



Preschoolers' oral language abilities: A multilevel examination of dimensionality



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ABSTRACT

This study explored the dimensionality of children's oral language using a fully crossed design, where modality (expressive versus receptive) was crossed with linguistic domain (grammar, semantics and phonology). The present study was also the first of its kind to employ multilevel factor analysis to control confounding classroom effects. Assessments of oral language were completed by 529 children who attended 85 preschool classrooms. The sample was heterogeneous with regard to language ability, ethnicity, sex and SES. Classroom membership was more highly associated with preschoolers' semantics and grammar than with preschoolers' phonological systems. A general language ability was found to drive preschoolers' performances on tests of semantics and grammar, regardless of modality. Furthermore, articulation and speech perception were found separate but correlated abilities. Implications for assessment and diagnosis of oral language impairments are discussed.

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"Oral language development is a critical foundation for reading, writing, and spelling, and it is the engine of learning and thinking".
[(National Institute for Literacy, 2010)]

1. Introduction

1.1. Conceptual basis for distinctions among oral language abilities

A longstanding linguistic conceptualization of oral language asserts separate language systems underlying each domain. Pinker (1997, 1998) proposed a separate mental grammar for rules and a separate mental dictionary for words. However, an extensive review by Bates and Goodman (2001) articulates a more recent linguistic perspective that spoken language is acquired and processed by a unified processing system, rather than discrete and discontinuous mental grammar and mental dictionaries.

Clinical neuropsychology has also provided insights into the processing of oral language. Patients with agrammatic aphasia (i.e., a difficulty in composing sentences) can analyze regular past tense forms of words but not irregular ones, whereas patients with anomia (i.e., a difficulty in retrieving words) can analyze irregular past tense forms of words but not regular ones. Because both types of patients

have injury to different brain regions, their linguistic weaknesses suggest a disassociation between the circuitry responsible for the grammatical analysis of words and for the memorization of words (Ullman et al., 1997). However in their review of the neuropsychology literature, Bates and Goodman (2001) argue that essentially all aphasic patients with deficits in grammar also demonstrate deficits in some aspects of lexical processing.

The American Psychiatric Association considered modality of deficit important for differential diagnosis of Expressive Language Disorder versus Mixed Receptive–Expressive Language Disorder in the prior version of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR; American Psychiatric Association, 2000). However, the recently published DSM-5 (American Psychiatric Association, 2013) foregoes the modality distinction and instead specifies that a Language Disorder is marked by persistent difficulties in acquisition and use of language across modalities. Furthermore, DSM-5's Language Disorder includes deficits in vocabulary, grammar, and discourse. Persistent difficulty with speech sound production was called Phonological Disorder in DSM-IV and subsequently called Speech Sound Disorder in DSM-5.

Speech–language pathologists generally work from a multidimensional framework, believing that distinctions along both linguistic domain and modality are important (Paul, 2001). Diagnostic evaluations are comprised of tests of semantics (e.g., vocabulary), grammar (i.e., morphology and syntax), and phonology (e.g., articulation, speech perception, phonological awareness, phonological memory) in both expressive and receptive domains. Multidimensional assessment permits treatment planning that follows differential diagnosis of those communication disorders outlined in DSM and other more fine grained

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language disorders, such as Specific Language Impairment, which is marked by a specific weakness in morphology in both modalities (Rice, 2003; Rice & Wexler, 1996; Rice, Wexler, & Hershberger, 1998).

In summary, oral language supports healthy academic, professional, family, community, and societal functioning. Many disciplines have contributed to the conceptualization of and understanding of the development and disorders of oral language. Oral language abilities are distinguished by linguistic domain (i.e., semantics, grammar, and phonology) and modality (i.e., expressive versus receptive). Many of these distinctions have been debated inconclusively, in part because most dissociation paradigms are prone to viable alternative interpretations.

1.2. Factor analytic research concerning dimensions of oral language

Exploratory factor analysis is a statistical method that can be used to examine distinguishability of oral language abilities. Most factor analytic research concerning the dimensionality of language has been carried out exclusively with children with atypical language abilities (e.g., Aram & Nation, 1975; Bishop & Edmundson, 1987; Rapin et al., 1996; Wilson & Risucci, 1986). Such methods may yield artificial distinctions among language abilities due to selection biases and attenuation of associations among language abilities due to restriction of range. To our knowledge, only three factor analytic studies have included typically developing children.

Colledge et al. (2002) administered a large assessment battery to 310 pairs of 4-year-old twins with normal language development. Exploratory factor analysis revealed a general Language factor and a Nonverbal ability factor. Most important for the topic at hand is that the Language factor was comprised of measures of semantics, grammar, and phonology. These results suggest that in the population of typically developing children individual differences in language domains overlap substantially, such that individuals who perform well in one domain tend to perform well in other domains too. Unfortunately, Colledge et al.'s study was not designed to specifically ask questions concerning the distinguishability of language skills along the dimensions of domain and modality, as many of their individual measures assessed multiple domains and some individual measures assessed multiple modalities. Also, Colledge et al.'s study did not detail how they excluded children with low language abilities. Such procedures could bias the results against finding factors that reflect separate abilities if the unique clustering of skills is present in children with low incident disorders, which is presumed by fields of speech and language pathology, special education, and psychology.

The most methodologically rigorous studies of the dimensionality of oral language were conducted by Tomblin and colleagues. Tomblin, Zhang, Weiss, Catts, and Ellis-Weismer (2004) studied 379 second grade children with normal language abilities and 225 second grade children with poor language abilities. The participants were administered both receptive and expressive measures of vocabulary and grammar. The participants were also administered expressive measures of phonological short-term memory, phonological awareness, and rapid naming. Exploratory factor analysis revealed that measures of expressive and receptive vocabulary and measures of expressive and receptive grammar formed a single Language factor and measures of expressive phonology formed a Phonological Processing factor. Tomblin and Zhang (2006) extended this work by performing analyses of these children's vocabulary and grammar scores obtained at kindergarten, second grade, fourth grade, and eighth grade. Exploratory and confirmatory factor analyses of data from each separate time point suggested that vocabulary and grammar formed a single language factor. Minor shortcomings of the studies by Tomblin and colleagues, for the purpose at hand, were that they did not include traditional expressive measures of articulation, and they did not include receptive measures of phonology that would be needed to complete a factorial design that fully crossed domain and modality.

1.3. Classroom effects on oral language

Complicating examination of relations among potentially distinguishable language abilities is the fact that children spend much of their time in classrooms. Moreover, much of the language instruction that young children receive is delivered by teachers. Teachers and classrooms differ systematically from one another, even within the same school. As such, the language abilities of children in the same classroom are more alike than those of children from different classrooms. For example, Branum-Martin et al. (2009) found that the clustering of children into classrooms, a.k.a., classroom nesting, accounted for up to 28% of the variance in children's vocabulary scores. The important implication is that statistical analyses that do not separate variability of children's performances into variability associated with classrooms and variability associated with individuals may yield erroneous results. Therefore, any substantive theory of language should be based on research that has accounted for the effects of classroom contexts, either methodologically by including only one child from each classroom or statistically by employing multilevel modeling.

1.4. Study purpose

Because this was the first study to examine dimensionality of oral language at the classroom-level and because it was the first study to examine dimensionality of preschool children's oral language while controlling for classroom nesting, which could have substantial impacts on the magnitude and directionality of child-level covariances, the present study was considered exploratory. Multilevel exploratory factor analysis was employed to simultaneously investigate dimensionality of oral language at both the child and classroom levels.

Extending prior research, the present study included assessments of three linguistic domains (i.e., semantics, grammar, and phonology) in both receptive and expressive modalities. The fully crossed design would permit factors reflecting separate domains or factors reflecting separate modalities to emerge from the factor analysis. A large and heterogeneous sample of preschool children was selected to reflect the full range of abilities in the population at large. However, like Tomblin et al. (2004), we purposefully overrepresented children at risk for having language impairments, so that the study had the power to detect patterns of associations among language skills that occur less frequently in at risk and disordered subgroups.

2. Method

2.1. Participants

Classroom inclusion criteria were full day programming and enrollment in the Texas Early Education Model (TEEM). This empirically validated model emphasizes frequent, intensive, and ongoing professional development for early childhood educators, onsite mentoring, regular monitoring of children's academic progress, and choice from among a list of research-based curricula (Landry, Anthony, Swank, & Monsegue-Bailey, 2009; Landry, Swank, Anthony, & Assel, 2011). Although utilizing a common educational model, TEEM classrooms are very diverse. For example, about an equal number of federally funded Head Start classrooms, state funded public school prekindergarten classrooms, and privately funded child care classrooms participated in the present study. Given that Head Start and state funded public pre-K programs both have eligibility requirements that include financial need, approximately two thirds of the sample was from a low SES background. Whereas all of the teachers from public pre-K programs had college degrees and were state certified in early childhood, teachers from Head Start and private programs ranged in educational attainment from high school through college.

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