assessment and the 4th object was the target object. If the child did not choose the specified object it was noted however, that stimuli was still used based on the parent-reported receptive knowledge on the CD. This occurred with12% of the stimuli, over 6 different opportunities across 4 children. The present task allowed the researcher to build up the teaching intensity (increasing exposures of the word throughout the block) and the level of cueing, as one would expect in a dynamic assessment. When providing exposures we were able to also monitor the child's learning to provide more detail on how the learning unfolds, according to the level of cueing the child needs. It was predicted that this procedure would show a range of performance of the children to see how each child's learning changed and what cueing was most helpful for these late talking children and their vocabulary-matched cohort.

Each of the four items was taught in isolation during a single block. Each block progressed through three levels of supported training and then testing was conducted at the end. The three levels of supported training got gradually more supportive. The lowest

level of support was naming the object, the next level of support was auditory semantic and phonological cues, and finally the child was presented with the more supportive cues, which were visual semantic and phonological cues. The testing phase also advanced through these 3 levels of support in addition to an imitation prompt, which was considered the most supported level. Testing concluded the block and the next block began focusing on the next target word. Each word was represented by a 3-D toy, which was incorporated into a play scene. For example, with *home*, there was a toy house that was used in a play scene. To begin each block, the toys were presented to the child and the child was allowed to explore the toys for one minute. The block began with the lowest level of cueing. The target toy (i.e., *home*) was presented and the child was prompted to name it (e.g., "What's this?" "It's a *home*"). The first level in the block also confirmed that the child did not verbally produce the name of the object. There were 6% of responses in which the children named the object during the training block.

The next level of the block provided auditory semantic and phonological cues. The order of these cues was counterbalanced across blocks so that in two of the blocks, semantic cues came first, whereas in the other two blocks, the phonological cue came first. For the semantic cue, three relevant semantic features were taught in conjunction with the word. This included semantic category, function, or parts. For example, for *home* the experimenter said, "The family lives in the *home*," "The *home* has lots of doors and windows," and "The *home* has a roof on top of it." For the phonological cue, three relevant phonological features were taught in conjunction with the word. These cues included, highlighting the first sound, highlighting the rhyme, highlighting other words that sound

familiar. For example, for *home* the experimenter said, "h-ome," "h-h-h-*home*," and "*home* is like dome." The child was exposed to the word *home* six times during this level of cueing.

The next level of the block provided visual support for the meaning and phonological form. The order followed the order from the prior level. For semantic forms a shape gesture was used. For *home* the experimenter had two arms up as the walls and her hands together in a triangle shape to form the roof. The child got three exposures for the semantic cue while the *home* was being used in a play scenario (e.g., "The family comes *home*," "Knock, knock is anyone *home*," "the *home* has a chimney on top of it."). Every time *home* was mentioned in these play scenarios the experimenter provided the shape gesture (e.g., hands together forming the roof with arms straight as the walls). For the phonological cue the child's production of the word was elicited three times with articulatory instructors and visual modeling with articulators. For example, for *home* the experimenter said, "Let's say *home* (e.g., the experimenter spread her fingers open for /h/ and closed them all together when producing /m/). During these examples the experimenter pointed to her mouth as she exaggerated the movements after giving the phonological cue. Also during this segment the experimenter gave the phonological cue as the child was playing with the toy, making sure that the child saw the cue whether he or she was playing with the toy or the experimenter was holding the toy.

Before the final test phase the child had 15 exposures total: three at the naming level, six at the next level (auditory semantic and phonological cues) and six at the final level (visual semantic and phonological cues). See Appendix A for a list of all levels of cues for each target word. For the final testing portion of the block the child was given all of the cues in order from least to greatest support. The first prompt was with no support at all.

The researcher showed the object to the child and asked, “What’s this?” After the first cue the researcher explained the remaining prompts. For example the researcher instructed the child, “Now I am going to give you some clues to see if they help.” This instruction was to elicit the target word from the child versus the child imitating the gesture or cue. The subsequent supports were the same order of the semantic and phonological cues from the training blocks. In the example provided the researcher provided the child with the semantic cues first in each block. Therefore, the researcher would follow the same order for the final testing phase. For example, the researcher gave the auditory semantic prompt, “The family lives there, what is it?” Then the researcher gave the auditory phonological prompt, “It sounds like “ho”, what is it?” Next the researcher provided the visual semantic prompt, “[Show gesture, e.g., hands together forming the roof with arms straight as the walls], what’s this?” Then the visual phonological prompt followed “Start like this [point to mouth], what’s this?” Finally, the last prompt was the greatest level of support. The researcher stated the word “Say *home*” to see if the child imitated the word.

Scoring. The scoring was completed separately for each child. As shown in Table 4 the child’s response to each prompt was transcribed as incorrect if the child failed to respond, correct if the child provided an approximation (i.e., any verbal communicative attempt) and correct if the child produced at least 2 of the 3 phonemes in the word in the correct order. A correct answer was transcribed as “+”, an approximation was transcribed as “A”, and the child’s failure to respond produced a “-“.

Table 4: Scores of Level of Response

Score	Level of Response Accuracy

2	Correct response (at least 2 out of 3 target phonemes)
1	Approximation (a verbal communicative attempt following the prompt)
0	Incorrect response (failure to respond)

To score the level of support in conjunction with the child's response, the levels of support were scored in a separate manner. The prompts were administered in the testing phase to provide a more accurate depiction of each child's ability considering the various levels of support. As shown in Table 5, the hardest cue (i.e., no support) had the highest score (4). The most support (i.e., imitation) had a lower score (1). If the child failed to produce a response for any of the supports the child received a score of 0.

Table 5: Scores of Prompts and Support

Score	**Prompts/Support**
4	No support "What's this?"
3	Auditory semantic prompt, "You can sleep in it, what is it?" Auditory phonological prompt, "It sounds like /b/, what is it?"
2	Visual semantic prompt, [provide gesture] "What is it?" Visual phonological prompt, "Start like this [point to mouth], what is it?"
1	Full support/imitation, "Say [WORD]."
0	No response to any prompt provided

Results

This project aimed to construct an initial dynamic assessment that will be used to conclude which level of supports are helpful for late talking children and younger

vocabulary-matched typically developing children to learn new words. Exploring the learning potential of these children lead to conclusions as to how these late talking children learn new words and what factors in their environment help facilitate the process. It also showed differences and similarities in vocabulary acquisition of their younger vocabulary-matched counterparts. Furthermore, using the children's current receptive and non-receptive knowledge of words provided insight into how these late talking children's current lexical ability influenced their future vocabulary growth and how this was similar or different to their vocabulary-matched cohort. By providing different levels of support, the learning potentials of both cohorts provided a better understanding of language trajectory to more efficiently estimate prognostic indicators in the late talking population.

The typically developing children and late talking children were analyzed separately. The results will conclude whether there are any trends between the two groups in each area that was explored.

Do late talking children and their younger vocabulary-matched peers learn to produce words that they have receptive knowledge of better than words in which they don't have receptive knowledge when given this dynamic assessment? Do late talking children and their younger vocabulary-matched peers learn to produce high PP/ND words better than low PP/ND words?

Table 6 shows the four stimuli in 4 separate panels: two words that the children had receptive knowledge of, two words that the children had no receptive knowledge of, two words with high PP/ND and two words with low PP/ND. The participants are arranged in the table by order of highest expressive scores on the parent-reported MCDI. The "X" in the

table portrays the lowest level of support needed for each participant to produce a partially correct response. Fully correct responses were rare due to the difficulty of learning a word with minimal exposure. Thus, partially correct responses were judged to be the most promising for this analysis. In the summary row for each word the percentages represent the percent of children who needed that level of support to produce a partially correct response for that particular target (e.g., word that is in the children's receptive knowledge with low PP/ND).

Typically Developing Children: The first panel of Table 6 contains the responses for the High PP/ND word that the child had receptive knowledge of. The summary row shows that 50% of the children produced a partially correct response at level 4, no support, 40% of the children required level 3, auditory semantic and phonological cues, and 10% needed level 2, visual semantic and phonological cues. The second panel contains the responses for the Low PP/ND word that the children had receptive knowledge. The children responded in similar fashion to this target as they did for the first target (e.g., High PP/ND and receptive knowledge). For this target word, 50% of children produced a partially correct response at level 4, no support, and 50% needed level 3, auditory phonological and semantic cues. Thus, for the two words that children had receptive knowledge of, the majority of children produced a partially correct response with relatively minimal support. The third panel shows the partially correct responses for the High PP/ND word that the children did not have receptive knowledge of. The responses produced for this target were slightly different than the previous two words. For this target word 50% of the children produced a partially correct response at level 4, no support. 20% of children produced partially correct responses at both levels 3 and 2, auditory phonological and semantic cues

and visual phonological and semantic cues, respectively. These responses differed from the first two targets due to the increase in responding at level 2, a more supportive level, suggesting that words lacking receptive knowledge required greater support for some children. For the final target, the Low PP/ND word that the children had no receptive knowledge of, the responses showed a different pattern than the first three target words. Of these 10 partially correct responses, 30% of children needed level 4, no support, 40% of children needed level 3, auditory phonological and semantic cues, and 20% of children needed level 1, full support-imitation. For this word, there were not as many responses produced without support (i.e., level 4) as the other three target words. More responses were produced at the more supportive levels (i.e., level 3 and level 1). In particular, for this target, there were more responses produced at level 1 than with any other word. Thus, low PP/ND words without receptive knowledge appeared to be the most difficult words to learn requiring the greatest support.

In summary, typically developing children needed more support to produce partially correct responses for words of which they had no receptive knowledge of than the words that the children previously had receptive knowledge of. This is especially true for the word that the children had no receptive knowledge of with low PP/ND.

Late Talking Children: Data for the late talking children are shown in the bottom of each panel in Table 6. The pattern for the late talkers was similar to that of the typically developing children. As shown in the top panel of Table 6, for the +receptive knowledge and high PP/ND word, 67% of the children produced a partially correct response at level 4, no support, and 33% of the children required level 3, auditory semantic and phonological cues. As shown in the second panel of Table 6, for the +receptive knowledge and low

PP/ND word, 100% of late talking children produced a partially correct response at level 4, no support. In the third panel, word 3-no receptive knowledge and high PP/ND, 100% of late talking children produced a partially correct response at level 4, no support. For word 4-no receptive knowledge and low PP/ND, 67% of children needed level 3, auditory phonological and semantic cues, and 33% of children needed level 1, full support-imitation.

Table 6: Lowest level of support needed to produce a partially correct response for each of the four words with receptive and no receptive knowledge and high and low PP/ND

WORD 1 High PP/ND + Receptive (Lowest support needed for an approximation)						
ID	*CDI %*	*CDI Vocab: Understood Produced* ***Out of 396***	*Level 4 No Support*	*Level 3 Auditory Semantic & Phonological*	*Level 2 Visual Semantic & Phonological*	*Level 1 Imitation*
TD11	84% 96%	269 149		X		
TD08	61% 75%	199 58		X		
TD06	53% 70%	218 76	X			
TD07	49% 67%	243 100	X			
TD13	49% 42%	171 20	X			
TD12	97% 35%	304 4			X	
TD01	45% 14%	238 28		X		
TD02	13% 10%	42 0		X		
TD09	<1% 7%	65	X			
TD10	35% <1%	144 0	X			
Summary			5/10 = 50%	4/10 = 40%	1/10 = 10%	0/10= 0%
LT01				X		
LT03			X			
LT04			X			
Summary			2/3=66%	1/3=33%	0/3=0%	0/3=0%

WORD 2 Low PP/ND + Receptive (Lowest support needed for an approximation)

ID	*CDI %*	*CDI Vocab: Understood Produced* ***Out of 396***	*Level 4 No Support*	*Level 3 Auditory Semantic & Phonological*	*Level 2 Visual Semantic & Phonological*	*Level 1 Imitation*
TD11	84% 96%	269 149		X		
TD08	61% 75%	199 58	X			
TD06	53% 70%	218 76	X			
TD07	49% 67%	243 100	X			
TD13	49% 42%	171 20	X			
TD12	97% 35%	304 4		X		
TD01	45% 14%	238 28		X		
TD02	13% 10%	42 0		X		
TD09	<1% 7%	65		X		
TD10	35% <1%	144 0	X			
Summary			5/10 = 50%	5/10 = 50%	0/10= 0%	0/10= 0%
LT01			X			
LT03			X			
LT04			X			
Summary			3/3=100%	0/3=0%	0/3=0%	0/3=0%

WORD 3 High PP/ND – Receptive (Lowest support needed for an approximation)						
ID	*CDI %*	*CDI Vocab: Understood Produced* ***Out of 396***	*Level 4 No Support*	*Level 3 Auditory Semantic & Phonological*	*Level 2 Visual Semantic & Phonological*	*Level 1 Imitation*
TD11	84% 96%	269 149	X			
TD08	61% 75%	199 58			X	
TD06	53% 70%	218 76			X	
TD07	49% 67%	243 100	X			
TD13	49%	171	X			

	42%	20				
TD12	97% 35%	304 4	n/a	n/a	n/a	n/a
TD01	45% 14%	238 28		X		
TD02	13% 10%	42 0		X		
TD09	<1% 7%	65	X			
TD10	35% <1%	144 0	X			
Summary			5/10 = 50%	2/10 = 20%	2/10 = 20%	0/10=0%
LT01			X			
LT03			X			
LT04			X			
Summary			3/3=100%	0/3=0%	0/3=0%	0/3=0%

WORD 4 Low PP/ND – Receptive (Lowest support needed for an approximation)						
ID	*CDI %*	*CDI Vocab: Understood Produced* ***Out of 396***	*Level 4 No Support*	*Level 3 Auditory Semantic & Phonological*	*Level 2 Visual Semantic & Phonological*	*Level 1 Imitation*
TD11	84% 96%	269 149	X			
TD08	61% 75%	199 58		X		
TD06	53% 70%	218 76	X			
TD07	49% 67%	243 100	X			
TD13	49% 42%	171 20				X
TD12	97% 35%	304 4				X
TD01	45% 14%	238 28		X		
TD02	13% 10%	42 0		X		
TD09	<1% 7%	65		X		
TD10	35% <1%	144 0	n/a	n/a	n/a	n/a
Summary			3/10 =	4/10 =	0/10 =	2/10 =

			30%	40%	0%	20%
LT01				X		
LT03						X
LT04				X		
Summary			0/3=0%	2/3=66%	0/3=0%	1/3=33%

As you can see from Table 7 below, late talking children produced the most partially correct responses across all words when provided with Level 4, no support. From the summary table, you can see that children needed the most support for words not in their receptive knowledge with low PP/ND. Across the two groups of children, words with no receptive knowledge and low PP/ND were the most challenging, requiring greater support to facilitate production of a partially correct response.

Table 7: Summary tables of lowest level of support needed to produce a partially correct response across all stimuli for typically developing and late talking children

Summary of partial responses from typically developing children for each target word	Level 4	Level 3	Level 2	Level 1
Word 1 (+/High)	50%	40%	10%	0%
Word 2 (+/Low)	50%	50%	0%	0%
Word 3 (-/High)	50%	20%	20%	0%
Word 4(-/Low)	30%	40%	0%	20%

Summary of partial responses from late talking children for each target word	Level 4	Level 3	Level 2	Level 1
Word 1 (+/High)	67%	33%	0%	0%
Word 2 (+/Low)	100%	0%	0%	0%
Word 3 (-/High)	100%	0%	0%	0%
Word 4(-/Low)	0%	67%	0%	33%

What level of support proved to be most beneficial for children?

Tables 8 and 9 show that the total number of responses and the types of those responses by each level of support. The types of responses included fully correct responses, partially correct responses (e.g., any approximation of the target word) and no responses.

Typically Developing Children-Level of support. As you can see from table 8, the children produced the most fully correct response when given level 1, imitation (15%). Furthermore, level 1 produced the most partially correct responses as well (55%). The least supportive level, level 4-no support, produced the most no response scores (55%). Data for the intermediate level of support – level 3 and 2 – produced responses between these two endpoints. These data indicate that the levels of support were as supportive as intended with the level of correctness improving as the intended level of support increased.

Table 8: Total number of responses produced by typically developing children for each word, at each level by the type of response given

Types of Responses from Typically Developing Children	Level 4 No Support N = 40	Level 3 Auditory Phonological & Semantic cues N = 80	Level 2 Visual Phonological & Semantic cues N = 80	Level 1 Imitation N = 40
Fully Correct	5%	5%	5%	15%
Partially Correct	40%	50%	43%	55%
No Response	55%	45%	53%	30%

Late Talking Children-Level of support. Table 9 shows us that late talking children had the most fully correct responses with imitation, level 1, and this was quite striking with 83% correct responses. In contrast to typically developing children, late talking children had relatively few no responses with the lowest level of support, level 4, with 25% fully correct responses and 50% partially correct responses. It is interesting that late talking children actually performed better without support (level 4) than younger typically

developing children. Recall that children received a number of exposures to the target words prior to the test. It may be that late talking children were better able to take advantage of these exposures due to their older age and the cognitive benefits associated with their age, allowing them to perform better without support. The most no responses took place when the late talking children were given level 3, auditory phonological and semantic cues (54%) but the percent of no responses was similar to the typically developing children. In summary, imitation (Level 1) was especially helpful for late talking children, even more so than for typically developing children, and cueing (Level 3 and Level 2) appeared to be equally effective across the two groups of children.

Table 9: Total number of responses produced by late takling children for each word, at each level by the type of response the children produced

Types of Responses from Late Talking Children	Level 4 No Support N = 12	Level 3 Auditory Phonological & Semantic cues N = 24	Level 2 Visual Phonological & Semantic cues N = 24	Level 1 Imitation N = 12
Fully Correct	25%	4%	17%	83%
Partially Correct	50%	42%	42%	8%
No Response	25%	54%	42%	8%

Tables 10 and 11 show the percent of responses for each type of response (e.g., fully correct, partially correct, and no response) for all phonological and semantic cues presented visually and auditorally. These tables show whether phonological or semantic cues, in either auditory or visual modality, proved to be more beneficial for the children.

Typically Developing Children-Auditory and visual presentation in relation to phonological and semantic cues. First, the effectiveness of each type of cue across the auditory and visual modalities is considered. Table 10 shows that typically developing

children produced the most partially correct responses when a phonological cue was presented auditorally (58%) rather than visually (38%). For semantic cues, auditory (48%) and visual cues (48%)were equally effective. Next, the effectiveness of semantic versus phonological cues within each modality is considered. Within the auditory modality, phonological cues (58%) were superior to semantic cues (48%) in facilitating partially correct productions. In contrast, within the visual modality, semantic cues (48%) were superior to phonological cues (38%). Thus, one might consider reducing Level 3 to solely auditory phonological cues and level 2 to just visual semantic cues.

Table 10: Auditory and visual levels by phonological and semantic cues for typically developing children

Types of Responses	Level 3: Auditory Cues		Level 2: Visual Cues	
	Phonological N = 40	Semantic N = 40	Phonological N = 40	Semantic N = 40
Fully Correct	3%	8%	5%	5%
Partially Correct	58%	48%	38%	48%
No Response	40%	45%	58%	48%

Late Talking Children-Auditory and visual presentation in relation to phonological and semantic cues. As you can see from Table 11, the late talking children produced the most fully correct responses when the semantic cues were presented visually (25%). This pattern is similar to the typically developing children who produced the most partially correct responses when given the visual semantic cues. Conversely, the late talking children showed a similar pattern to the typically developing children when presented with auditory phonological cues. The late talking children produced significantly more partially correct responses when given auditory phonological cues (50%) than when given auditory semantic cues (33%). In summary, the auditory phonological cues and the visual semantic cues proved to be the most beneficial for the late talking children as well. Therefore,

reducing Level 3 and Level 2 cuing to auditory phonological and visual semantic is supported for both groups.

Table 11: Auditory and visual levels by phonological and semantic cues for late talking children

Types of Responses	Level 3: Auditory Cues		Level 2: Visual Cues	
	Phonological N = 12	Semantic N = 12	Phonological N = 12	Semantic N = 12
Fully Correct	8%	17%	8%	25%
Partially Correct	50%	33%	50%	33%
No Response	42%	50%	42%	42%

Discussion

The data analysis revealed similarities between late talking children and their vocabulary-matched younger typically developing children. The first research question explored if children learn to produce words that they have receptive knowledge of better than words they have no receptive knowledge of. Furthermore, do the phonological properties of the words have any influence (e.g., high or low phonotactic probability and neighborhood density)? This data analysis showed that both typically developing and late talking children needed more support for Low PP/ND words that they had no receptive knowledge of. The second question determined the support that proved to be most valuable for both groups of children. When considering fully correct responses, imitation was the most successful level for fully correct responses for both late talking and typically developing children. In relation to partially correct responses, all levels of support were equally effective for both late talking and typically developing children. The effectiveness of no support differed between late talking and typically developing children. Late talking children produced more fully and partially correct responses when provided this level of support versus typically developing children who had more no responses when given the

least supportive level. The second part of this analysis determined what types of cues (e.g., phonological or semantic; auditory or visual) were the most helpful for both groups of children. Auditory phonological and visual semantic cues proved to be most effective for both typically developing and late talking children

Future Dynamic Assessment

Participants and Target Groups. The late talking children and typically developing children showed both similarities and differences across analyses. It was found that the scores from the children already working on speech were not low enough to fit the typical late talking profile (e.g., more than 2 standard deviations below the mean on expressive language standardized assessments). Thus, they may not be representative of the group of children that one would typically want to conduct a dynamic assessment with. In the future, this dynamic assessment should be conducted on children who are being evaluated for speech and language that have not yet begun treatment. This would make it possible to determine how the dynamic assessment can contribute to the diagnostic process. In addition, for children who initiate treatment, performance in treatment could be examined in relation to the dynamic assessment results to determine whether the dynamic assessment is useful in predicting treatment response. Likewise, for children who either do not pursue treatment or for whom a "wait and see" approach is recommended instead of treatment, language growth could be monitored for several months. This would make it possible to examine whether the dynamic assessment predicted language growth in the absence of treatment.

Stimuli. The stimuli were created by targeting phonological features of the words and the receptive knowledge that the children had of the target words. The children were

provided with four target words: two words that the child had previous receptive knowledge of, one word with high PP/ND and one with low PP/ND, in addition to two words that the child had no receptive knowledge of, with high and low PP/ND. The combination of receptive knowledge and phonological properties of the words proved to show distinct patterns across both groups of children. For future evaluation of this dynamic assessment, pursuing Low PP/ND words without receptive knowledge, the hardest words for children to learn, would be the most beneficial for extracting the best level of support for each individual child and across groups of children. Even though late talking children in other studies did not show the same PP/ND sensitivity as typically developing children, our results showed that children in both groups struggled the most with Low PP/ND words that they had no receptive knowledge of (MacRoy-Higgins et al., 2012). By targeting four harder words (e.g., Low PP/ND) that are not in the child's receptive knowledge, the next evaluation can focus more on the levels of support, which may better differentiate late talking children who will continue to struggle from those who will catchup to their peers.

Level of support. The scaffold of support provided children with four levels of cues. Across both groups, the children produced the most fully and partially correct responses when provided the auditory phonological cue in level 3 and the visual semantic cue in level 2. The auditory phonological cue focuses on the distinct sounds and manner in which words are produced. The late talking children may have been the most successful with this cue due to the fact that they are learn less well through typical environmental, auditory input than their typically developing counterparts (e.g., inferential learning using contextual clues through every day auditory conversations). Therefore, having this additional level of supportive input may yield better word learning for these children. In

regards to visual semantic cues, since auditory semantic learning through every day conversation is potentially less beneficial for late talking children, seeing the visual semantic cues may lead to better understanding of the word, thus improving fast mapping of new words. With future use of the dynamic assessment, focusing on auditory phonological and visual semantic cues may be sufficient for both late talking children and typically developing children. This will shorten the protocol to one cue for each level (1-4), which will allow for quicker assessment and more controlled analysis of what cues are eliciting the most consistent responses from individual participants and across both groups of children.

Conclusion

This study provides guidance on how to further refine and test a dynamic assessment of word learning for toddlers. . The findings suggest that the current dynamic assessment could be more focused for future studies using Low PP/ND target words that a child does not have receptive knowledge of and auditory phonological, visual semantic, and imitation levels of support. Future work to develop this dynamic assessment would be enhanced by using a larger number of newly identified late talking children and also by examining how dynamic assessment performance predicted treatment response (for those pursuing treatment) or language growth (for those not pursuing treatment).

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Appendix A. Cues for target words.

Target Words	3-D Object	Naming Phase	Auditory Semantic Cues (3)	Auditory Phonological Cues (3)	Visual Semantic Cues (3)	Visual Phonological Cues (3)
Bead	A foam ring that had a hole with a colorful shoe string.	What's this? It's a bead.	1. There is a bead on the necklace. 2. The bead is used for arts and crafts. 3. The mom put the bead on the string. 4. You use beads to make bracelets. 5. The bead is round and colorful. 6. You can put the bead on clothes.	1. B-ead 2. B-b-b-bead 3. Bead is like feed	[Closed circle with on hand] 1. Put the bead on the string to make a bracelet. 2. Stack the beads on top of each other. 3. Put the beads together to make a pretty picture. 4. The bead has a hole in the middle for the string. 5. The beads stack on top of each other to make a necklace 6. The bead is round and has a hole in it.	Let's say bead. [Keep hands closed like your lips and open them, point back for /d/] -Use this gesture when using the target word during the play session 3 times.
Man	A male doll	What's this? It's a man.	1. The man is wearing a suit to work. 2. The boy grew up to be a man. 3. The boy's father is a man. 4. A man is a grown-up boy. 5. The man is a grown up. 6. The man is older than a boy.	1. M-an 2. M-m-m-man 3. Man is like fan	[Point two fingers down under your second open hand] 1. The man is going to work today. 2. The man is hungry give him something to eat. 3. The man wants to watch TV, put him in the TV room. 4. The boy's father is a man. 5. The boy grew up to be a man. 6. The man comes home from work	Let's say man. [Keep hands closed like lips and point up for /n/] -Use this gesture when using the target word during the play session 3 times.
Pen	Toy pen	What's this? It's a pen.	1. The pen is used to write. 2. The pen can draw many pictures. 3. The pen has lots of different colored ink. 4. A pen is small and long. 5. You color with the pen 6. Mommy and daddy use pens to write on paper	1. P-en 2. P-p-p-pen 3. Pen is like ten	[Make a line motion with your thumb and pointer finger] 1. You can use the pen to draw pictures. 2. The pen can write on the paper. 3. Mommy uses a pen to write down notes. 4. A pen can be lots of different colors 5. A pen can draw or write. 6. You can color with a pen.	Let's say pen. [Keep hands closed like lips and point up for /n/] -Use this gesture when using the target word during the play session 3 times.
Head	A Mr. Potato Head	What's this? It's a head.	1. The head is on top of the neck. 2. The head has two eyes, two ears, a nose, and a mouth. 3. Your hair is on your head. 4.The head is on top of the body. 5. Your head is where your mouth is. 6. Your head has 2 ears on either side.	1. H-ead 2. H-h-h-head 3. Head is like fed	[Make the outline of a ball with both hands] 1. Your head is on top of your body. 2. Your brain is in your head. 3. You shake your head to say no. 4. Your head has a mouth. 5. Your head is on top of your shoulders. 6. You have hair on your head.	Let's say head. [Keep hands open like lips and point up for /d/] -Use this gesture when using the target word during the play session 3 times.
Bed	A plastic, dollhouse bed	What's this? It's a bed.	1. When you go night-night you sleep in your bed. 2. Mommy reads a book to the baby in bed 3. There are lots of blankets and a pillow on the bed. 4. The bed is where you	1. B-ed 2. B-b-b-bed 3. Bed is like red	[Make a field goal in the air with hands] 1. Time to go night-night, put the baby in the bed. 2. Mom is tired, put the mom in the bed. 3. Dad needs to sleep, put Dad in the bed. 4. You're tired, go sleep in your	Let's say bed. [Put fingers together like lips, open and spread wide, point up for /d/] -Use this gesture when using the target word during the play session 3 times.

			sleep at night 5. There is a pillow on the bed. 6. The baby wakes up in the morning and gets out of bed.		bed 5. Read a book to baby in bed 6. The bed is upstairs in the house	
Dad (Daddy)	A male doll with a baby	What's this? It's a Dad.	1. The son likes to play with Dad. 2. Dad says hi to Mommy when he comes home. 3. Dad is a boy. 4. The dad gets home from work in time for dinner 5. Dad likes to watch TV with the kids. 6. Dad cooks dinner for everyone after work.	1. D-ad 2. D-d-d-dad 3. Dad is like bad	[Make a gesture like rocking a baby] 1. Daddy rocks the baby to sleep. 2. Daddy reads a story to the kids before bed. 3. Daddy fixes Mom's car that is broken. 4. Dad comes home from work and says hi to the kids. 5. Dad feeds the kids dinner after work. 6. Dad says hi to Mom when he gets home from work	Let's say dad. [Point finger up then make a fist and point finger back up for second /d/] -Use this gesture when using the target word during the play session 3 times.
Home	A plastic house	What's this? It's a home.	1. The family eats dinner at home. 2. The kids go night-night at home. 3. The school bus takes the kids home after school. 4. The home has doors and windows. 5. There is a roof on top of the home. 6. The home has lots of rooms in it.	1. H-ome 2. H-h-h-home 3. Home like dome	[Put tips of fingers together in a point with arms straight] 1. The family lives at home together. 2. The mommy and daddy bought a new home. 3. The home has many rooms in it. 4. There are lots of windows and doors on the home. 5. The home is where the family lives. 6. The kids play inside the home	Let's say home. [Keep hands open like lips and shut them together for /m/] -Use this gesture when using the target word during the play session 3 times.
Bird	Toy bird	What's this? It's a bird.	1. The bird has a beak and feathers. 2. The bird lays eggs in its nest. 3. The bird flies high in the sky. 4. The bird is sitting in the tree. 5. The bird flies over the house. 6. The bird is sitting on the roof.	1. B-ird 2. B-b-b-bird 3. Bird is like word	[Connect thumbs, flap hands like wings] 1. The bird flies over the trees. 2. The bird lays eggs in its nest. 3. The bird eats worms when its hungry. 4. The bird has yellow feathers. 5. The bird flaps its' wings when it flies. 6. The bird makes a nest for its eggs.	Let's say bird. [Put fingers together like lips, open and point one finger up for /d/] -Use this gesture when using the target word during the play session 3 times.
Nap	A baby sleeping in a bed	What's this? It's a nap.	1. The baby lays in the crib for her nap. 2. The baby is tired so mom puts her down for a nap. 3. Mom reads a book to the baby before her nap. 4. You take a nap in your crib. 5. When you are tired during the day you take a nap. 6. During the day the baby naps in her crib.	1. N-ap 2. N-n-n-nap 3. Nap is like map	[Put to hands together next to your head like you're sleeping] 1. A nap is when you get to sleep during the day. 2. Kids take a nap during the day. 3. The baby is sleepy so the baby takes a nap. 4. The baby naps during the day when she's sleepy. 5. A nap is when you lay down and sleep for a little during the day. 6. Babies and big kids can all take naps during the day.	Let's say nap. [Point finger up and back for /n/ and flip it forward for /p/] -Use this gesture when using the target word during the play session 3 times.