Measuring the Relationship Between Lexical and Phonological Development in Typically Developing 2- and 3- Year Olds

Brooke Santos, BA & Anna Sosa, PhD, CCC-SLP

Communication Sciences and Disorders; Northern Arizona University; Flagstaff, Arizona, USA

BACKGROUND

Lexical-Phonological Relationships

Lexical and phonological development tend to be commensurate in typically developing children (Stoel-Gammon, 2010).

- Vocabulary size predicted 2-year-olds' performance on tasks of phonemic sensitivity (Schwarz, et al., 2006).
- Rates of intra-word variability were more strongly correlated with vocabulary size than with chronological age in typically-developing 2-year-olds (Sosa & Stoel-Gammon, 2012).
- Expressive vocabulary was a better predictor of non-word repetition accuracy than chronological age in typically developing 3- to 8-year-olds (Edwards et al., 2004).
- In Spanish-English bilingual 2-year-olds, vocabulary size and non-word repetition accuracy were significantly correlated within each language, but not across languages (Parra, et al., 2011).
- This relationship has also been observed in 2-year-olds with language impairment (LI) (Rescorla & Ratner, 1996) and in lexically precocious 2-year-olds (Smith, et al., 2006), in whom vocabulary size was associated with accuracy of final consonant production.

Types of Phonological Errors Associated with Language Development

- A higher rate of atypical sound changes was associated with poor phonemic awareness and lower receptive vocabulary in 4-5-year-olds with SSD (Preston & Edwards, 2010).
- Children aged 3 ½ to 5 ½ years with comorbid SSD and LI exhibited more omission errors than children with SSD only (McCrae & Tyler, 2014). The two populations had similar error rates, but differed in types of errors.
- Children with SSD whose speech did not normalize within one year had a higher rate of omission errors than children whose speech did normalize (Shriberg, et al., 1994).

Goals of the Current Study

1. To investigate whether a relationship exists between lexical and phonological development in typically developing preschool-aged children, and whether such a relationship can be detected using standardized clinical assessments of receptive and expressive vocabulary, articulation, and phonology.
   - *Hypothesis 1:* Vocabulary size will be negatively correlated with total number of articulation and phonological errors in children aged 2;6 to 3;11.
2. To investigate whether specific types of phonological errors are associated with vocabulary size.
   - *Hypothesis 2:* Based on previous findings, it was hypothesized that vocabulary size will be most strongly correlated with deletions and atypical phonological errors.

METHODS

Participants

- 86 children (37 male, 49 female) ages 2;6 to 3;11
- Residents of Northern Arizona whose primary language is American English
- Typically developing, with no history of speech, language or hearing concerns (based on parent report)
- All participants attained standard scores of 85 or higher (i.e. no more than 1 standard deviation below the mean) on each of the four assessments administered

Assessments

- Goldman-Fristoe Test of Articulation, 2nd Edition (GFTA-2)
- Khan-Lewis Phonological Analysis, 2nd Edition (KLPA-2)
- Expressive Vocabulary Test, 2nd Edition (EVT-2)
- Peabody Picture Vocabulary Test, 2nd Edition (PPVT-4)

METHODOLOGY (continued)

Procedures

- Children participated in hour-long data collection sessions in a university clinic therapy room or at their preschool. Sessions were audio recorded using a high-quality Zoom shotgun microphone.
- The clinician who administered the assessments used the audio recording of the session to produce a broad phonetic transcription of the GFTA-2 stimulus words.
- All assessments were scored using ASSIST software for GFTA-2 and KLPA-2. This software automatically counts individual phonological processes, along with distortions, deletions, additions, substitutions, and atypical phonological errors.

Reliability

- A second researcher independently transcribed GFTA stimulus words for 12 participants. Overall point-to-point inter-rater reliability for consonants ranged from 78% to 99% with a mean of 91%.

RESULTS

Table 1: Correlations Between Assessment Raw Scores

		Age (Months)	GFTA Raw	KLPA Raw	EVT Raw	PPVT Raw
Age (Months)	Pearson Correlation	1	-.308**	-.287**	.649**	.656**
	Sig. (2-tailed)		.004	.007	.000	.000
GFTA Raw	Pearson Correlation	-.308**	1	.903**	-.510**	-.537**
	Sig. (2-tailed)	.004		.000	.000	.000
KLPA Raw	Pearson Correlation	-.287**	.903**	1	-.493**	-.484**
	Sig. (2-tailed)	.007	.000		.000	.000
EVT Raw	Pearson Correlation	.649**	-.510**	-.493**	1	.802**
	Sig. (2-tailed)	.000	.000	.000		.000
PPVT Raw	Pearson Correlation	.656**	-.537**	-.484**	.802**	1
	Sig. (2-tailed)	.000	.000	.000	.000	

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations Between Assessment Raw Scores

- Significant correlations were observed between the raw scores of each of the four assessments.
- GFTA and KLPA raw scores were more strongly correlated with EVT and PPVT raw scores than with chronological age, suggesting that vocabulary size is a better predictor of speech sound production ability than chronological age.

Table 2: Correlation by Type of Error

		Age (Months)	EVT Raw	PPVT Raw	Distortions	Substitutions	Additions	Deletions	Atypical Errors
Age (Months)	Pearson Correlation	1	.649**	.656**	-.104	-.134	-.271*	-.449**	-.327**
	Sig. (2-tailed)		.000	.000	.339	.218	.012	.000	.002
EVT Raw	Pearson Correlation	.649**	1	.802**	-.126	-.350**	-.248*	-.651**	-.550**
	Sig. (2-tailed)	.000		.000	.250	.001	.021	.000	.000
PPVT Raw	Pearson Correlation	.656**	.802**	1	-.164	-.394**	-.259*	-.580**	-.549**
	Sig. (2-tailed)	.000	.000		.132	.000	.016	.000	.000
Distortions	Pearson Correlation	-.104	-.126	-.164	1	.243*	.052	.297**	.155
	Sig. (2-tailed)	.339	.250	.132		.024	.632	.005	.154
Substitutions	Pearson Correlation	-.134	-.350**	-.394**	.243*	1	.277**	.415**	.689**
	Sig. (2-tailed)	.218	.001	.000	.024		.010	.000	.000
Additions	Pearson Correlation	-.271*	-.248*	-.259*	.052	.277**	1	.314**	.326**
	Sig. (2-tailed)	.012	.021	.016	.632	.010		.003	.002
Deletions	Pearson Correlation	-.449**	-.651**	-.580**	.297**	.415**	.314**	1	.562**
	Sig. (2-tailed)	.000	.000	.000	.005	.000	.003		.000
Atypical Errors	Pearson Correlation	-.327**	-.550**	-.549**	.155	.689**	.326**	.562**	1
	Sig. (2-tailed)	.002	.000	.000	.154	.000	.002	.000	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

RESULTS (continued)

Correlations by Error Type

The error types that were most strongly associated with lower EVT and PPVT raw scores were deletions (i.e. final consonant deletion, cluster reduction, and syllable reduction) and atypical phonological errors (e.g. backing, initial consonant deletion). A much weaker but significant relationship was noted between substitution errors and EVT and PPVT raw scores. Addition errors were slightly correlated with lower EVT & PPVT at $\alpha = 0.05$. All of these error types were more strongly correlated with vocabulary scores than they were with the child's chronological age. There was no significant relationship found between distortions and vocabulary size.

Correlations by Age

Interestingly, when the participants were grouped by age, the correlation between vocabulary scores and phonological accuracy was strongest in children aged 2;6-2;11 (Group 1) and 3;6-3;11 (Group 2), but this relationship was largely absent in 3;0-3;5 year olds (Group 2). Similarly, the correlation between deletions and atypical errors and vocabulary was weak in the 3;0-3;5 age group.

CONCLUSIONS & DISCUSSION

- *Hypothesis 1 was supported:* A significant correlation was evident between the raw scores of all 4 assessments, even though these assessments are not designed to be sensitive to this relationship. This indicates a strong, measurable relationship between lexicon size and rate of articulation and phonological errors for children in this age group.
- *Hypothesis 2 was supported:* Certain error types were more strongly associated with vocabulary size. Specifically, deletions and atypical phonological processes were associated with lower vocabulary scores. These types of phonological errors may suggest weak underlying phonological representations associated with both poor phonological awareness and smaller vocabulary size.
- Current results replicated previous findings indicating that phonological knowledge is more closely related to vocabulary size than chronological age.
- Further research should examine the changes in the lexical-phonological relationship over time, and over a broader age range.
- This study is the first step in a larger project aiming to determine whether the relationship between lexical and phonological development may be used clinically to help predict short-term speech sound normalization in children with SSD.

References

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Additional Information

Correlations of Assessment Raw Scores: Ages 2;6-2;11 (n = 38)

		GFTA Raw	KLPA Raw	EVT Raw	PPVT Raw
GFTA Raw	Pearson Correlation	1	***.885****	***-.495****	***-.640****
	Sig. (2-tailed)		.000	.002	.000
KLPA Raw	Pearson Correlation	***.885****	1	***-.489****	***-.551****
	Sig. (2-tailed)	.000		.002	.000
EVT Raw	Pearson Correlation	***-.495****	***-.489****	1	***.698****
	Sig. (2-tailed)	.002	.002		.000
PPVT Raw	Pearson Correlation	***-.640****	***-.551****	***.698****	1
	Sig. (2-tailed)	.000	.000	.000	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Correlations of Assessment Raw Scores: Ages 3;0-3;5 (n = 26)

		GFTA Raw	KLPA Raw	EVT Raw	PPVT Raw
GFTA Raw	Pearson Correlation	1	***.941****	-.366	-.126
	Sig. (2-tailed)		.000	.066	.539
KLPA Raw	Pearson Correlation	***.941****	1	-.307	-.075
	Sig. (2-tailed)	.000		.128	.715
EVT Raw	Pearson Correlation	-.366	-.331	1	***.640****
	Sig. (2-tailed)	.066	.153		.000
PPVT Raw	Pearson Correlation	-.126	-.075	***.640****	1
	Sig. (2-tailed)	.539	.715	.000	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Correlations of Assessment Raw Scores: Ages 3;6-3;11 (n = 22))

		GFTA Raw	KLPA Raw	EVT Raw	PPVT Raw
GFTA Raw	Pearson Correlation	1	***.855****	*-.489**	***-.663****
	Sig. (2-tailed)		.000	.021	.001
KLPA Raw	Pearson Correlation	***.855****	1	***-.542****	***-.634****
	Sig. (2-tailed)	.000		.009	.002
EVT Raw	Pearson Correlation	*-.489**	***-542****	*1*	***.638****
	Sig. (2-tailed)	.021	.009		.001
PPVT Raw	Pearson Correlation	***-.663****	***-.634****	***.638****	1
	Sig. (2-tailed)	.001	.002	.001	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

CONTACT INFORMATION

Brooke Santos: bs732@nau.edu **Anna Sosa:** anna.sosa@nau.edu

NAU Child Speech and Language Lab

Email: childspeech@nau.edu **Phone:** 928-523-7432
Website: http://nau.edu/CSD/CSL-Lab **Address:** 208 E. Pine Knoll Dr. Rm 309 Flagstaff , AZ 86011

Vocabulary / Speech Sound Error Correlations: Age 2;6-2;11 (n = 38)

		Distortions	Substitutions	Additions	Deletions	Atypical Errors
EVT Raw	Pearson Correlation	-.155	-.377*	-.070	-.702**	-.570**
	Sig. (2-tailed)	.352	.019	.675	.000	.000
PPVT Raw	Pearson Correlation	-.244	-.571**	-.063	-.549**	-.555**
	Sig. (2-tailed)	.140	.000	.705	.000	.000

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Vocabulary / Speech Sound Error Correlations: Age 3;0-3;5 (n = 26)

		Distortions	Substitutions	Additions	Deletions	Atypical Errors
EVT Raw	Pearson Correlation	.053	-.284	-.379	-.326	*-.463**
	Sig. (2-tailed)	.798	.160	.056	.104	.017
PPVT Raw	Pearson Correlation	-.110	-.059	*-.398**	-.249	-.249
	Sig. (2-tailed)	.594	.774	.044	.220	.219

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Vocabulary / Speech Sound Error Correlations: Age 36-3;11 (n = 22)

		Distortions	Substitutions	Additions	Deletions	Atypical Errors
EVT Raw	Pearson Correlation	-.196	*-.437**	-.211	*-.531**	-.332
	Sig. (2-tailed)	.382	.042	.346	.011	.131
PPVT Raw	Pearson Correlation	.111	***-.594****	-.132	***-.566****	*-.521**
	Sig. (2-tailed)	.624	.004	.559	.006	.013

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

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