

**Exploring the Use of Parent Report in Child Speech and Language Screening**

by

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## Abstract

Early detection of speech-language disorders in preschool children have been found to improve academic, behavioral, and social outcomes. As the USPSTF reports, there is currently no gold standard measure for assessing children for a developmental delay such as deficits in speech and language (Voight & Accardo, 2015). The aim of this study was to investigate the accuracy of parent screeners such as the Ages and Stages Questionnaire-3 (ASQ-3) and the Intelligibility in Context Scale (ICS) to identify children who are and are not at risk for speech and/or language delays. Thirty children and their participating parents were included in the study. Children were screened as a part of screening activities performed by the Auburn Speech and Hearing Clinic. Parents completed questionnaires to provide information about their child's communication skills. Children were later assessed to determine group status, with without disorder. Congruence between parent and clinical measures were observed. A strong positive correlation ( $r = +0.71$ ,  $p < 0.001$ ) with substantial agreement ( $k = 0.71$ ,  $p < 0.001$ ), was found between the parental and clinician categorization of children when the ASQ-3 qualitative questions and the PLS-5 Articulation Screening are compared. It was found that the ASQ-3 qualitative "overall" questions were a statistically significant indicator of children who could be potentially at risk for speech/language delay, rather than the standardized scored section. It was concluded that parents who voice concern when asked such qualitative questions, may possibly be aware of a risk factor, leading to more thorough routine surveillance of the concern over time. Although there are arguments that can be made in support that this is already standard practice, evidence suggests that it is not consistent enough and that many children slip through the cracks which can lead to a number of negative long-term outcomes (Nelson et al., 2006; Sui, 2015; Stott et al., 2002; Voight & Accardo, 2015).

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## Table of Contents

Abstract.....	ii
Acknowledgements.....	iii
Table of Contents.....	iv
List of Tables.....	vi
List of Illustrations.....	vii
List of Abbreviations.....	viii
Introduction.....	1
Statement of the Problem.....	2
Research Purpose Statement.....	4
Specific Questions to be Answered.....	5
Literature Review.....	5
Classification and Characteristics of Speech and Language Disorders in Children.....	5
Characteristics of Speech Disorders in Children.....	6
Characteristics of Language Disorders in Children.....	6
Communication Disorders and Educational Achievement.....	8
Background to Early Identification and Early Intervention in Child Speech and Language Delay.....	9
Current Methods Used for Child Screening.....	10

Role of a Primary Physician.....	10
Role of an SLP.....	12
Role of a Parent.....	13
Current Speech and Language Screeners.....	14
Direct Administration vs. Parent Questionnaire.....	15
Directly Administered Screening Measures.....	16
Parent Questionnaires.....	17
Correlation between Parent Survey Questionnaires and Early Identification.....	21
Project Rationale.....	22
Research Questions.....	25
Hypothesis.....	25
Methods.....	26
Results.....	35
Discussion.....	43
References.....	48

## List of Tables

Table 1.....	28
Table 2.....	34
Table 3.....	37
Table 4.....	39
Table 5.....	42

## List of Illustrations

Illustration 1.....	40
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## List of Abbreviations

ASHA	American Speech Language Hearing Association
PCP	Primary Care Providers
SLP	Speech-language pathologist
ASQ-3	Ages and Stages Questionnaire, Third Edition
ICS	Intelligibility in Context Scale
AAP	American Academy of Pediatrics
PEDS	Parent Evaluation of Developmental Status
Denver-II	Denver Developmental Screening Test
LDS	Language Development Survey
CDI	McArthur Bates Communicative Development Inventory
CAT/CLAMS	Clinical Adaptive Test/Clinical Linguistic and Auditory Milestone Scale
WILSTAAR	Ward Infant Language Screening Test Assessment/Acceleration/Remediation
Fluharty	Fluharty Preschool Speech and Language Screening Test
PLS-5 ST	Preschool Language Scales, Fifth Edition Screening Test
ELMS	Early Language Milestones Scale
ICF-CY	International Classification of Functioning, Disability, and Health: Children and Youth Version
USPSTF	United States Preventative Services Task Force
IRB	Institutional Review Board



AUSHC Auburn University Speech and Hearing Clinic

PPV Positive Predictive Value

## Introduction

The American Speech-Language Hearing Association (ASHA) defines communication disorders as “an impairment in the ability to receive, send, process, and comprehend concepts...that may be present in the processes of hearing, language, and/or speech” (ASHA, 1993). Broadly, communication disorders affect roughly 59 out of every 1000 children (Siu, 2015) with speech-language deficits affecting about 1 in 12 children or 5% to 8% of preschool children (Burden, Stott, Forge, & Goodyer, 1996; Randall, Reynell, & Curwen, 1974; USPSTF, 2006). By the first grade, roughly 5 percent of children have a noticeable speech disorder (Black, Vahratian, & Hoffman, 2015). The ramifications of untreated speech-language delay can lead to a multitude of problems such as behavioral challenges, mental health issues, delayed literacy, and academic failure (Bashir & Scavuzzo, 1992; Beitchman, Wilson, Brownlie, Walters, & Lancee, 1996; Glogowska, Roulstone, Peters, & Enderby, 2006; Nelson, Nygren, Walker, & Panoscha, 2006; Peterson, Pennington, Shriberg, & Boada, 2009; Raitano, Pennington, Tunick, Boada, & Shriberg, 2004; Shonkoff & Phillips, 2000; Stern et al., 1995; Young et al., 2002). Early detection of speech and language disorders can significantly improve academic outcomes for young children (Beitchman et al., 1996; Catts, Fey, Tomblin, & Zhang, 2002; Scarborough & Dobrich, 1990; Silva, Williams, & McGee, 1987; Stern, Connell, Lee, & Greenwood, 1995). Current methods of screenings are completed by primary care providers (PCPs) during an annual well visit or by referral to a Speech-language pathologist (SLP). Although communication disorders have been found to be the most common disorder in children, the organized identification of children with speech and language delay may be hindered by the lack of a universal screening measure (Skarzynski & Piotrowska, 2012; Siu, 2015; Voight & Accardo, 2015).

## **Statement of the Problem**

Pediatric health programs specialize in the science of child development with the PCP's role being that of monitoring health development and identification of development disorders, therefore encompassing the development of speech and language. Despite the importance of early detection, there is inadequate evidence to support the consistency of screening for speech and language delay in pediatric care settings (Halfon, Olson, Inkelas, & Lange, 2000; King & Glascoe, 2003; Law, Boyle, Harris, Harkness, & Nye, 1998; Nelson et al., 2006). It was also determined that there is not sufficient evidence on the accuracy of active monitoring (surveillance) conducted by pediatric care clinicians to identify children for further evaluation of speech and language delay and disorders (Siu, 2015; USPSTF, 2006). These findings may be the result of conflicting definitions in pediatric medicine versus speech-language pathology. Screenings in pediatric offices are typically a brief questioning process between the physician and parents for the purposes of distinguishing those who do not need further evaluation from those who would benefit from a more comprehensive assessment. In the field of speech language pathology, screenings fall into the scope of practice of a qualified SLP, trained in providing screening, evaluations, and assessment for the purpose of early identification and treatment of such disorders (ASHA, 2008).

Despite conflicting definitions and varying approaches to child screening, a common method of screening children for such delays occurs as a part of preventative pediatric care (Skarzynski & Piotrowska, 2012). Although pediatric PCPs do traditionally provide developmental screenings during well-care visits, there is research that suggests these physicians are not adequately trained to detect such disorders (Voight & Accardo, 2015). Historically, their training includes a requirement to undergo a 4-week sub-specialty experience in developmental-behavioral pediatrics (Accreditation Council of Graduate Medical Education, 2013; Shahidullah

et al., 2018; Soares, Baum, & Patel, 2017; Stein et al., 2017). The limited clinical rotation is scarce in comparison to the two years of specialized training received by SLPs in the evaluation and treatment of speech and language and communication at large (ASHA, 2017). Since pediatricians receive minimal training to identify such disorders and may not have the time or resources to identify children during their typical surveillance routines, it is important to identify others who might reliably gather or provide accurate information that monitors risk factors during the early developmental years.

Other health care providers that may serve in this role are pediatric nurses and SLPs. Pediatric nurses, who provide well-child care, may also conduct repeated measures of child developmental milestones including speech and language during their annual visit (Stokes, 1997). SLPs are also trained to detect the presence of such delays; however, many children are not exposed to a SLP before they go to Kindergarten and by that time, they are of school age and may have already missed many important developmental milestones. Unless a child's parent has a concern and consequently obtains a referral from a PCP to see a SLP before kindergarten for a formal screening or diagnostic evaluation.

Preschool-aged children that have failed developmental screening tests often have parents who had expressed concerns about their child's speech and/or language development (Diamond, 1987; Glascoe & MacLean, 1990; Glascoe, MacLean, & Stone, 1991; Tomblin, 1987). Parents have the potential to provide critical information that could lead to early identification of communication disorders because of their intimate relationship with their child. One which often leads to asking their pediatrician about their child's current level of development and a subsequent referral for a more formal evaluation (Glascoe & MacLean, 1990). Since parents provide developmental information about communication interactions in the child's natural

environment, many questions have surfaced about whether parent report is valid or reliable enough to be considered a feasible and cost-effective method for early identification. Subsequent research suggests that parent report is a cost effective, reliable way to screen children (Dale, Bates, Reznick, & Morisset, 1989; Diamond, 1993; Hall 1989; Rescorla, 1989) and an effective primary foundation for the decision of whether or not a child needs to be referred for further evaluation or treatment (Bricker & Squires, 1989; Diamond, 1993; Regalado & Halfon, 2001).

### **Research Purpose Statement**

The primary purpose of this study was to investigate the accuracy of parent screeners such as the Ages and Stages Questionnaire, Third Edition (ASQ-3) and the Intelligibility in Context Scale (ICS) to identify children who are and are not at risk for speech and/or language delays. In this research, two approaches will be used to identify children with potential speech and language deficit: 1) a formal screening approach provided by trained clinicians and 2) a questionnaire approach, querying parents about their child's speech and language development. The questionnaire approach incorporates parent/caregiver observation and provides objective quantitative total scores obtained from cutoff scores to determine the need for further assessment. Clinician administered screening and diagnostic measures elicit responses from the child that are subsequently scored, analyzed, and compared to the performance of a normative sample. The ASQ-3 and the ICS will be compared with a standardized developmental screening measure and a gold standard diagnostic evaluation for both speech and language.

### **The specific aims of the study are**

1. To determine if parent reported concerns are an accurate indicator of children at risk for speech disorders?
2. To compare the relationship between parent reported concerns indicated by questionnaires and those obtained by formal SLP administered screening tests and diagnostic evaluations.
3. To explore the benefits of combining parent report with formal SLP administered screening tests for determination of children at risk for speech and language disorders.

### **Literature Review**

This chapter serves to present a review of the literature relevant to the purpose of this thesis. It is organized into six sections: a) Classification and Characteristics of Speech and Language Disorders in Children, b) Communication Disorders and Educational Achievement, c) Background to Early Identification and Early Intervention in Child Speech and Language Delay, d) Current Methods Used for Child Screening, e) Current Speech and Language Screeners, and f) Correlation Between Parent Survey Questionnaires and Early Identification.

#### **Classification and Characteristics of Speech and Language Disorders in Children**

Screening for speech and language disorders is a procedure used to determine if children are in need of a more comprehensive evaluation for the determination of a communication impairment. Since the etiologies of most developmental speech and language impairments are unknown (Wallace et al., 2015) and commonly affect children; investigations have historically sought efficient and reliable methods for early detection and further clinical diagnosis. Many studies report that the prevalence rate of detected speech and language delay is between 5 to 8%

for preschool children ranging in age from two years to four and a half years and that the rate ranges from 40% to 60% for children under the age of five who have not yet been treated for a speech and/or language delay (Nelson et al, 2006; USPSTF, 2006).

### **Characteristics of Speech Disorders in Children.**

Articulation is described as the production or motor based aspects of speech. Speech requires exact placement, sequencing, timing, direction, and force of the articulators and is susceptible to malfunction due to the complexity of such movements (Bernthal, Bankson & Flipsen, 2017; Kent, 2000; Shipley & McAfee, 2009; Van Riper, 1972). The precise articulation of speech sounds that form words is responsible for conveying meaning to a listener. A speech disorder, occurs when misarticulated speech sounds persists beyond a certain age (ASHA, 2017). As a result of speech production disorders, many children are determined to have decreased intelligibility; resulting in detectable speech differences (Brice & Roseberry-McKibbin, 2001; Namasivayam et al., 2013; Sices, Taylor, Freebairn, Hansen, & Lewis; 2007). Decreased intelligibility is often due to errors such as distortions, substitutions, omissions, and additions.

### **Characteristics of Language Disorders in Children.**

Language has been referred to as a verbal or written code used to convey information to others (Bloomfield, 1926). A language disorder is an impairment of a person's comprehension or use of spoken, written, or other symbol systems (ASHA, 1993). The prevalence of language disorder in preschool-age children ranges between 2% and 19% (ASHA, 2011). Impairments in language disorders can encompass different areas such as phonology, semantics, morphology, syntax, or pragmatics (Visser-Bouchane, Gerrits, van der Schans, Reijneveld, & Luinge, 2015).

A developmental language disorder describes children who are not typically acquiring language compared to other children their same chronological age (Paul & Norbury, 2012). Signs of a language disorder in children may be that they are quiet, don't initiate conversation, and are very passive either because they do not understand language or they are unable to use it properly (Owens, 2009). Some common characteristics of a language disorder reported during assessment and intervention are classified as receptive or expressive (Heward, 2010). Problems with receptive language involve deficits in comprehending language. In contrast, problems with expressive language involved deficits in producing language despite being able to comprehend it (ASHA, 1993).

Expressive language deficits manifest in many different ways. For example, deficits in grammar are common hallmarks of developmental language disorders (Paul & Norbury, 2012). Children will most consistently struggle with omissions of past tense—ed, third person singular, and the copular form of the verb be when difficulties with syntax are present (Rice, Wexler, & Cleave, 1995). Deficits in phonology are also linguistic in nature and reflect the child's difficulty in learning the sounds relevant to their native language. Some children have consistent error patterns and these errors are commonly referred to as phonological processing errors (Shriberg, Tomblin, & McSweeny, 1999). They experience difficulty with learning the phonological rules that govern patterns of speech sounds specific to the native language (Bernthal et al., 2017; Shriberg & Kwiatkowski, 1982). Deficits in language content also contribute to developmental language disorders. These children have difficulty learning and retaining new words, and when they do it is difficult for them to retain for later use. In addition, semantically encoding or attributing meaning to a word can be strenuous (Alt, Plante, & Creusere, 2004). Specifically, when words are introduced to or read by them they are unable to attach meaning to them which



creates deficits in their developmental language abilities. Children with developmental language disorder find it especially difficult to integrate language into different environmental and social contexts.

### **Communication Disorders and Educational Achievement**

Developmental communication disorders are typically detected in the preschool years when children are becoming competent users of their native language. Communicative competence is considered a basic academic skill (Billeaud, 2003). Speech and language development is an indicator of a child's overall communicative competence and cognitive ability and is also central to the process of predicting educational success (Nelson et al., 2006). A 15-year study of children with speech and language disorders revealed that 52% of children initially identified as possessing a speech or language delay had lasting learning disabilities and poor academic achievement later in their lives (King, Jones, & Lasky, 1982). Bashir & Scavuzzo (1992) conclude that when preschool-aged children experience speech and language delay, they are severely at-risk for detrimental learning disabilities once they enter kindergarten and their school-aged years. Children with a history of speech sound disorders have been shown to be at an elevated risk of literacy impairment; however, it should be noted this risk is greatest when there is a co-occurrence of a language impairment (Anthony et al., 2011; Masso, Baker, McLeod, & Wang, 2017; Peterson et al., 2009). Severe disruptions in the typical development of speech and language can carry far into adolescence and adulthood with lasting effects on literacy, mental health, and employability (Skebo et al., 2013; Wake et al., 2012). These risks can be decreased with the intentional prioritization of early identification and early intervention.

## **Background to Early Identification and Early Intervention in Child Speech and Language Delay**

Screening is an early identification method that predicts the possibility of a delay or indicates a child who may have a disorder (Stott, Merricks, Bolton, & Goodyer, 2002). Public Law 94-142 of 1975 also known as the Education for All Handicapped Children Act ensures developmental care for children ages three to twenty-one with disabilities. One of the central intentions of this law was to improve prevention by allowing young children to be identified as early as possible to receive intervention in a timely manner. Accordingly, when preschool-aged children at risk are identified to have a developmental delay and are given the eligibility to receive intervention services, their chances for improvement are the highest (Nelson et al., 2006).

From the late 1970s to the 1990s, empirically rooted advances were made regarding the value of early intervention for children in the 3-to 5-year age range with developmental delays and disabilities (Billeaud, 2003). Furthermore, Billeaud reported that “a great deal of what is known about infant-toddler development and effective intervention practices emerged from studies and pilot demonstration programs in the 1980s and 1990s” (2003, pg., 11). An amendment was added to the Education for All Handicapped Children Act in 1986 known as Part H or Public Law 99-457 and required states to provide early intervention programs for children birth to three years of age. More recent evaluation of early intervention efforts affirmed that early identification and therefore intervention is effective and yields faster improvement than what would be seen in impaired/delayed children who do not receive intervention (Camilli, Vargas, Ryan, & Barnett, 2010; Guralnick, 1997; McLean and Cripe, 1997; National Research Council, 2001; Reynolds, Want, & Wahlberg, 2003; Schuster, 2000). Intervention at this early stage may render superior outcomes because it is designed specifically for a child’s interests, personality and learning style, and the child’s need are prioritized to make a functional impact in

their day to day lives (ASHA, 2008). Ultimately, the goal of intervention is to help a child successfully use language as a form of communication both receptively and expressively (Prelock et al., 2008).

### **Current Methods Used for Child Screening**

Screening children for speech and language delay and disorders can involve multiple approaches, as there is no uniformly accepted screening technique (Nelson et al., 2006). Milestones for speech and language development in young children are usually determined to be delayed if the child doesn't talk before their first birthday, if speech is not clear, or if speech or language differs from other children the same age (American Academy of Pediatrics, 1997; Ireton & Glascoe, 1995). Screeners are brief, triage evaluations that detect the possible presence of a delay or disorder and alert providers of the need of a more extensive diagnostic procedure (Prelock et al., 2008; Stott et al., 2002). Proper surveillance of such impairments involves a relationship between professionals and parents because of the observational knowledge parents offer, combined with the proficiency of professionals like primary physicians and SLPs (Charman & Gotham, 2012). The section below describes in detail the operations of how parents, primary physicians, and SLPs complete child screeners.

### **Role of a Primary Physician.**

It was recommended by the American Academy of Pediatrics (AAP) in 2006 that pediatric health care professionals monitor children under 36 months during annual wellness check-ups (Pediatrics, 2006). The AAP published clinical guidelines which suggested that standardized developmental screening tools be used during pediatric annual well-visits.

Therefore, screening for speech and language disorders is most commonly completed in pediatric outpatient clinics in the form of developmental surveillance (Prelock et al., 2008; Wallace et al., 2015). The AAP formed the Bright Futures Guidelines for Health Supervision of Infants, Children, and Adolescents (American Academy of Pediatrics, 1990), which serves to provide processes and tools for proper surveillance to primary care providers (Hagan, Shaw, & Duncan, 2017). These guidelines urge that speech and language be screened during these regular well-child visits so that the primary care provider can make a referral for further evaluation by a SLP if needed.

The child's pediatrician is most often the health professional that oversees the completion of the developmental speech and language screening. As the child's primary care provider, the pediatrician has access to relevant medical, family, and developmental records and is considered a professional who has a longitudinal relationship with children and their families (Voight & Accardo, 2015). There is no universally accepted screening method currently used in a primary care setting. Instead, monitoring for speech and language delay in children involves a variety of approaches (Nelson et al., 2006). Primary physicians commonly use broad-band assessment tools that screen for a wide range of developmental problems (Pediatrics, 2006). Broad-band screeners are designed to detect children who are at-risk for multiple developmental disorders (Wetherby, Brosnan-Maddox, Peace, & Newton, 2008). Popular broad-band screeners used by health care professionals include the Parents' Evaluation of Developmental Status questionnaire (PEDS), the Denver Developmental Screening Test, Second Edition (Denver-II), and the ASQ-3 (Pediatrics, 2006). The PEDS asks one question across various developmental domains per parent report to obtain information regarding developmental status. Although the Denver-II is a child based report and ASQ-3 a parent report; both serve to gather more detailed information

about the various developmental domains. Alternatively, primary physicians are also capable of scoring narrow-band parent screeners like the Language Development Survey (LDS) (Rescorla, 1989) and the MacArthur-Bates Communicative Development Inventory (CDI) (Siu, 2015). It is interesting to note that these surveillance tools are all parent-based reports that survey the parents' observations regarding their child's development, with the exception of the Denver-II, which directly assesses the child. The typical practice of a PCP during the annual well-visit of a preschool-aged child is to pay close attention to if the child is meeting their developmental milestones in regards to speech and language (Nelson et al., 2006). If milestones are not met, a screener is used to determine if the child is potentially at risk for delay. Accordingly, if the screener results in the detection of a delay, the child is referred by the primary physician to a speech-language pathologist for a formal diagnostic evaluation (Prelock et al., 2008).

### **Role of a Speech-Language Pathologist.**

SLPs have a wide range of skills, knowledge, and personal characteristics that aid in providing clinical services. Their skills include the capability to be a case selector/evaluator, diagnostician, interviewer, family counselor, teacher, coordinator, record keeper, consultant, researcher, and life-long learner (Haynes, Moran & Pindzola, 2011). Being proficient in all these areas allow them the potential to provide optimal care in the assessment and treatment processes. SLPs are uniquely trained to measure and describe communication and are qualified to diagnose, determine eligibility, and create a plan of care (ASHA, 2008). Traditionally when screening preschool-aged children, SLPs either conduct screening in a clinical or school environment (ASHA, 2007). Information can be drawn from direct interaction with the child, indirect methods like parent questionnaires or interviews, and from observing the child in a natural setting

(ASHA, 2008). There are many standardized speech and language screening tools used by SLPs. Since the screening process is designed for efficient gathering of information, its brevity may result in the SLP having little opportunity to establish a close relationship with the family or obtain extensive background knowledge regarding the child.

### **Role of a Parent.**

Parents have the potential to play an important role in the traditional method of child speech and language screening. Their observation can be critical in early identification and early intervention. Concerns raised by parents are considered by most professionals to be an effective screening tool. They are usually the first to notice a problem developing with a child because of the amount of time they spend with them, knowledge of behaviors at home, and their ability to compare their child to other children who are the same age (Billeaud, 2003; Capute et al., 2008; Dale et al., 1989; Diamond, 1993; Diamond & Squires, 1993; Law et al., 1998; Rescorla, 1989). Research suggests that infants, toddlers, and preschool-aged children that have failed developmental screeners have parents who also had prior concerns about their child's development (Glascoe & MacLean, 1990; Glascoe et al., 1991). Parents have valuable insight due to the amount of time they spend with their children. This parental involvement that provides supplemental information like medical history and personality traits can help detect developmental impairment not observed during a regular screening (Diamond & Squires, 1993). Traditionally, parents are the ones who raise concerns to their child's primary physician who then in turn screens them and refers them as needed (Glascoe, 1999; Ireton & Glascoe, 1995; Olswang, Rodriguez, & Timler, 1998). Most screeners utilized in a physician's office are based on the opinion of the child's parent indicating how central the role of parents is to early

identification and the screening process at large. Evidence has supported the role of parents as excellent resources that can be used to enhance the effectiveness of efforts to identify and monitor children who are at-risk for developmental delay (Diamond, 1987; Hall, 1989; Tomblin, 1987).

### **Current Speech and Language Screening Instruments**

Screening tools in health-care (also described as medical surveillance), are widely used to assess the likelihood of presences of a condition in a specific population. Screening tests are designed to prompt providers to refer subjects for further evaluation. Screening test may be based on direct observation, questionnaires, or qualitative standardized measurement. The major object of such tools is to reduce the long-term effects of the undetected health concern (Maxim, Neibo, & Utell, 2014). Comprehensive assessment, including analysis and interpretation are often resource and time-intensive for practitioners. Screening procedures to identify potential communication disorders provide a means for cost effective and an efficient means of early detection (Bauman-Waengler & Camarillo, 2016; Bernthal & Bankson, 2016).

Developmental screeners that are purposed to assess multiple domains include the ASQ-3 (Squires, Twombly, Bricker, & Potter, 2009), the PEDS (Glascoe, 1991), the Clinical Adaptive Test/Clinical Linguistic and Auditory Milestone Scale (CAT/CLAMS) (Accardo & Capute, 2005), and the Denver-II (Frankenburg, Dodds, Archers, Shapiro, & Bresnick, 1990; Nelson et al., 2006). Although they are designed to detect the presence of a delay in numerous developmental facets, they also have subtests that focus on speech and language. Instruments used for screening that are more concentrated on specific communication domains include the CDI (Fenson et al., 2007); the Ward Infant Language Screening Test

Assessment/Acceleration/Remediation (WILSTAAR) (Ward, 1992); the LDS (Rescorla, 1989); the Fluharty Preschool Speech and Language Screening Test (Fluharty) (Fluharty, 1978); Preschool Language Scales, Fifth Edition, Screening Test (PLS-5 ST) (Zimmerman, Steiner, & Pond, 2011); and the Early Language Milestone Scale (ELMS) (Coplan, 1983; Nelson et al., 2006). Of these screeners that are considered to be more concentrated measurements, only the Fluharty and PLS-5 ST screen for delay in both speech and language (Simmons, 1988). The CAT/CLAMS, CDI, WILSTAAR, LDS, and ELMS are more focused on the early identification of a language delay (Accardo & Capute, 2005; Coplan, 1983; Fenson et al., 2007; Rescorla, 1989; Ward, 1992). While the identification of a language delay is important, it is crucial that children be screened for both speech and language capabilities for early detection of communication based disorders. Important factors in selecting the appropriate screening measure is that it has adequate sensitivity (it identifies children who are at risk for the disorder) and specificity (it does not identify children who are not at risk). In order to be considered a good discriminatory tool, most experts in the field expect sensitivity and specificity to be over 85%. A rating of 80% to 89% is considered fair. Sensitivity and specificity below 80% would indicate a greater likelihood of misidentifications occurring (Pindzola, Plexico, & Haynes, 2016; Plante & Vance, 1994).

### **Direct Administration vs. Parent Questionnaires.**

Child screeners fall into one of two categories: those either to be directly administered to the child or to be completed by a parent figure in the form of a questionnaire or checklist. Screeners that are meant to be administered directly to a child include the Denver-II (Frankenburg et al., 1990), the CAT/CLAMS (Accardo & Capute, 2005), the Fluharty (Fluharty,



1978), the WILSTAAR (Ward, 1992), Early Language Milestones Scale (Coplan, 1983), and the PLS-5 ST (Zimmerman et al., 2011). In contrast, screeners that are intended to be completed by a parent figure are the CDI (Fenson et al., 2007), the LDS (Rescorla, 1989), the PEDS (Glascoe, 1991), and the ASQ-3 (Squires et al., 2009).

### **Directly Administered Screening Measures**

This investigation was focused primarily on the screening instruments that have the capability to detect the presence of both speech and/or language delay. This excluded the CAT/CLAMS, WILSTAAR, Early Language Milestones, CDI, and LDS because of their primary function being to detect language delay. The tests that were further examined included the Denver-II, Fluharty ST, PLS-5 ST, PEDS, and ASQ-3. The Denver-II (Frankenburg et al., 1990) that is designed to be administered directly to the child, has become a commonly used preschool developmental screening test because of its ease of use and practicality (Borowitz & Glascoe, 1986; Feeney & Bernthal, 1996). Within the screener there are four sections that assess different developmental aspects, including social, fine motor, gross motor and language (Frankenburg et al., 1990). Although the Denver-II was designed to identify children at risk for developmental delay, it has a reported average combined specificity and sensitivity to identify these preschool children facing such delays (Borowitz & Glascoe, 1986; Diamond, 1990). Its specificity is limited at 0.43 and has a moderate sensitivity of 0.83 (Glascoe, 2001); however, this screening's sensitivity and specificity has been known to fluctuate based on the study which affects its validity and reliability (Shahshahani, Vameghi, Azari, Sajedi, & Kazemnejad, 2010). The Fluharty is designed to be given directly to a preschool-aged child between the ages of 2 and 6 (Fluharty, 1978). It is a short but comprehensive assessment that is standardized based on a

large population sample and has solid reliability scores (Sturner, Heller, Funk, & Layton, 1993). Within the Fluharty screener there are four subtests that include identification, articulation, comprehension, and repetition (Simmons, 1988). There are mixed results about the sensitivity and specificity of the Fluharty screener. Illerbrun, Haines, & Greenough reported a sensitivity of 65% and a specificity of 93% (1985). In turn, a study conducted by Blaxley, Clinker, & Warr-Leeper (1983) reported less favorable results with a sensitivity of 36% and a specificity of 96%. In addition, there is mixed construct validity based on questionable reports of internal consistency, discriminant, and item analysis (Simmons, 1988). The PLS-5 Screener is designed to be administered directly to the child and usually identifies children at risk for a speech and/or language delay. Specifically, it has subtest sections that provide norm-referenced scores for articulation and language and social/interpersonal communication skills. It can be used for children from birth to seven years and 11 months of age and takes only 5-10 minutes to complete. The sensitivity is 83% and the specificity is 80% for this screener when there is a cut score of one standard deviation below the mean. Although these measures are considered to have a rating of "fair" according to standards in the field (Plante & Vance, 1994), the PLS-5 screening tool is a widely accepted and utilized because of its broad-band capabilities to assess both aspects of speech and language (Zimmerman et al., 2011).

### **Parent Questionnaires**

The PEDS is a parent based screening tool with respected psychometrics and a short administration time (Sices, Stancin, Kirchner, & Bauchner, 2009). Within the PEDS there are 10 questions to be completed by parents that will help to identify developmental delay. Unique to this screener, the PEDS asks a variety of questions that encourage the parent to discuss their

concerns with their child's developmental progress (Cox, Huntington, Saada, Epee-Bounya, & Schonwald, 2010). This parental concern is measured in terms of being predictive of an actual developmental issue or not. Their predictive accuracy is found to be dependent on how old their child is at the time of assessment (Sices et al., 2009). This preschool screener has an average sensitivity and specificity of 0.79 and 0.80 (Glascoe, 1991).

The ASQ-3 is another parent based screening tool commonly used in pediatric settings based to identify at-risk children between the ages of 1 month and 66 months (Squires et al., 2009). It is considered cost-effective and easy to administer (King-Dowling, Rodriguez, Missiuna, & Cairney, 2015). The ASQ-3 is used frequently as a screener because it identifies not just speech and language delays but also developmental delays such as problem solving, communication, and personal-social behavior (Steenis, Verhoeven, Hessen, & van Baar, 2015). Within the test there are six developmental domains that add up to twenty-one total questions. This parent-based questionnaire identifies children for further assessment with an excellent sensitivity level of 86% and specificity level of 85% (Squires et al., 2009). A two-phased systematic review reported the ASQ-3 to be an appropriate calculation of developmental aspects such as a child's physical, social, emotional, cognitive, and speech and language abilities in addition to a reliable way to predict outcomes (Bedford, Walton, & Ahn, 2013; Kendall et al., 2014). Although these measures are all broad-band screeners that include the assessment of speech and language, the feasibility and ease of the parent-based screeners like the ASQ-3 and the PEDS and if they are valid and reliable enough to be considered a practical way to screen children for speech and language delay before having a health professional or SLP perform a diagnostic evaluation are of particular interest in this study.

In terms of speech intelligibility, measures of intelligibility frequently used by SLP's were found by Kent et al. (2014) to assess intelligibility in a primarily clinical context; therefore, the ICS was designed to evaluate children's intelligibility based on parent's estimates of how well their child is understood in natural environments by various communication partners (McLeod, 2012). It was constructed in accordance with the International Classification of Functioning, Disability, and Health: Children and Youth Version (ICF-CY) Environmental Factors to take into consideration different ranges of contexts and listeners that a child communicates with on a daily basis (World Health Organization, 2007). The ICS is a seven question, parent based, subjective questionnaire that utilizes a five-item Likert response scale to measure intelligibility. An investigative study conducted by McLeod, Harrison, & McCormack (2012) examined intelligibility in context using the ICS with 120 four to five-year-olds in Australia. It was found based on parent report that a child's intelligibility varies depending on the communication partner. In addition, they reported children were more easily understood by familiar listeners (e.g., parents, teachers, etc.) and less easily understood by unfamiliar listeners (e.g., strangers, distant acquaintances, etc.). The study conducted factor analysis and tests of inter-item consistency and determined the ICS to be an internally reliable way to measure functional intelligibility. It also evidenced the ICS as a valid and sensitive measure of intelligibility per parent report. Despite worldwide popularity, in 2015 normative studies had not yet been reported. Therefore, a follow-up study conducted by McLeod, Crowe, & Shahaian (2015) aimed to provide normative and supplementary evidence for validity for English-speaking preschoolers. 803 Australian English-speaking preschoolers participated in the study to provide normative data. The study concluded the ICS to be a promising primary screening method with a

short administration time that can be given to parents in an effort to measure children's speech intelligibility in various contexts.

Our investigation is particularly interested in the operations and procedures of parent questionnaires as screening instruments because of their brief, practical but comprehensive reputations. It is reported that the traditionally accepted methods of screening could benefit greatly by including parental knowledge in the assessment of a child's development (Glascoe & Dworkin, 1995; Steenis et al., 2015). Parents are the first line of defense when detecting the presence of a speech and language delay because of their daily surveillance of their child's capabilities and their ability to compare them to other children they meet (Glascoe, 1991). Evidence supports the claim that parent observation in the identification of their children's developmental risk can increase validity, expand reliability, and lower the economic impact of child speech and language screenings (Diamond, 1993; Squires, Nickel, & Bricker, 1990). Therefore, it is suggested that parents be systematically included in the screening process in order to gain as much information specific and accurate to the child as possible (Diamond & Squires, 1993). Because of their previously established and longitudinal relationship with the child, parents have the ability to not only screen accurately but also save valuable time and money while aiding in early identification.

In comparisons of the various types of child screening instruments currently available psychometrically sound parent based screening approaches such as the PEDS and ASQ-3 save an enormous amount of provider time when compared to traditional provider-administered screeners (Sices et al., 2009). The PEDS and ASQ are continually reported as favorable tools in many practices based on their quality and feasibility (Sand et al. 2005; Sices, Feudtner, McLaughlin, Drotar, & Williams, 2003). However, these two tools present different approaches

to collecting observations from parents regarding their children's development to detect the presence of a delay. The PEDS asks parents about their overall developmental concerns, whereas the ASQ-3 focuses their items more on the child's specific skills. For example, the PEDS asks questions such as "Do you have any concerns about your child's learning, development, and behavior?" and the ASQ-3 asks questions such as "Can you understand most of what your child says?". The ASQ-3, however, has been reported to have greater sensitivity and specificity, and is somewhat more favorable for identifying children who are at risk for developmental issues (Sices et al., 2003). Utilizing this valuable information from parents could serve as aid in developing a systematic approach for the detection of delayed speech/language. Research suggests that gathering information from parents can serve to widen the effectiveness of efforts to increase the accurate early identification of preschool-aged children at risk for delay (Diamond, 1993).

### **Correlation Between Parent Survey Questionnaires and Early Identification**

Significant concerns have developed regarding the validity, reliability, and screening efficacy of various screening procedures intended to identify preschool-aged children who were at risk for developmental delay (Glascoe, Martin, & Humphrey, 1990). Despite the questions about the validity of parent report, the inclusion of information from parents in the assessment process is becoming a widely popular practice (Bailey & Wolery, 1989). This popularity is a direct result of recent research that reports parents' report to be as effective as formal standardized screeners in the identification of preschool-aged children with a speech and/or language delay (Diamond, 1987; Tomblin, 1987). Parents that are concerned with their child's developmental abilities typically have children who have failed a clinician-directed

developmental screening (Glascoe & MacLean, 1990; Steenis et al., 2015). Specifically, their observation has been shown to be effective in detecting preschool-aged children with a speech and language delay (Dale et al., 1989). Therefore, parent-based screeners may be a new, beneficial method for the early identification of speech and language delay in preschool-aged children.

The AAP (2006) guidelines suggest that sensitivity and specificity be between 70% and 80% to be considered appropriate for pediatric developmental screening methods, however specificity closer to 80% would help reduce over-referrals (Glascoe, 2005). There is evidence to suggest that the type and content of the task may influence congruence between parental and professional measures. Agreement also may be affected by the greater number of opportunities that parents have than the professionals. Higher levels of parent-professional agreement occurred when the professional had an opportunity to observe the child's behavior over a longer period of time (Hagekull et al., 1984; Prout et al. 1978). Complete agreement between parents and professionals is not the goal since research suggests that, on average, the agreement between parents and professionals ranges between 75-95% (Diamond, 1993). Parental difference of opinion may be valuable in indicating skills that could be seen in one environment and not the other. If a parent based screener meets these guidelines, perhaps parent based report could be a centrally accepted method for early identification as long as the screener encompasses the desired developmental domains. (Diamond & Squires, 1993).

### **Project Rationale**

The AAP (2006) recommendation of screening during a child's annual well-visit highlighted the importance of the role of the primary physician in screening. Despite the push for

developmental surveillance by health professionals during annual well-visits to detect the presence of a delay, only 30% of children in the United States with a developmental issue are identified before they reach kindergarten (King & Glascoe, 2003). This gap in identification could be attributed to the fact that it is not clear how consistently health professionals are screening for speech and language impairments during a child's annual well-visit (Nelson et al., 2006). The National Center for Health Statistics reported that 43% of parents claimed that their preschool-aged child did not receive developmental assessment during their annual check-up, and 30% of parents were frustrated that their child's primary physician did not discuss with them how their child was communicating or if the communication was within normal limits (Halfon et al., 2000). It is suggested that primary physicians are lacking consistency because of time constraint, definite guidelines, and competing demands of the other health aspects of an annual well-visit (Nelson et al., 2006). Also, screenings may be a low priority to some primary physicians because the screenings are time consuming and the monetary compensation for completing such screenings is low (Wallace et al., 2015).

Another limitation to the effectiveness of physician screening reported by the United States Preventative Services Task Force (USPSTF) is that pediatricians may not receive sufficient training to complete such a delicate and specialized assessment. The lack of proper training has been reported to cause confusion about which screening tool or approach would be best because of the wide variety of approaches available to them (Wallace et al., 2015). It has been found that in the absence of the proper measures primary physicians concede to using an informal developmental milestone checklist which lacks in substance and are the primary reason approximately only one in four children are referred for necessary intervention (Prelock et al., 2008). In addition to downgrading from a screener to an informal checklist, primary physicians



are also dismissive of concerns coming from the parent. Olswang, Rodriquez, & Timler (1998) state this as a risk because pediatricians who do not use appropriate screening tools often write off legitimate parent concerns with statements such as: “He’s a boy. Boys talk later” or “Let’s wait and see if it continues,” even though concern from parents regarding their child's speech or language development is correlated with disability (Prelock et al., 2008).

One of the main issues that lies in opposition to physicians effectively implementing child speech and language screenings is the confusion regarding an appropriate method for completing the screenings most effectively and efficiently. As the USPSTF reports, there is currently no gold standard measure for assessing children for a developmental delay such as deficits in speech and language (Voight & Accardo, 2015). This is detrimental because of the mixed reviews regarding traditional practice for screening and whether these practices align with current research on the best method for screening preschool-aged children for delay. Simply, we are in need of a reliable and versatile screening method—a method that has the ability to closely monitor the subject of concern on a routine basis and provide insight about their communication during daily life.

Evidence suggested that parents can effectively screen a child’s speech and language (Dale et al., 1989; Diamond, 1993; Law et al., 1998; Rescorla, 1989; Squires, Nickel, Bricker, 1990). In prior studies, parent-based reports were hypothesized as useful supplementary information because of parent’s ability to be in close contact with the child and compare their child’s development to the development of other children. In this study, the ASQ-3 will be compared to a screening and formal diagnostic examinations administered by an SLP in order to explore the effectiveness of this parent screener as a sound method for identifying speech and language disorders in young children.

## **Research Questions**

1. What is the comparative sensitivity and specificity of the ASQ-3 and ICS when measured against both a developmental screener and diagnostic speech and language assessments administered by an SLP? (True Negative and True Positive)
2. Is there an association between the parent questionnaires (ASQ-3, ICS) and the administered screening measure (PLS-5 ST)?
3. Is there an association between the parent questionnaires (ASQ-3, ICS) and the administered assessment measures (Diagnostic Evaluation of Articulation and Phonology (DEAP) and Preschool Language Scales, Fifth Edition [PLS-5])?
4. Do parents and clinicians agree when classifications by the two questionnaires and the PLS-5 ST are compared?
5. Do parents and clinicians agree when classifications by the two questionnaires and the assessments (DEAP and PLS-5) are compared?

## **Hypothesis**

We expect the parent questionnaires (ASQ-3 & ICS) to be valuable clinical tools for detecting a speech sound disorder and/or a language disorder when compared to an SLP-based screener and gold standard diagnostic evaluations. Specifically, it is suspected that the ASQ-3 will be more sensitive to identifying children at risk of experiencing a language disorder because of the language based questions on the ASQ-3 when compared to a gold standard measure. We would expect the ICS to be more sensitive to identifying children at risk of experiencing a speech sound disorder because the questions address speech based concerns when compared to a gold standard measure.

## **Methods**

### **Ethics Approval**

Study approval was obtained from the Institutional Review Board, Auburn University's (IRB) authorization number 17-204 EP 1707 and 17-388 EX 1709. Permission was obtained from the Auburn University Speech and Hearing Clinic (AUSHC) to provide parents with information about the study to parents during annual screening activities. Parents who consented to participate in the study were provided a demographic form, a case history form, the ASQ-3, and ICS to complete. Researchers collected this information independently from the screening activities performed by clinicians. Once all completed forms were returned to the researchers, children were scheduled for an evaluation of speech and language skills either at the Technologies for Speech and Language Research Lab or at the Auburn Early Learning Center. Screening results were retrieved from AUSHC files under departmental, clinic and IRB approval (17-388 EX 1709).

### **Participants**

Parental consent was received for thirty-six children who participated in hearing, speech, and language screenings provided by the AUSHC clinic outreach activities. Articulation and language skills were screened using the PLS-5 ST. Parents who consented to be in the study were provided three questionnaires: 1) An in-house demographic and background questionnaire; 2) the ASQ-3; and 3) the ICS. Of the thirty-six consented to the study, thirty parents returned demographic and background questionnaires, the ASQ-3, and ICS questionnaires. Children whose parents did not return completed questionnaires were excluded from the study (n=6). Education levels reported by 58 of 60 parents indicated that parents obtained high school and

higher-level education degrees. Thirty-four percent had obtained Bachelor's degrees and forty-six percent graduate degrees.

Thirty child subjects were subsequently evaluated to determine with or without disorder group status. The diversity of the sample included two African-American (7%), two Asian-American (7%), and twenty-six Caucasian children (86%). Children assessed were between the ages 3 years 1 months and 5 years 9 months ( $M = 4.13$ ,  $SD = 0.57$ ). There were slightly more females ( $n = 17$ , 53%), compared to males ( $n = 13$ , 41%). All participants included in the study demonstrated: (1) binaural hearing at 20dB for 0.5kHz, 1kHz, 2kHz, and 4kHz (20dB pass at those four frequencies using Beltone Audio Scout portable audiometer with fitted headphone cups); (2) no parental reports of prior diagnosis of speech-language disorders, neurological deficits or pervasive developmental disorders; (3) oral communication that include at least one word utterances.

### **Speech and language assessors**

Graduate research assistants and supervised student clinicians were trained to collect data, including collection of parent survey/questionnaire, screening measures, and diagnostic evaluations and in scoring procedures. Graduate research assistants were trained by a certified SLP researcher (Research Advisor) and a graduate research assistant (PI) with extensive training in pediatric assessment. Research assistants attended two training sessions and were provided two hands-on training sessions in assessment procedures while under 100% supervision by the research advisor. Students were required to demonstrate competency in both administration and scoring.

## Instruments

### Parent Questionnaire.

Parents were given the ASQ-3 and the ICS to complete. The ASQ-3 is a parent-completed developmental questionnaire for children from one month to 5 years 6 months of age. Parents are queried about their child's developmental across several domains including communication. The completion time is 10-15 minutes. Questions are asked across five developmental domains: communication, gross motor, fine motor, problem solving, and personal-social. Six questions are asked and scored according to the parent's responses of "Yes" (10 points), "Sometimes" (5 points), or "Not Yet" (0 points). Since our focus for this study was in the communication domain, parents were provided the communication subset only. Total scores were obtained by adding the total number of points accumulated from each response and then comparing to standardized cutoff scores specified for each age group to determine not at-risk or at-risk status.

Months	Cutoff score
36	35
42	30
48	35
54	35
60	35

Table 1. Children who score below cutoff score for the age group should be considered for further assessment.

An "Overall" qualitative section is not scored but allows parent to provide information "Yes/No" and open-ended answers about the perception of quality of skills. Three qualitative questions were utilized to determine parent perception of communication skill: 1) "Do you think your child talks like other children her age? If no, explain." 2) "Can you understand most of what

your child says? If no, explain.” 3) “Can other people understand most what your child says?, If no, explain.”. “No” responses for any one of the three questions determined the classification of children to the at-risk category.

The parent’s ASQ-3 scored responses did not indicate that any children across the three, four, and five-year-old age groups were at risk when compared to the cutoff scores ( $n = 30$ ,  $M = 53$ ,  $SD = 7.06$ , Range 35-60). Observation of the qualitative data however revealed parental concern for four children who were not determined to be at risk by cutoff scores. Since there was contradiction between the scores and qualitative responses, the ASQ-3 qualitative determination was examined independently.

The ICS is a quick parent reported measure of child’s intelligibility. Seven questions are rated on a 5-point scale to determine the degree to which children’s speech is understood by parents. The ICS is scored by adding up all the ratings marked by parents on the 7-item questionnaire and dividing that number by 7. The total score is the average of the completed items. All 7 test items must be completed in order to score the screening measure. Scoring is completed by an SLP or trained clinician. The ICS scores range from 1.00 (low intelligibility) to 5.00 (high intelligibility). An average score of 3.5 indicates that the child is usually to sometimes understood (McLeod, 2012). Anything below that score indicates that intelligibility may be impaired. Questions asked by the ICS are similar to those asked by the qualitative questions of the ASQ-3. ICS ratings were scored ( $M = 4.28$ ,  $SD = 0.55$ , Range 3.00 – 4.57) and children given a zero ( $n = 3$ , 10%) if the average was below 3.5.

## **Speech-Language Screeners and Assessments.**

Each child was administered the PLS-5 ST (Zimmerman et al. 2011). The PLS-5 ST was used to briefly assess a broad spectrum of speech and language competence through a series of short subtests with a completion time of 5-10 minutes. The PLS-5 ST is designed for children from birth to seven years, eleven months of age. The test contains six sections (Language, Articulation, Connected Speech, Social/Interpersonal, Fluency, and Voice). Pass criterion are determined by age. Age three, requires four or more language items and five or more speech sounds to be correct; age four, four or more language items and eight or more speech sounds; and age five, five or more language items and eight or more speech sounds to be correct in order to pass. Three children were determined as not passing ( $n = 3$ , 10%) the language section, and four failed the articulation section ( $n = 4$ , 13%).

The PLS-5 (Zimmerman et al. 2011), is also available as an interactive assessment tool used to formally assess the child's overall language ability. Standard Scores are obtained for 1) Auditory Comprehension, Expressive Communication, and Total Language. Group membership was determined based on the Total Language Standard Score. A standard score of 85 corresponds to one standard deviation below the mean. Scores of one standard deviation below the mean were used as the criterion for determining with disorder classification. One child was determined to have a language disorder ( $n=1$ , 3%,  $M = 105$ ,  $SD = 11.47$ , Range 85 to 120).

The DEAP (Dodd, Hua, Crosbie, Holm, & Ozanne, 2002) was given to establish diagnostic category for with or without articulation disorder. The DEAP is a standardized diagnostic evaluation that assess the child's articulation and phonological awareness by subtests such as Sounds in Words, Phonological Process Use, and Connected Speech. It is designed for children between the ages of 3:0 to 8:11. It can be administered to children birth to 7:11 years-

old. The articulation subset of the DEAP will be administered to determine classification of with or without speech disorder. DEAP scaled scores are normed-referenced score that can be used to determine the presences of a speech sound disorder. The scores are on a scale of 10 and a standard deviation of 3. A score of 7 is one standard deviation below the mean and was used as the criterion for determining with disorder classification. Most children were determined to have typically developing articulation skills ( $n = 25$ , 83%,  $M = 9.33$ ,  $SD = 10.19$ , Range 6 to 14). Five children were determined to have scores that were one or more standard deviations below the mean.

### **Procedure**

The Auburn University Child Screening Project involves children in the preschool population who do not have a predetermined diagnosis of communication disorders and their parents. Outcomes from the articulation and language subtests of the PLS-5 ST were retrieved from the AUSHC through clinic and IRB protocol procedures. Children results were recorded as pass/fail based on clinical results. As a part of this study, parents provided demographic information that included a) ethnicity and race, b) home language, c) years of education, d) mother/father occupation, e) birth order, and (f) developmental/health history. Parents complete two questionnaires: 1) The ASQ-3, and 2) the ICS. Two graduate student researcher scored questionnaires independently. Final agreement of 100% was achieved by consensus.

Children were directly administered assessments of speech and language by trained graduate student researchers. These assessments were conducted in the Auburn University Communication Science and Disorders Technologies for Speech and Language Research lab or in a quiet room at the child's early learning center. Assessments were completed in



approximately one-hour and thirty minutes. Some children required two assessment sessions for completion of the tasks. Two graduate student researchers scored the assessments independently. Discrepancies in scoring were resolved by an independent third rater and final score obtained by consensus of the three raters. Final agreement of 100% was achieved by consensus. Group status classification reliability was based on the agreement of assessment standard scores and questionnaire scores obtained for the DEAP, PLS-5, ICS, and ASQ. Two raters were assigned to independently score each measure. For instances of disagreements between the two raters, a third rater independently scored the tools, then findings of the third rater were discussed to evaluate discrepancies in the initial raters findings. The Inter-rater agreement was 96.67% for DEAP between two raters and reached 100% following review of the third-raters score. The agreement between two raters for the PLS-5 was 86.67% and 100% after the third rater scored. For the ASQ and ICS, the inter-rater agreement between the two raters is 100%. Binary classifications (1) for disordered and (0) for non-disordered were determined independently by the Research Advisor and graduate research assistant (PI) from the agreed score of the three raters. Interrater reliability of group classifications was determined to be 100% percent.

### **Data Analysis**

All data were analysed using the Statistical Program for the Social Sciences Version 22 (SPSS). ASQ-3 and ICS. The PLS-5 articulation and language ST's were used to classify children to be at risk for speech and language disorders. Binary classification of children as at-risk (0) and not at-risk (1) were assigned based upon cutoff scores from parent questionnaires and speech and language screening measures. If a parent indicated a concern based upon any of

the three ASQ-3 Overall qualitative questions, children were classified as at risk (1). Children who scored 1 or more standard deviations below the mean on the DEAP and PLS-5 diagnostic measures were considered to be speech and/or language disordered (1) by the gold standard measure.

### **Sensitivity and Specificity**

Diagnostic tests are used in health care provision to classify patients into two groups according to the absence or the presence of a specific tested condition. In this study, we classified participants into without disorder and with disorder groups for speech and language functioning. One approach to quantify how well clinical tools classify individuals into the correct categories is to measure the proportions of the two groups that were correctly diagnosed by the screening and assessment tools. Sensitivity is the proportion of true positives identified while specificity is the proportion of true negatives identified (Altman & Bland, 1994).

	Disordered (number)	Non-disordered (number)	Total (number)
<b>Positive (number)</b>	A  (true positives)  Children with speech- language disorder failed the screener	B  (false positives)  Children without a speech-language disorder failed the screener	<sup>T</sup> Test Positive
<b>Negative (number)</b>	C  (false negative)  Children with the disorder passed the screener	D  (true negative)  Children without with a speech-language disorder passed the screener	<sup>T</sup> Test Negative
	<sup>T</sup> <b>Disordered</b>	<sup>T</sup> <b>Non-Disordered</b>	<b>Total</b>

Table 2. Sensitivity and Specificity

A good screener will have a minimal number of children in cells B and C. Cell B identifies false positives, or individuals without the disorder who failed the screener. In this case individuals without a speech-language problem would be identified as having a problem, while Cell C indicates the number of individuals with the disorder classified as normal. These would be false negatives. A useful screener will identify 85% or more individuals tested in cells A and D. Cell A indicates individuals who failed the screener and are identified with a speech-language disorders and Cell D indicates that those who passed the screener are identified to have normal speech and language development when compared to a standard measure (Haynes et al., 2011). The number of children identified by two measures were retrieved from cross-tabulation classification tables and categorized as true positive, false positive, false negative, true negative, false negative.

## **Correlations**

Bivariate Pearson correlations were used to analyze the relationship between parent group classifications and those classified by clinical based measures. Correlations sizes were classified according to the following criteria: small or no correlation (0.00-0.30), low (0.30-0.50), moderate (0.50-0.70), high (0.70-0.90), or very high (0.90-1.00) (Hinkle, Wiersma & Jurs, 2003).

## **Parent and Clinical Assessor Agreement**

Cohen's (1960) kappa statistics were measured to observe level of agreement between parent classification by questionnaire and clinician classification by screening and assessment measures. Cohen's Kappa is calculated by subtracting  $P(e)$  (probability of expected agreement due to chance taking) from  $P(a)$  (the observed percentage of agreement) and dividing it by  $1 - P(e)$ .  $P(a)$  (degree of observed agreement) is determined by cross-tabulating ratings for two individuals.  $P(e)$  (agreement expected by chance) is determined by the marginal frequencies of each individual's rating [ $K = \frac{P(a) - P(e)}{1 - P(e)}$ ]. Kappa statistics range from 0-1, 0 indicating no agreement and 1 perfect agreement; 0.0 -0.20 slight; 0.21-.40 fair; 0.41-0.60 moderate; 0.61-0.80 substantial; 0.81-1.0 almost perfect or perfect agreement (Hallgren, 2012; Landis & Koch, 1977).

## **Results**

### **Preliminary analyses**

Of the thirty children screened using the PLS-5 ST, four children failed the articulation portion and three children failed the language portion. Further evaluation using "gold standard"

measures of articulation (DEAP) and language (PLS-5) was conducted. Five children were scored  $n \leq 1$  SD below the mean with the DEAP. Of these five children, one child was also identified as having a language disorder when given the PLS-5. Twenty-eight children were without disorder. The prevalence of children with disorders in this sample is equivalent to the national average between 5-8% (Black, Vahratian, & Hoffman, 2015).

### **Sensitivity and Specificity**

The numbers of children identified by two measures, parent questionnaire and either administered screener or assessment, were retrieved from cross-tabulation classification tables in SPSS and were categorized as true positive, false positive, false negative, true negative, or false negative. The ASQ-3 cutoff scores indicated that no children were in need of further assessment. Frequencies from the ASQ-3 qualitative questions and the ICS are provided in Table 3.

Table 3. Results from Classification Table.

		Status determined by clinician assessment		
		D	ND	Totals
Status determined by parent questionnaire	D	TP	FP	
	ND	FN	TN	
	Totals			

	True Positive (1,1)	False Positive (1,0)	False Negative (0,1)	True Negative (0,0)
ASQ-3 qualitative/PLS-5 Articulation screen	3	1	1	25
ASQ-3/PLS-5 Language screen	1	3	2	24
ASQ-3 /DEAP	1	3	4	22
ASQ-3 PLS-5 Assessment	1	3	0	26
ICS/PLS-5 Articulation screen	2	1	2	25
ICS/PLS-5 Language screen	1	2	2	25
ICS /DEAP	1	2	3	24
ICS/PLS-5 Assessment	1	2	0	27

Preliminary analyses of sensitivity and specificity were performed; however, the small sample size of the number individuals with disorders limits the results. The sensitivity of parental questionnaire outcomes was determined by calculating the number of true positives over the sum of number of true positives and false negatives (the total number of children identified to be at risk for or identified to have a disorder for the test population). The specificity of parental questionnaire outcomes was determined by calculating the number of true negatives divided by the sum of the true negatives and false positives (the number of children without disorders). The measure of sensitivity provides information about how many children with disorders were correctly identified by parents as having speech and/or language disorders. High sensitivity indicates that parent questionnaires identify children at-risk who are later determined to have a

speech and language disorder by the comparative measure. Measures of specificity indicate how well parents indicated that they have no concern when children do not have a speech and/or language disorder based on screening and diagnostic measures. Sensitivity and specificity surpassed the levels of between 70% to 80% deemed acceptable by the American Academy of Pediatrics (2006). Comparative analysis of sensitivity and specificity of the ASQ-3 Overall and the ICS were examined. Since the ASQ-3 scored section yields no concerns from any parents our comparisons focused on the ASQ-3 Overall and ICS. When measured against the PLS-5 Articulation ST, the ASQ-3 Overall qualitative questions were found to have a sensitivity of 75% and a specificity of 96% and the ICS had a sensitivity of 50% and a specificity of 96%. When measured against the PLS-5 Language ST, the ASQ-3 Overall qualitative questions were found to have a sensitivity of 33% and a specificity of 89% and the ICS had a sensitivity of 33% and a specificity of 93%. When measured against the DEAP, the ASQ Overall indicated a sensitivity of 50% and specificity of 89%, while the ICS had a sensitivity of 66% and a specificity of 89%.

Table 4. Evaluation of parental reported outcomes vs. clinical screening and assessment measures.

	Sensitivity	Specificity	False positive	False Negative	Percentage agreement	Under-identified	Over-identified
ASQ-3 /PLS-5 Articulation screen	0%	100%	0%	100%	87%	13%	0%
ASQ-3 /PLS-5 Language screen	0%	100%	0%	100%	90%	10%	0%
ASQ-3 /DEAP	0%	100%	0%	100%	93%	7%	0%
ASQ-3 PLS-5 Assessment	0%	100%	0%	100%	97%	3%	0%
ASQ-3 qualitative/PLS-5 Articulation screen	75%	96%	4%	25%	93%	3%	3%
ASQ-3 qualitative/PLS-5 Language screen	33%	89%	11%	67%	83%	7%	10%
ASQ-3 qualitative/DEAP	50%	89%	11%	50%	87%	3%	10%
ASQ-3 qualitative PLS-5 Assessment	100%	90%	10%	0%	90%	0%	10%
ICS/PLS-5 Articulation screen	50%	96%	4%	50%	90%	7%	3%
ICS/PLS-5 Language screen	33%	93%	7%	67%	87%	7%	7%
ICS /DEAP	66%	89%	7%	50%	90%	3%	7%
ICS/PLS-5 Assessment	100%	93%	7%	0%	93%	0%	7%

The positive predictive value (PPV) of a test is determined by the number of true positives divided by the sum of true positives and false positives. The PPV indicates the proportion of subjects in which parents indicated concerns that are at risk or are with speech or language disorder. PPV was evaluated as a measure of the accuracy of parent report when compared to professional screening and assessment outcomes. Parental agreement was measured for the ASQ-3 scored subset, the ASQ-3 Overall, and the ICS. Results indicated PPV values of 0%, 75%, and 66% respectively.



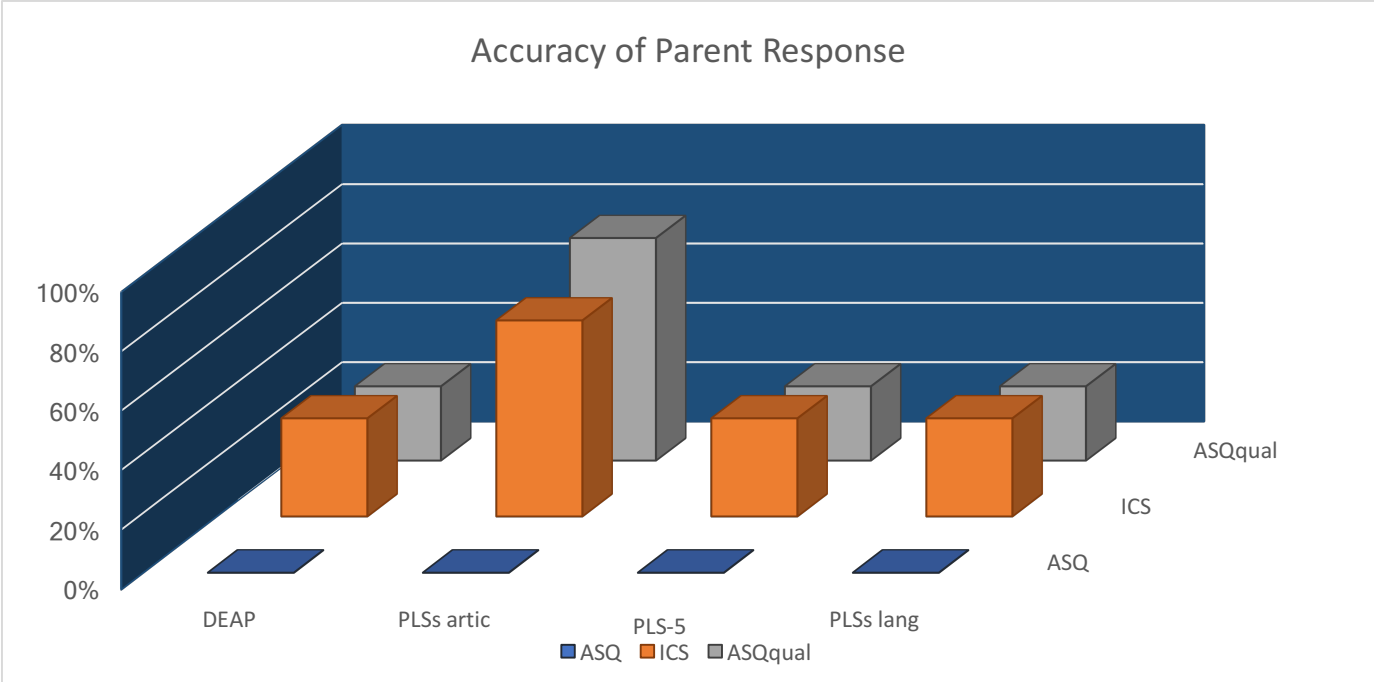


Figure 1: Positive predictive value (PPV) as an indicator of parental accuracy

**Association and Agreement Amongst Parent Report and Professional Measures**

Hypotheses were tested using Pearson’s Correlation two-tailed test to determine if there is a significant relationship between parent questionnaires (ASQ-3 and ICS) and the clinician administered measures for screening (PLS-5 ST) and diagnosis (PLS-5 and DEAP) of speech and language disorders. Cohen’s Kappa statistic was used to measure agreement between parents’ classification of children into non-disordered/disordered group status to that of the assignment by the clinician administered measures.

**ASQ-3**

Correlation analysis was inconclusive since ASQ-3 pass/fail findings were a constant. The cutoff scores from the ASQ-3 did not differentiate between children with and without

disorders indicating that parents did not identify any children to be at risk for communication disorders.

### **ASQ-3 Overall Qualitative questions**

Comparisons of the ASQ-3 overall questions and the professional measure were used to examine the association between each measure. A strong positive correlation ( $r = 0.71$ ,  $p < 0.001$ ) with substantial agreement ( $k = 0.71$ ,  $p < 0.001$ ), was found between the parental and clinician categorization of children when the ASQ-3 Overall qualitative questions and the PLS-5 Articulation ST are compared. When comparing the ASQ-3 Overall qualitative questions to the PLS-5 Language ST, evidence indicated slight agreement ( $k = 0.19$ ,  $p > 0.05$ ) in group classification assignment with a positive weak correlation that did not reach statistical significance ( $r = 0.19$ ,  $p > 0.05$ ). Findings did not indicate a relationship between the ASQ-3 Overall qualitative questions and the DEAP ( $r = 0.23$ ,  $p > 0.05$ ). A significant moderate correlation ( $r = 0.47$ ,  $p < 0.01$ ) was found between ASQ-3 qualitative questions and the PLS-5, with fair agreement ( $k = 0.36$ ,  $p = 0.01$ ) between parents and clinicians.

### **Intelligibility in Context Scale**

Comparisons were then subsequently made using the ICS. A moderate significant relationship between the ICS and the PLS-5 Articulation ST ( $r = 0.52$ ,  $p < 0.01$ ), with evidence of moderate agreement between parents and clinicians ( $k = 0.52$ ,  $p < 0.001$ ) was identified. The correlation between the ICS and PLS-5 Language ST was not significant ( $p = 0.25$ ,  $p > 0.05$ ). Evidence indicated a medium correlation that approached significance at  $p = 0.053$  with moderate agreement ( $k = 0.34$ ,  $p = 0.051$ ) between the ICS and DEAP. A significant moderate correlation

( $r = 0.55$ ,  $p < 0.01$ ) with moderate agreement ( $k = 0.47$ ,  $p < 0.01$ ) was evidenced when comparing the ICS and the PLS-5 assessment.

### Screening Tools and Diagnostic Measures

There is strong evidence of a highly statistically significant positive correlation between the children categorized as non-disordered or disordered when comparing the PLS-5 Articulation ST and the DEAP diagnostic measure,  $r = 0.68$ ,  $p < 0.001$  and when comparing the PLS-5 Language ST to the PLS-5 assessment ( $r = 0.55$ ,  $p < 0.001$ ), each with significant moderate agreement ( $k = 0.55$ ,  $p < 0.001$ ). Moderate agreement ( $k = 0.52$ ,  $p < 0.01$ ) with a positive moderate correlation ( $r = 0.52$ ,  $p < 0.01$ ) was revealed when comparing the ICS and the ASQ-3 Overall qualitative questions.

Table 5. Statistical significance between all reported measures

	ASQ-3 O	ICS	PLS-5STA	PLS-5STL
PLS-5STA	0.712**	0.523**		
PLS-5 STL	0.196	0.259		
DEAP	0.288	0.356	0.681**	
PLS-5	0.473**	0.557**		0.557**
ICS	0.523**			

*Note.* \*\* $p < 0.01$ , \* $p < 0.05$ . ASQ-3 O=ASQ-3 Overall Questions, ICS=Intelligibility in Context Scale, PLS-5STA=Preschool Language Scale Screening Test Articulation, PLS-5STL=Preschool Language Scale-5 Screening Test Language, DEAP=Diagnostic Evaluation Test of Articulation and Phonology

## Discussion

This study aimed to answer three specific research questions regarding parent involvement in the speech and language screening process to determine the usefulness of published parent-based measures the aid in identification of children at-risk for speech and/or language disorders. In preliminary analysis of sensitivity and specificity, we observed that the ASQ-3 Overall qualitative questions when compared to the PLS-5 Articulation ST, fell within the range of 70% and 80% considered appropriate by the AAP (2006), while the other parent-based measures examined did not reach this recommended level. When compared to the DEAP gold standard measure for articulation, the sensitivity and specificity were below 70%. This indicated that although parents may have a sense of the problem and valuable input, they cannot replace the gold standard measure. Observations related to the language assessment were taken with caution since only one child from this test population was identified with a language disorder; however, it was noted that for both the ASQ-3 Overall qualitative questions and the ICS that high levels of sensitivity and specificity were observed, which warrants further investigation with a large sample of children with language disorders. Examination of the PPV of the parent-based measures also confirmed higher levels of congruence between parent and clinical raters for the ASQ-3 Overall qualitative questions and the ICS when compared to the PLS-5 Articulation ST. One important observation was that the ASQ-3 scored questionnaire commonly used in pediatric settings as a surveillance tool for communication development failed to identify children later identified to have a disorder using the clinical screening tools and the gold standard diagnostic assessment.

Associations between the parent-based classification and those derived by clinical measures were tested to examine the statistical significance of the preliminary findings. The

ASQ-3 Overall qualitative questions and the PLS-5 Articulation ST had a statistically significant strong positive correlation with substantial agreement between the parent. A slight agreement was noted when the ASQ-3 Overall qualitative questions were compared to the PLS-5 Language ST. However, the slight agreement did not reach statistical significance. No relationship was found between the ASQ-3 Overall qualitative questions and the DEAP. The ASQ-3 Overall qualitative questions and the PLS-5 assessment indicated a statistically significant moderate correlation with fair agreement between parent and clinician categorizations. The findings, pose interesting considerations about the utility of the tool for routine surveillance, as the test rendered mixed results. The scored section of the ASQ-3 could not be evaluated due to parent result categorizing all of the children into the without disorder category. Surprisingly, however the results from ASQ-3 Overall qualitative questions suggest the possible usefulness of three questions focused on intelligibility of speech, may be vital to early identification of children at-risk for communication disorders.

Correlations were examined between the ICS and the child based language and articulation screeners and diagnostic evaluations. A statistically significant relationship was found between the ICS and the PLS-5 Articulation ST. In addition, the parent and clinician categorization revealed moderate agreement. There was no significant relationship between the ICS and the PLS-5 Language ST. The ICS and DEAP revealed a medium correlation that was not significant and moderate agreement between parents and clinicians. Finally, when the ICS was compared to the PLS-5 assessment, a significant moderate correlation with moderate agreement was found. We hypothesized that a relationship would exist between the ICS parent based questionnaire and the clinician administered measures when assigning children into non-disordered or disordered categories for speech sound disorders. Based on the results, the ICS vs.

PLS-5 Articulation ST showed the strongest correlation when classifying children into typically developing or at-risk categories. The ICS vs. PLS-5 Language ST categorization was not significant indicating agreement with our initial prediction that the ICS would be a more robust indication for children with speech sound disorders. The ICS and the DEAP revealed a medium correlation that did not reach significance. The lack of significance suggests that parent's knowledge should again be considered to be supplementary and not a replacement for the gold standard measure findings.

Correlations were examined between the screening tools (ASQ-3, ICS, PLS-5 ST) and diagnostic measures (DEAP and PLS-5). Between the children categorized as non-disordered or disordered, strong evidence of a statistically significant positive correlation was found when the PLS-5 Articulation ST and the DEAP were compared and the PLS-5 Language ST and the PLS-5 assessment were compared. In addition, each were found to display statistically significant moderate agreement between parent and clinician categorizations. We hypothesized that a relationship would exist between the clinician administered screening and assessment measures when assigning children into non-disordered and disordered categories. The results were consistent with our hypothesis in that the PLS-5 Articulation ST and DEAP and the PLS-5 Language ST and the PLS-5 assessment had a statistically significant correlation.

### **Clinical Implications and Conclusions**

It was determined that for future study and more descriptive results, a larger population would need to be sampled. In this study only one child was identified by a standardized diagnostic assessment to have a language delay. Therefore, the lack of representative data of the effectiveness of parent report in accurately identifying children with a language disorder made it

difficult to draw conclusions. Further considerations for recruitment of children with suspected disorders are needed. Since it is important to have parents who are uninformed about the child's true status prior to completing the questionnaires and since the prevalence of the disorder is 5-8%, a large sample of the population would be needed to increase the number of participants with disorders.

A surprising finding with strong clinical implications is that the ASQ-3 Overall qualitative questions were a statistically significant indicator of children who could be potentially at risk for speech/language delay rather than the standardized scored section. Associations were found between parents who expressed any type of concern on based on the qualitative questions to children found to be at risk for delay or articulation disordered. In observation of the questions that are asked of parents through the scored portion of the ASQ-3, the ASQ-3 may fail to ask critical questions that would identify potentially at-risk children. Questions such as "Does your child consistently move the zipper up when you say up and down when you say down?" were not found to be most indicative of detecting children either at-risk or typically developing.

Another important limitation to note is that all parents who consented to participate or completed the study reported at minimum receiving a high-school diploma or higher education. The majority of parent participants in this study reported receiving a graduate degree, thus indicating that the parents reporting their child's developmental statuses were highly educated. It can be assumed that with a wider range of demographics in a larger sample size that some parents/primary caregiver participants will have varying levels of education and this may have an influence on parental congruence with professional based measures. Additional studies would warrant a more in-depth evaluation of the parent's education level and personality characteristics

in an attempt to profile parents more able to accurately determine their child's speech and/or language developmental status.

In response to the USPSTF concern that there are no well-identified systematic measures for screening young children, one recommendation that could be made is that parents are consistently asked at minimum these three questions: “Do you think your child talks like other children his/her age? Can you/others understand most of what your child says? Can other people understand most of what your child says?” These questions asked within the ASQ-3 Overall qualitative questions beginning at 30 months through 60 months. Since these questions were found to be an important indicator of potential speech sound disorder in this preliminary study, the value of adding these questions to common triage procedure in pediatric health care and education settings should be investigated. Parents that voice a concern when asked these questions may possibly be aware of a risk factor, and their children could be considered to not have passed the triage screening, leading to more thorough routine surveillance of the concern over time. Although there are arguments that can be made in support that this is already standard practice, evidence suggests that it is not consistent enough and that many children slip through the cracks which can lead to a number of negative long-term outcomes (Nelson et al., 2006; Sui, 2015; Stott et al., 2002; Voight & Accardo, 2015).



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