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Analysis of Children's Errors in Comprehension and Expression

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Abstract

Children's oral language skills typically begin to develop sooner than their written language skills; however, the four language systems (listening, speaking, reading, and writing) then develop concurrently as integrated strands that influence one another. This research explored relationships between students' errors in language comprehension of passages across oral and written modalities (listening and reading) and in language expression across oral and written modalities (speaking and writing). The data for this study were acquired during the standardization of the Kaufman Test of Educational Achievement–Third Edition (KTEA-3). Correlational analyses from the total sample (n = 2,443-3,552) and within grade bands revealed low to moderate correlations (.26-.50). No evidence of convergent or divergent validity was found when comparing correlations of "same-name" error types (e.g., inferential errors across modalities) with correlations of "different-name" error types. These results support previous research findings and hypotheses that language by ear, eye, hand, and mouth are separable but interacting systems that differ in more ways than modality of input/output.

Keywords

written expression, reading comprehension, oral expression, listening comprehension, achievement errors, KTEA-3, Berninger theory

Language acquisition and development are important topics of research with implications for a variety of fields including literacy, academic achievement, and educational interventions. In searching for ways to help children and adults alike develop their language skills, researchers have investigated ways to model the interaction and progress from sensory information through cognitive processes. From examining evidence from current educational practices, there are multiple pathways, which offer opportunities for discussion. Although there are several differences in how language development can be modeled and differentiated, the majority can be grouped broadly into two developmental frameworks that share common features but ultimately differ pragmatically in the way that language is perceived (comprehension) and produced (expression).

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They are (a) through the use of computational modeling of cognition to study language development as a linear cognitive process from input to a corresponding output—the modalities of reception and expression—which share common factors; and (b) language development with independent unique language systems that are dependent on the receptacle of stimulus rather than the mode of perception and expression, and where development is non-hierarchal and each language system is unique and will develop largely independent of other systems.

A large body of research exists to support two primary methods of language development through the use of computational modeling. The first is through the development of a learning algorithm, which relies largely on back propagation (Rumelhart, Durbin, Golden, & Chauvin, 1995; Rumelhart, Smolensky, McClelland, & Hinton, 1986). This method has been used successfully in developing theories of reading through orthographic and phonological representation (Plaut, McClelland, Seidenberg, & Patterson, 1996; Seidenberg & McClelland, 1989; Zorzi, Houghton, & Butterworth, 1998). The second method does not rely on a learning algorithm and back propagation; instead, the creators specify the model. One very successful example of this method is the Dual-Route Cascade Model (DRC; Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001). Both methods have proven to be successful modeling agencies of language development. However, regardless of which computational model is used, progression can be conceptualized as being dependent on the input and output of modalities, which places the language systems into two separate modalities. Thus, development in expression (speaking and writing) is paired with and largely dependent on comprehension (listening and reading). Overall, language development can be viewed to a large degree as resulting from a difference of input listening versus reading (Patterson & Shewell, 1987) and from a shared language processing system (Coltheart, Patterson, & Leahy, 1994; Lukatela & Turvey, 1994; Perfetti, Zhang, & Berent, 1992; Van Orden, Johnston, & Hale, 1988). By extension, this may suggest that language develops linearly given that there are specific paths which must occur first (reading and listening) followed by cognitive processing and progressing to output (speaking and writing). The process cannot occur in reverse, and speaking and writing cannot occur without the corresponding reading or listening modality.

Alternatively, there has been a growing amount of support for a different conceptualization of language development where each language system is largely independent and the developmental trajectory is non-linear. This second system is an attractive alternative for researchers and educators who want to conceptualize and operationalize individual differences that are observed in the development of reading, writing, listening, and speaking. In this model, the language system can be viewed as four separate language systems with unique functional organization and cognitive processes but which share some common processes and characteristics (Berninger & Abbott, 2010; Berninger, Cartwright, Yates, Swanson, & Abbott, 1994). Learners will exhibit both inter-individual and intra-individual differences in each language system independent of modality of the input/output system. From a developmental perspective, individual progress can be conceptualized as progressing concurrently (Berninger, 2000) rather than following a linear progression or in a set hierarchy. In this model, language is divided into four language systems: language by ear (aural), language by eye (visual), language by hand (physical), and language by mouth (oral).

The conception of four unique language systems rather than through paired perception and production are an extension of Liberman's (1999) conceptual framework. Development of the language is not dependent upon modality of stimulus and not learned sequentially but allows for development to be conceptualized as occurring concurrently (Berninger, 2000). Evidence for this conclusion has developed over a long period starting with early studies in the relationship between reading and writing. Shanahan (1984, 2006) showed that in normal language development, reading and writing have at most 50% common processes and shared variance never exceeds 43%. Indeed, when considering reading and writing, the visual modality does not provide a complete picture: Reading is not the inverse of writing and writing is not the inverse of

reading (Read, 1981). Furthermore, research has shown that spelling, an orthographic representation, is situated not only in a visual modality but also in listening (Berninger, 1994, 1995; Varnhagen, Boechler, & Steffler, 1999).

In considering the common and unique mental processes associated with the four systems, there are a number of studies that show how these four systems have unique processes with respect to sensory–motor link (Richards, Berninger, & Fayol, 2009), mental processes (Altemeier, Abbott, & Berninger, 2008), working memory (Carretti, Borella, Cornoldi, & De Beni, 2009; Hoskyn & Swanson, 2003; Swanson & Berninger, 1995, 1996), and executive functions (Altemeier, Jones, Abbott, & Berninger, 2006; Berninger, Abbott, Thomson, et al., 2006). In addition, these common and unique patterns have been confirmed through the study of neurological functioning and functional magnetic resonance imaging (fMRI) activation (Michael, Keller, Carpenter, & Just, 2001; Richards et al., 2006; Richards et al., 2005).

Looking beyond unique functional processes, there are many studies that have provided evidence to support general development within and across modalities, such as the association of writing skills with reading comprehension skills concurrently and at different times (Babayiğit & Stainthorp, 2011). A growing body of research has shown that oral language continues to develop concurrently with written language (Beers & Nagy, 2009; Nagy, Berninger, & Abbott, 2006; Semel, Wiig, & Secord, 2003). Literature has not just been limited to trends in general development. There is support for the development of particular characteristics related to the individual language systems. Examples include studies looking at aspects of function between reading comprehension and written expression (Abbott & Berninger, 1993; Shatil, Share, & Levin, 2000), reading comprehension and oral expression (Cain & Oakhill, 2008; Catts, 1989), and phonological processing (listening) and handwriting (writing; Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008).

The complexity, interrelatedness, and variance of the four language systems have not only been studied in pairs within the visual-to-visual modality or visual-to-oral modality. There is additional evidence when looking at all four language systems together that not only do inter- and intra-individual differences develop stably, but that each language system is only moderately correlated with the other (Berninger, Abbott, Jones, et al., 2006). Likewise, there have been several longitudinal studies that support concurrent but separate development of the four systems (Berninger, 2000; Berninger & Abbott, 2010; Berninger, Abbott, Thomson, et al., 2006). Factor analysis conducted in these studies has consistently shown that the language systems load onto different factors but are correlated (Abbott & Berninger, 1993; Berninger & Abbott, 2010).

In the present study, our main goal was to evaluate Berninger and colleagues' theory of modality specificity by examining the kinds of errors that students make on the standardized measures of comprehension (reading and listening) and expression (written and oral) that are included in the third edition of the Kaufman Test of Educational Achievement–Third Edition (KTEA-3; Kaufman & Kaufman, 2014).

Listening Comprehension and Reading Comprehension

Listening and reading comprehension are both significant predictors of many factors related to language development and language ability in language learning (Cutting & Scarborough, 2006; Juel, 1988; Juel, Griffith, & Gough, 1986). As both listening and reading are important skills related to input of external stimuli, they share common comprehension processes as well as relating substantially to other language development skills. However, if we view both of these through the lens of Berninger's framework of four unique systems, they should share common traits and processes while also exhibiting unique characteristics, explaining unique variance in skills developed in relation to literacy, and exhibiting dissimilar relationships with the other three systems.

Listening comprehension is an aural skill that relies on both linguistic and non-linguistic skills to develop. Linguistically, the most important factors are phonological processing and knowledge of syntax and semantics (Boyle, 1984). Non-linguistically, accurate listening comprehension requires topical, contextual, and general knowledge of the auditory source (Boyle, 1984). Reading comprehension is a visual receptive skill and like listening comprehension requires both linguistic and non-linguistic factors. Research in reading has consistently shown that decoding, word-recognition, syntax, semantics, and discourse are important to accurately assess reading comprehension (Curtis, 1980; Fromkin, Rodman, & Hyams, 2011). Along with these linguistic factors, non-linguistic knowledge of topic and context is also important for reading comprehension.

The two receptive language skills (listening and reading comprehension) have been studied extensively; current educational philosophy places a large emphasis on their development (Berninger & Abbott, 2010). Studies looking at poor readers or comprehenders have shown that problems in developing accurate and fluent reading are often associated with low phonemic awareness (listening; Bradley & Bryant, 1983). To more accurately represent this interrelationship between phonology and reading, Stanovich (1988) developed the Phonological-Core-Variable Difference Model, which shows that the more specific an impairment is phonologically, the more specific it is in reading. Training studies have shown that, by increasing phonological processing and letter–sound mapping, students have shown an improvement in reading ability (Ball & Blachman, 1988). A regression analysis done by Berninger and Abbott (2010) showed that reading comprehension explained unique variance in listening comprehension and listening comprehension explained unique variance in reading comprehension, which may be evidence for some degree of interaction between specific modality and environment.

While there is evidence to support an extensive interrelationship between listening and reading comprehension, there is also evidence that supports a definitive distinction between the two. In the same study by Berninger and Abbott (2010), factor analysis successfully confirmed a four-factor model of language development and showed through multiple regression that the four language systems—listening, reading, writing, and speaking—shared variance and exhibited dynamically changing unique interrelationships among all four systems. This study served as confirmation of an earlier longitudinal study and initial factor analysis, which differentiated listening and reading and looked at developmental trajectory of these in early and middle childhood (Berninger, 2000; Berninger, Rutberg, et al., 2006).

In addition to Berninger and colleagues' methodology, another useful way to study the interrelatedness of comprehension skills is through the study of the kinds of errors that students make that may be common to both listening and reading comprehension, such as knowledge of syntax, semantics, discourse, topic, and context. The KTEA-3 error analysis permits comparisons across domains across a broad spectrum of learners. The KTEA-3 error categories derived from comprehension of hearing and reading are categorized as literal, inferential, narrative, and expository. The narrative category captures the errors made on literal and inferential questions about narrative passages, which are fictional and use literary text structures. The expository category captures errors made on literal and inferential questions about expository passages, which present factual informational in a non-literary format. Literal comprehension involves finding the answer stated explicitly or similarly in the passage. Inferential comprehension involves looking beyond the text to infer what is not explicitly stated. When trying to establish whether a weakness is specific to reading or more a general language comprehension problem, it is important to develop a comprehensive understanding of the exact relationship between errors in these two receptive skills. If the errors correlate significantly across modalities, then it would support the notion that reading and listening are in fact part of a larger input and modal language system. If, however, listening and reading comprehension are developed concurrently but each as a unique system, the errors should display dissimilar patterns across learners. Importantly, the paragraphs that the students read for Reading Comprehension and listen to for Listening Comprehension are

comparable in content, complexity, and difficulty level; the paragraphs were assigned randomly to one subtest or the other during the development of the KTEA-3. The test formats are also the same: The examinee is exposed to a passage by listening or reading and orally answers questions printed below the written story or asked by the examiner after the audio-recorded story.

Written Expression and Oral Expression

In language development, comprehension is concerned primarily with the receptive skills of language (listening and reading) whereas expression is focused on productive skills, an output. Both written and oral expression are characterized as processes that require the integration of multiple abilities including cognitive, metacognitive, linguistic, and muscle control.

Written expression is characterized as language by hand (Berninger & Graham, 1998) and involves at least three distinct language skills: letter formation (handwriting), word formation (spelling or keyboarding), and text formation (composition; Berninger & Abbott, 2003). Similarly, oral expression has its own particular characteristics and skills. Oral language processes encompass various skill sets including vocabulary (receptive and expressive), syntactic and semantic knowledge, and narrative discourse processes (memory, comprehension, and storytelling; National Reading Panel & National Institute of Child Health and Human Development, 2000).

Just as with comprehension skills, researchers have used comparisons of expressive skills to determine how development in these two systems progress. Unlike with comprehension, however, written and oral expression have more unique characteristics and use distinct skills. For example, handwriting skill is a fundamental skill in motor output, which is unique to a writing system (Abbott & Berninger, 1993). Poor handwriting, such as illegible cursive writing, can be caused by weak motor abilities or coordination problems, limited memory of letter forms, or weaknesses in orthographic processing (Fletcher, Lyon, Fuchs, & Barnes, 2006). Another example is spelling, which is based primarily on the integration of phonological, orthographic, and morphological skills (Gregg & Mather, 2002); however, oral expression does not share any characteristics related to the morphology or orthography—thoughts are conveyed by mouth and it will be received and comprehended through sound.

Although written and oral expression exhibit marked differences in their characteristics and application, they share common traits and processes such as overlapped grammatical structure (Lemon & Buswell, 1943). More than a half century ago, Harrell (1957) conducted longitudinal studies showing that oral language is related to writing. In Berninger and Abbott's (2010) study, both stable talents (relative strengths) and stable disabilities (relative weaknesses) were identified in individual students' language profiles and these were identified for both oral and written language. In the same study, a factor analysis of expression factors showed evidence for a correlation between oral and written factors in Grades 1 to 3, 3 to 5, and 5 to 7. In addition, oral expression explained unique variance in written expression in Grades 3 and 7. Multiple results from this study indicate that oral language continues to develop concurrently with written language during early and middle childhood (Nagy et al., 2006).

Error analysis and error structure of written expression in KTEA-3 Written Expression subtests were categorized into five types: task, structure, word form, capitalization, and punctuation. There is a general belief that understanding test performance by studying the student's incorrect responses is an exemplary method to study growth in language development (Corder, 1967). Greenberg, Ehri, and Perin (2002) argued that error analysis provides a valid method to reveal the strategies that underlie literacy performance. Berninger (1996) encouraged researchers to focus on the constraints (barriers) rather than causes influencing writing skills. Myklebust (1965) also stated the importance of studying errors in writing tasks, "there are many children who readily learn the auditory and visual aspect of words but who cannot convert these aspects into motor patterns" (p. 8).

Performance across writing components (e.g., handwriting, spelling, syntax) and across different types of task formats (i.e., copy, dictation, spontaneous) can help clarify a student's writing competence (Gregg & Mather, 2002). Written expression errors including subword-level transcription (letter production) and word transcription (spelling) are fundamental indicators early in schooling for preventing writing problems later in schooling (Berninger & Amtmann, 2003). Meanwhile, errors vary at different grade levels. Graham (1999) indicated that if children from kindergarten through fourth grade were thinking about letter formation and production, they focused on how to write rather than what to write because they were trying to think and write at the same time (Mayer, 2007). Thus, writing difficulties are not easy to identify until about fourth grade because at this point writing progresses from low-level demands (providing single-word responses or filling in blanks) to higher level demands (composing); meanwhile, the errors they made at the low level will be indicators to help identify children with writing disabilities.

Similar to Written Expression, error analysis and error structure of oral expression on the KTEA-3 Oral subtests were categorized into three types: task, sentence structure, and grammar/word form. The oral expression errors are valid indicators for predicting language disability. Semantic substitutions were found to be the most frequent error type made by language-disabled students ranging in age from 4.3 to 12.7 (Rubin & Liberman, 1983).

For each KTEA-3 subtest, the total number of an examinee's errors per category was transformed into one of three descriptive categorization (weakness, average, or above average) based on a normative comparison. Each student's total number of errors per category was compared with that of other students in their grade who completed the same items on the same form, and was then dichotomized as either a weakness (0) or average/above average (1).

Just as with listening and reading comprehension, to develop a meaningful comparison between weaknesses in language development from expression, we compared patterns of errors between these two expressive skills. If the errors common to both means of expression (task, structure, and word form) correlate significantly across modalities, then it would support the notion that writing and speaking may be part of a larger output and modal language system. If, however, these systems develop concurrently but are in fact two unique systems based on the means of expression, the errors should display some commonality but largely dissimilar patterns across learners.

Method

Participants

The participants in this study were students tested during the standardization of the KTEA-3 (Kaufman & Kaufman, 2014) between August 2012 and July 2013. Demographic data for these samples are provided in the *KTEA-3 Technical and Interpretive Manual* (Kaufman, Kaufman, & Breaux, 2014). About half of the sample was tested on KTEA-3 Form A and half on KTEA-3 Form B.

The total sample (N = 3,842) included 1,988 females and 1,854 males in Grades pre-K-12 (median grade = 4) who ranged in age from 4 to 19 years (M age = 10.4 years, SD = 3.9 years). The sample was 54.9% White, 20.5% Hispanic, 14.7% African American, 3.9% Asian, and 6% "Other" (e.g., Native American). Parent's education (mostly mothers, used as an estimate of socioeconomic status) was 32.0% with <12 years of schooling, 32.2% with high school diplomas or General Educational Development (GED) certification, 34.5% with 1 to 3 years of college or technical school, and 1.3% with 4-year college degrees or more. All participants lived in the United States with 24.1% residing in the Midwest, 14.1% in the Northeast, 39.5% in the South, and 22.2% in the West. Table 1 presents the sample size and demographic information for the total sample by age band: 4 to 5, 6 to 11, and 12 to 19. As is evident from the table, each of the

Table 1. Demographic Characteristics of the Total Sample.

Age range	4-5	6-11	12-19	Total = 4-19
n	464	1,867	1,512	3,843
Grade range	PK-K	K-7	4-12	PK-12
Grade median	PK	3	9	4
Age *M*	4.6	8.4	14.5	10.4
Age *SD*	0.5	1.7	1.9	3.9
Sex				
Female	49.4	51.3	53.0	51.7
Male	50.6	48.7	47.0	48.3
Ethnicity				
White	55.6	52.9	57.3	54.9
Hispanic	18.3	21.4	20.1	20.5
African American	16.2	15.4	13.4	14.7
Asian	2.8	4.4	3.6	3.9
Other	7.1	6.0	5.6	6.0
Parent education				
<12 years	28.7	31.3	33.8	32.0
12 years	36.4	32.1	31.1	32.2
13-15 years	34.9	35.2	33.5	34.5
16+ years	0	1.3	1.7	1.3
Region				
Midwest	22.6	23.9	24.9	24.2
Northeast	16.6	12.8	15.0	14.1
South	38.1	40.7	38.6	39.5
West	22.6	22.6	21.6	22.2

Note. Except for sample size (*n*) and age, data are reported as percentages. PK = prekindergarten.

three age bands had extremely similar distributions on the demographic variables of sex, ethnicity, parent's education, and geographic region. Furthermore, all age bands and the total sample closely matched the percentages in each category as reported by the U.S. Census Bureau's American Community Survey 2012 1-year period estimates (Ruggles et al., 2010; although citation is 2010, reported census data are from 2012), which are reported in the *KTEA-3 Technical and Interpretive Manual* (Kaufman et al., 2014).

Procedure

Data for the factor analysis were collected from the total sample. Participants with incomplete data within any of the Comprehension or Expression subtests were removed from further analysis.

KTEA-3. The third edition of the KTEA-3 (Kaufman & Kaufman, 2014) is an individually administered diagnostic achievement test for grades prekindergarten through 12, or ages 4 through 25. The KTEA-3 covers a wide range of achievement and language domains, and provides subtest error analysis capabilities.

Statistical Analysis

To develop meaningful comparisons of error patterns across both comprehension and expression, it was decided to find the dimensions that underlie the error categories of listening, reading,

Table 2. PCA for Errors in Comprehension for the Total Sample (n = 2,443).

	Factor 1	Factor 2	Factor 3	Factor 4
Reading Comp–Literal Comp	.78	.06	−.09	.23
Reading Comp–Inferential Comp	.42	−.01	.10	.58
Reading Comp–Narrative Comp	.12	−.02	−.03	.93
Reading Comp–Expository Comp	.92	.00	.06	.05
Listening Comp–Literal Comp	−.18	.27	.80	.13
Listening Comp–Inferential Comp	.33	.76	.07	−.18
Listening Comp–Narrative Comp	−.11	.97	.03	.10
Listening Comp–Expository Comp	.17	−.06	.97	−.08

Note. PCA = principal components analysis; Comp = comprehension.

speaking, and writing. Because each Comprehension and Expression subtest has a smaller number of error scores that, in general, are the same across the subtest type (comprehension or expression), one polychoric correlation matrix was generated for each subtest type (comprehension and expression) to generate factor scores. For the generation of factor scores polychoric correlations were used instead of Pearson correlations because our variables were on an ordinal rather than interval scale. Comprehension and Expression subtests include a small number of error scores, so principal components analysis (PCA) was used to extract the factors for these subtests. In addition to analyses conducted on the total sample, separate analyses were conducted by grade level: pre-K to 4, 5 to 8, and 9 to 12.

Interrelationships Between Comprehension and Expression

Polychoric correlational studies were conducted to investigate the convergent and divergent validity of these variables with respect to the total sample of students in Grades 1 to 12 (n = 2,443-3,552). Those students from the total sample with incomplete or missing data that corresponded to each individual analysis were removed from the sample pool, thus creating variable sample sizes dependent on the subtests included in the analysis: Comprehension subtests (n = 2,443) and Expression subtests (n = 3,087).

Results

Dimensions of Error Categories

Results from the PCA are presented in Tables 2 (comprehension) and 3 (expression). For both, a four-factor solution was deemed the best fit based on the magnitude of eigenvalues, the scree test, and psychological meaningfulness of the solution. For the PCA of errors in comprehension, loadings were moderately strong across the four factors

In the comprehension PCA, there was a clear distinction of loading between listening and reading errors. Errors in reading comprehension loaded onto two factors while listening comprehension loaded onto two other factors. The factor structures for both reading and listening were very similar. Factor 1 included literal and expository reading comprehension, and Factor 3 included literal and expository listening comprehension. Factor 2 included inferential and narrative listening comprehension, and Factor 4 included inferential and narrative reading comprehension. In addition, the PCA result in the analysis of errors for comprehension revealed that inferential listening comprehension had adequate loadings on Factor 2 (inferential and narrative comprehension) as well as Factor 1 (literal and expository reading comprehension). Consequently,

Table 3. PCA for Errors in Expression for the Total Sample (n = 3,087).

	Factor 1	Factor 2	Factor 3	Factor 4
Written Expression–Task	.78	−.06	.03	.18
Written Expression–Structure	.71	.00	.19	.08
Written Expression–Word Form	.93	.10	−.07	−.16
Written Expression–Capitalization	−.08	.05	.98	−.06
Written Expression–Punctuation	.19	−.05	.76	.05
Oral Expression–Task	−.01	.05	−.02	.97
Oral Expression–Structure	.04	.86	.05	.11
Oral Expression–Word Form	.01	.98	−.02	−.04

both listening inferential (0.33) and reading inferential (0.42) have adequate secondary loadings on Factor 1, a reading factor. Although these loadings were small, this was one instance where reading and listening comprehension contradict the otherwise uniform results, which support separate modalities.

PCA results for errors in expression are presented in Table 3. Similar to the results for comprehension, expression errors loaded moderately to strongly across four distinct factors.

Errors in written expression and oral expression each loaded onto two factors. Factor 1 included errors in general written expression (task, structure, word form) and Factor 4 included errors in Oral Expression–Task. Factor 2 included errors in oral expression grammar (structure, word form), and Factor 3 included errors in writing mechanics (capitalization, punctuation), which do not have an analog in the oral test.

Factors 1 and 2 share "Structure" and "Word Form"; however, "Task" is included in Factor 1 (written) but not Factor 2 (oral). This result may be explained by differences in the way task is operationally defined and scored for the KTEA-3 Written Expression and Oral Expression subtests. Task errors on either subtest indicate that the response was not meaningful or did not meet the basic requirements of the task; however, the task demands differ across subtests. Written Expression items require a number of different tasks such as writing sentences from dictation, completing or combining sentences, editing passages, or writing an essay (Kaufman & Kaufman, 2014). For this reason, the Written Expression–Task criteria are item specific. Task errors indicate one or more of the following: the response was off topic; did not make sense; did not correctly use required words, phrases, or ideas; or did not follow the instructions (Kaufman & Kaufman, 2004). In contrast, Oral Expression items require the examinee to say a complete sentence that describes a photograph, and later items require the use of target words or a beginning phrase. The Oral Expression–Task criterion is the same across all items. Task errors indicate one or more of the following: the response did not relate to the picture or did not make sense, did not include the target words (if applicable), or did not include a verb and at least one noun or pronoun (Kaufman & Kaufman, 2004).

To produce a more accurate representation of the relationship between errors across the entire spectrum of academic language development, we next conducted PCA using errors in comprehension and expression across three separate grade bands: pre-K to 4, 5 to 8, and 9 to 12. The factor structure of these grade bands was nearly identical to the factor structure of the total sample, so the total sample PCA will be used for general discussion.

Interrelationships Between Comprehension and Expression

To evaluate convergent and divergent validity of the KTEA-3 error analysis categories, polychoric correlational studies were conducted on the total sample of students in Grades 1 to 12

Table 4. Polychoric Correlations Between Errors of Reading and Listening Comprehension.

n	2,792	2,792	2,443	2,661	3,552	3,552	3,543	3,026
M	0.96	0.94	0.95	0.95	0.89	0.91	0.85	0.90
SD	0.67	0.69	0.68	0.70	0.69	0.63	0.63	0.67
	Reading Literal	Reading Inferential	Reading Narrative	Reading Expository	Listening literal	Listening Inferential	Listening Narrative	Listening Expository
R-literal	1.00	.65	.72	.86	.41	.40	.35	.43
R-inferential	—	1.00	.81	.81	.44	.48	.39	.48
R-narrative	—	—	1.00	.59	.35	.35	.32	.37
R-expository	—	—	—	1.00	.45	.47	.40	.50
L-literal	—	—	—	—	1.00	.56	.76	.86
L-inferential	—	—	—	—	—	1.00	.72	.70
L-narrative	—	—	—	—	—	—	1.00	.48
L-expository	—	—	—	—	—	—	—	1.00

Table 5. Polychoric Correlations Between Errors of Written and Oral Expression.

n	3,087	3,087	3,087	3,669	3,669	3,669
M	0.88	0.94	0.89	0.92	0.90	0.92
SD	0.48	0.58	0.45	0.62	0.64	0.63
	Written Task	Written Structure	Written Word Form	Oral Task	Oral Structure	Oral Word Form
Written Task	1.00	.56	.45	.35	.32	.22
Written Structure	—	1.00	.43	.34	.34	.27
Written Word Form	—	—	1.00	.31	.30	.26
Oral Task	—	—	—	1.00	.39	.28
Oral Structure	—	—	—	—	1.00	.75
Oral Word Form	—	—	—	—	—	1.00

(n = 2,443-3,552). Descriptive statistics and polychoric correlations for comprehension are presented in Table 4.

Low to moderate correlations were observed in the total sample for literal, inferential, narrative, and expository errors made in comprehension (listening vs. reading) ranged from .32 to .50. Descriptive statistics and polychoric correlations for expression are presented in Table 5.

Again, low to moderate correlations were observed in the total sample for literal, inferential, narrative, and expository errors made in comprehension (listening vs. reading) and ranged from .26 to .35.

Correlations between errors on parallel Comprehension–Expression subtests across the three grade bands revealed trends toward slightly higher correlations as students progress in grade level. However, overall similar correlation patterns were observed across the grade bands. No evidence of convergent or divergent validity was found when comparing correlations of "same-name" error types with correlations of "different-name" error types.

Discussion

The goal of this study was to examine the relationship between student errors in comprehension and expression based on results from the KTEA-3 and to interpret these results from the context

of Berninger's modality-specific theory (e.g., Berninger & Abbott, 2010). We hoped to determine an appropriate method to conceptualize the relationship between the language systems of listening and reading (comprehension) and speaking and writing (expression). Specifically, the primary hypothesis predicted a pattern of dissimilar error patterns across learners and across both comprehension and expression modalities. Results of our correlation matrices and PCA support this hypothesis and indicate that the two language systems that make up comprehension and the two language systems that make up expression should be viewed as independent. In addition, our results also support concurrent and independent development of all four language systems. Simply stated, this means that language systems do not depend on modality for development and are not wholly dependent on other systems for development (listening to speaking, reading to writing). Our findings are consistent with the framework provided by Berninger and colleagues (Abbott & Berninger, 1993; Berninger & Abbott, 2010) and add evidence to a growing body of literature in conceptualizing language development.

Methodological and Theoretical Significance

PCA and underlying dimensions. In comparing student errors across subtests of comprehension and expression, we first used PCA to determine what, if any, underlying dimensions exist in the tests. Our findings support a four-factor model across comprehension and expression and across all ages and grades.

The expository category captures errors made on literal and inferential questions about expository passages, which present factual information in a non-literary format. Literal errors involve finding the answer stated explicitly or similarly in the passage. The narrative category captures errors made on literal and inferential questions about narrative passages, which present factual information in a literary format. Inferential errors involve looking beyond the text to infer what is not explicitly stated. For both listening and reading comprehension subtests, literal and expository errors tended to group together as did inferential and narrative errors. These factor groups were unexpected. The number of inferential expository items on the KTEA-3 is similar to the number of inferential narrative items, although there tend to be more literal expository items than literal narrative items. On average, literal comprehension tends to be relatively easier than inferential comprehension, and the more familiar text structures utilized in narrative texts tends to make narrative comprehension relatively easier than expository comprehension (Basaraba, Yovanoff, Alonzo, & Tindal, 2013). Alternatively, the expository passages are generally written in a logical progression, which may lead to more errors in literal comprehension as opposed to inferential errors. Narrative comprehension, however, may be associated primarily with inferential errors because the narrative passages are written to allow readers to draw inference and conclusions from the text.

These error pairings, although common across comprehension, are dependent on the modality of comprehension, such that errors in reading comprehension do not correspond to errors in listening comprehension or vice versa. Conversely, stability of these patterns across ages provides additional evidence for independence of development in reading and listening rather than a dependence of one modality on another.

There is one notable exception to these results: Errors in inferential listening were found to load onto both the listening comprehension inferential and narrative factor as well as to the reading comprehension, literal, and expository factor. It is possible that inferential comprehension is a reflection of an individual's fluid intelligence (*Gf*) and general intelligence (*g*), which has been shown to correlate highly and consistently over broad tests of achievement (Kaufman, Reynolds, Liu, Kaufman, & McGrew, 2012) and would, therefore, load promiscuously over both the reading and listening inferential comprehension sections subtests. Although these results were not entirely unexpected, it was somewhat surprising that there were not more small or moderate cross

loadings across listening and reading comprehension. One possible explanation may be that for weak word-level readers, listening comprehension tends to be well above grade-level reading comprehension (D. Kilpatrick, personal communication, April 2, 2016). This would imply that differences in the loading between reading and listening may be due to differences in ability at grade level, rather than evidence for a developmental relation between reading and listening language systems. Alternatively, listening comprehension may require an inordinate amount of attention and short-term memory compared with reading comprehension, which will affect performance and error patterns across those modalities.

The PCA results for the Expression subtests suggested that similar error categories are dependent on the modality of the expression rather than the type of error. Likewise, the errors were stable across ages, which implies that development in the two expressive language systems of writing and speaking are independent of one modality and may develop concurrently.

The PCA results suggest that error patterns in comprehension and expression are indicative of the development of four language systems as opposed to a dual-route system based on modality of input. The findings also suggest minimal interaction developmentally across oral and written modalities. These findings support and expand earlier work done using factor analysis, which has shown similar results of independent listening, reading, writing, and speaking language systems (Abbott & Berninger, 1993; Berninger & Abbott, 2010).

Relationships among the four systems. After examination of the underlying dimensions of the errors, correlational analyses of errors were conducted to provide evidence of convergent and divergent validity for the interdependence of errors between listening, speaking, reading, and writing. The data revealed a trend of dissimilar errors across parallel subtests (listening–reading, speaking–writing). These results confirmed our hypothesis of relative independence of modalities during language development and supported Berninger and Abbott's framework (Abbott & Berninger, 1993; Berninger & Abbott, 2010) of independent language systems with distinct characteristics. No significant correlations were found across any of the language systems, lending support to the idea that errors in one language system will not necessarily correspond directly to errors in another system. This evidence taken together with the earlier PCA results suggests that errors in a specific modality should be viewed as having a developmental effect, which is limited to the specific skills required for the specific task. These same errors will not necessarily translate into more errors in a similar task that originates in a different modality. In addition, stability of errors across ages and grades implies that these language systems do not show developmental interdependence and may in fact develop largely concurrently and independently as has been suggested in prior studies (Berninger, 2000). Alternatively, as suggested by recent work through fMRI (Michael et al., 2001; Richards et al., 2006; Richards et al., 2005), development may be mediated by common cognitive processes, which may be shared across all modalities.

Educational Implications

Language is not a unitary construct. Rather, four language systems exist: language by eye (reading), language by hand (writing), language by ear (listening), and language by mouth (speaking; Berninger & Abbott, 2010). Each of these language systems has a specific developmental trajectory. Instruction should not be limited to addressing what a student can see followed by what they can write or alternatively going from what they can hear to what they can say. Instruction throughout K-12 should focus on developing each individual language system as a means of increasing overall language ability and as a way to address an individual student's strengths and weaknesses in language and literacy. In the context of evaluation and education testing, evaluators can leverage the KTEA-3 to carefully examine the specific error patterns on tests of each of the four systems.

Limitations and Future Research

This research sought to better understand the relations between the four language systems of listening, reading, writing, and speaking by investigating student error patterns. Although error analysis can provide a rich and detailed picture of developmental trajectory across grade levels, it is not without its limitations. Foremost is the generalizability of our results to all school-age children. This study was conducted with the explicit goal of looking at the relationship of comprehension and expression in typical students. As such, these results and conclusions may only be applicable to a similar demographic. Certainly these results can and should inform further research into the language development of other important student populations such as students with clinical disorders, students who are categorized as gifted, and adults. Furthermore, the assessment and error analysis systems utilized were specific to the KTEA-3. Findings may vary with other measures of listening, speaking, reading, and writing.

A second consideration is the scope of our population. Similar to the first issue, which limits generalizability to similar populations, our analysis is limited to the broadest conceptualization of a typical student. In this study, we did not address the effects of other factors that may have significant impacts on language and literacy development such as gender, parental education, and socioeconomic status. Thus, additional studies will be worthwhile for further investigating educational implications as well as increasing understanding of how language develops in a variety of contexts.

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