The Role of Phonotactic Frequency in Sentence Repetition by Children with Specific Language Impairments

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Abstract

To examine potential deficits in extracting phonological regularities from over the lexicon, 18 children with SLI, aged 7;3 – 10;6, and 18 age-matched controls participated in a sentence repetition task. Sentences were taken from the Hearing in Noise Test (HINT; Nilsson et al., 1994), and contained CVC target words in either subject or sentence-final position, differing in phonotactic pattern frequency. Sentences were degraded spectrally by replacing frequency bands with speech-shaped noise (Shannon et al., 1995). Thus, temporal information was retained while spectral information was severely degraded. Results revealed that children with SLI repeated CVC target words less accurately than typical controls, with all children repeating sentence-final target words and words with high frequency phonotactic patterns more accurately than words in subject position or with low phonotactic frequency. Further, there were no significant interactions, suggesting that children with SLI extract and use phonological regularities much like their typically developing peers. [Research supported by NIDCD DC-05263, DC-04072, and DC-005650.]

Phonological Processing in SLI

Children with SLI experience phonological deficits.

The clearest example comes from nonword repetition tasks, in which semantic and syntactic demands are eliminated. Children with SLI consistently repeat nonwords less accurately than children with normal language development[1]. Some theories view these deficits as an example of a combinatorial system with which children with SLI have difficulty[2], while other theories view them as an underlying cause of SLI[3].

[1]Coady & Evans, in press; Graf Estes, Evans & Else-Quest, 2007; [2]van der Lely, 2005; [3]Chiat, 2001; Joanisse & Seidenberg, 2003

Nonword repetition accuracy depends on phonological complexity.

Nonwords were originally designed to measure language performance independent of language knowledge. Even so, any manipulation that increases phonological complexity decreases nonword repetition performance. Repetition accuracy is facilitated by:

• easily discriminable consonants	*Kamhi & Catts, 1986*
• singleton consonants vs. clusters[SLI]	*Gathercole & Baddeley, 1989*
• higher subjective wordlikeness ratings[SLI]	*Gathercole, Willis, Emslie & Baddeley, 1991*
• embedded real words	*Dollaghan, Biber, & Campbell, 1993*
• frequent phonotactic patterns[SLI]	*Vitevitch, Luce, Charles-Luce & Kemmerer, 1997*
• attested consonant sequences	*Beckman & Edwards, 2000*

Complexity reflects generalizations extracted from over the lexicon.

Children extract phonological and phonotactic regularities from over the corpus of speech that they hear and know. As the lexicon grows, children gain more experience with individual sounds and they can use this sublexical knowledge to support repetition.

Edwards, Beckman & Munson, 2005; Metsala, 1999; Snowling, Chiat & Hulme, 1991

Do children with SLI extract regularities similarly to unimpaired peers?

Children with SLI are more affected by articulatory complexity than their age-matched peers, likely due to motor planning difficulties.[1] However, they show similar sensitivity to adult ratings of subjective wordlikeness.[2] Their sensitivity to phonotactic frequency remains an open question. Children with SLI are more affected by phonotactic frequency when differences are carried globally throughout nonwords.[3] However, they are similarly affected when phonotactic frequency differences are limited either to just consonant frequency of occurrence or to just diphone frequency.[4]

[1]Bishop, North & Donlan, 1996; [2]Briscoe, Bishop & Norbury, 2001; [3]Munson, Kurtz & Windsor, 2005; [4]Coady, Evans & Kluender, submitted

Nonwords are not the best tokens for measuring language abilities of children with SLI.

In a speech perception task, children with SLI perceived naturally spoken versions of real words just like age-matched peers, but perceived nonwords less categorically than their peers. Thus, measuring sensitivity to phonological and phonotactic generalizations extracted from over their lexicons through nonword repetition likely gives a skewed picture of their language abilities. Real words should be used instead.

Coady, Evans, Mainela-Arnold & Kluender, 2007

Research Questions

1. In a sentence repetition task, will children repeat real words with frequent phonotactic patterns more accurately than those with less frequent phonotactic patterns?

2. Will children with SLI show a similar pattern of sensitivity to phonotactic pattern frequency (PPF) as age-matched controls?

Method

Participants

18 monolingual English-speaking children with SLI and 18 age-matched control children participated. All children had highly intelligible articulation and nonverbal IQ scores greater than 85. The children with SLI included 8 with E-SLI and 10 with ER-SLI, 10 females and 8 males aged 7;3 to 10;6. The age-matched control children included 12 females and 6 males aged 7;4 to 10;0.

Group	Age	CELF ELS	CELF RLS	Oral Directions	NWR	CLPT
SLI	9;0 *(1;1)*	71.2* *(10.5)*	78.7 *(18.1)*	6.67* *(2.8)*	63.5* *(19.1)*	21.6* *(16.6)*
TYP	8;10 *(0;11)*	103.7 *(15.1)*	---	10.28 *(3.4)*	82.9 *(8.4)*	48.3 *(12.7)*

Stimulus Materials & Procedure

Sentences appropriate for children were drawn from the Hearing in Noise Test (HINT; Nilsson et al., 1994). These sentences are simple declaratives, 4—7 words in length (6—7 syllables), containing early-acquired words in semantically predictable contexts.

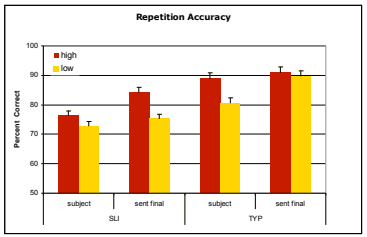
Sentences contained consonant-vowel-consonant (CVC) target words differing in phonotactic pattern frequency (PPF), occurring in either subject or sentence-final position. The high and low PPF words did not differ in word frequency.

Subject Position	WF	PPF
The ball broke the window.	128	0.000128
The shop closes for lunch.	101	0.00000272
Sentence-Final Position		
The dishcloth is soaking wet.	57	0.000392
She took off her fur coat.	58	0.00000416

To degrade the spoken sentences, they were divided into eight frequency bands. The amplitude envelope from each frequency band was then used to modulate speech-shaped noise. Amplitude-modulated noise bands were then recombined into sentences with preserved temporal and amplitude cues, but with severely degraded spectral cues (Shannon et al., 1995).

Children completed the sentence repetition task as part of a larger experimental test battery. They were told that they would be hearing a man with a scratchy voice, and their job was to repeat what he said. Repetitions were recorded and scored offline for target accuracy.

Results



All main effects were significant: group, $p < .0001$; PPF, $p = .01$; and sentence position, $p = .05$.

No two-way interactions were significant, including group × PPF, $p = .89$, indicating that children with SLI and age-matched controls were similarly affected by phonotactic frequency.

The three-way interaction approached significance, $p = .08$. Children with SLI were more affected by PPF in sentence final position, while typical controls showed a larger effect in subject position.

Conclusions

By the age of 9;0, children with SLI have extracted phonological regularities from over their lexicons and can use them to support real word repetition, replicating our previous results for nonword repetition.

Will younger children show this same pattern?

While children with SLI and typical controls showed similar sensitivity to PPF, this effect was mediated by sentence position differently for the two groups.

Does this difference reflect ceiling effects for typical controls, delayed or atypical acquisition for children with SLI?

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