

Word Frequency and Phonotactic Pattern Frequency Effects in Free Recall of Words by Children with and without Specific Language Impairments



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Abstract

Previous studies have reported that children with SLI encode phonological materials less efficiently than age-matched peers. This evidence comes from recall tasks in which participants recall fewer phonologically similar words, presumably because similar traces interfere with one another. Recall is also affected by word frequency and phonotactic pattern frequency. In a previous study, children with SLI were less affected by similarity, indicating less efficient phonological processing, but similarly affected by word and phonotactic pattern frequency, suggesting similar memory processes. However, these results are confounded by significant group differences in overall recall. In the current study, results were compared for conditions where recall rates matched at 50% for both groups—4-item lists for children with SLI and 6-item lists for typical controls. Results revealed that children with SLI showed a larger similarity effect for lists with high frequency and high phonotactic frequency words, while typical controls showed the opposite effect. These results suggest that basic language knowledge of word and phonotactic pattern frequency affects children with SLI and typical controls differently. [Research supported by NICHD DC05263, DC04072, and DC05650].

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Working Memory Deficits in SLI

Children with SLI have difficulty with verbal recall.

In recall tasks, children with SLI recall fewer items than their typically developing peers. Some theories view this as an underlying cause of SLI¹, while others view memory deficits as resulting from a more pervasive linguistic deficit².

¹Gathercole & Baddeley, 1990; ²van der Lely & Howard, 1993

Language knowledge influences working memory.

Recall is better for frequently occurring words¹ and for words with frequently occurring phonotactic patterns². One explanation is that this reflects the secondary process of reintegration, where decaying phonological traces are reconstructed from long-term lexical knowledge. A proposed alternative is that working memory is itself an emergent property of language knowledge and brain architecture⁴.

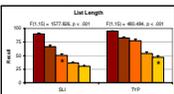
¹Majerus & Van der Linden, 2003; ²Gathercole et al., 1999; ³Hulme et al., 1997; ⁴MacDonald & Christiansen, 2002; Postle, 2006; Buchsbaum & D'Esposito, 2008

Children with SLI may use less efficient encoding strategies.

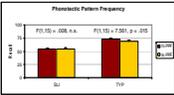
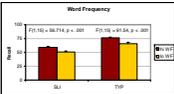
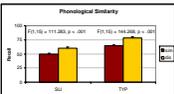
As a measure of the efficiency of phonological encoding, participants recall lists of phonologically similar vs. dissimilar words. Recall is typically worse for similar words because phonological traces interfere with one another in working memory. Children with SLI show a reduced similarity effect, suggesting inefficient phonological encoding.

Gathercole & Baddeley, 1990; James et al., 1994; c.f., Montgomery, 1995; van der Lely & Howard, 1993

Previous results implicate inefficient phonological encoding & reduced language knowledge support for working memory in children with SLI.



1. SLI < TYP
2. shorter > longer, with a larger effect for children with SLI
3. sim < dis, with a smaller effect for children with SLI
4. hi-WF > lo-WF, with a comparable effect for both groups
5. hi-PPF > lo-PPF, with no effect for children with SLI



Obvious confound of overall recall performance.

Group differences in recall strategies are complicated by overall group differences in recall performance. Therefore, recall strategies were compared for conditions where overall performance was similar—4-item lists for children with SLI and 6-item lists for CA-matched peers, where both groups recalled approximately 50% of items.

Research Questions

1. When groups are equated for overall recall, will group differences in phonological encoding strategies and in long-term language knowledge support persist?
2. Given that the phonological similarity effect represents efficient phonological processing, how does similarity interact with the two language knowledge factors—word frequency and phonotactic pattern frequency?

Methods

Participants

16 monolingual English-speaking children with SLI and 16 age-matched control children participated. All children had highly intelligible articulation. The children with SLI included 2 with E-SLI and 14 with ER-SLI, 9 females and 7 males aged 8;7 to 11;8. The age-matched control children included 8 females and 8 males aged 8;5 to 12;3.

Group	Age	LIPS-R	CELF ELS	CELF RLS	PPVT-III	EVT	NWR	CLPT
SLI	10;2 (1;0)	99.4 (8.6)	72.4* (11.0)	68.7 (13.2)	91.3* (10.3)	81.9* (6.7)	78.9* (8.2)	36.3* (13.7)
TYP	10;2 (1;2)	103.1 (7.3)	110.7 (12.6)	---	107.1 (8.5)	98.3 (11.9)	87.5 (5.9)	55.5 (14.4)

Stimulus Materials

Eighty lists of CVC words ranging from two to six items in length were created. Two lists at each of five lengths varied along three orthogonal dimensions: phonological similarity, word frequency, and phonotactic pattern frequency.

Each word appeared in only a single list.

Procedure

Children were told that they'd be hearing lists of words, and that their job was to repeat them back in any order. In a blocked design, two-item lists were presented first, with list length increasing, concluding with six-item lists. Children's responses were recorded for subsequent scoring.

A word was scored as correct if it was repeated, with no restriction on order.

4-item lists for children with SLI

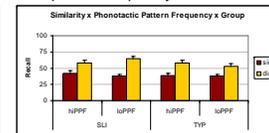
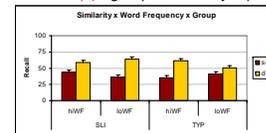
vs.

6-item lists for CA-matched controls

hi wf, hi ppf	hi wf, lo ppf
dis	sim
give	rice
worse	mouth
yell	chain
ride	tip
phone	loop
make	cheap
	pitch
	keep
	chip
lo wf, hi ppf	lo wf, lo ppf
dis	sim
deed	pun
hip	tin
wool	kean
chess	ping
fern	kin
cave	thief
	jig
	chuck

Results

1. Only main effect of similarity. No differences due to group, word frequency, or phonotactic pattern frequency.
2. No two-way interactions were significant: similarity x group, word frequency x group, or phonotactic pattern frequency x group.
3. Two three-way interactions were significant:
 - (a). group x similarity x word frequency
 - (b). group x similarity x phonotactic pattern frequency

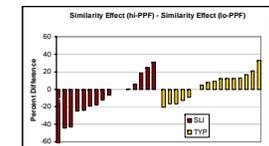
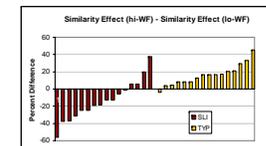


Children with SLI show a larger similarity effect for low-frequency items, but CA-matched controls show a larger effect for high-frequency items.

Individual Data

Similarity effect = Recall for dissimilar lists – Recall for similar lists

Difference = Similarity effect (hi freq) – Similarity effect (lo freq)



Conclusions

Nonsignificant main effects and interactions raise the possibility that children with SLI use efficient phonological encoding strategies. However, the lack of significant effects is more likely the result of low statistical power.

The 3-way interactions provide evidence that children with SLI differ from typical controls in how they use long-term language knowledge to support short-term memory. **Lexical uniqueness drives the performance of children with SLI**, while familiarity drives the performance of children acquiring language typically.

Differences in phonological processing suggest that children with SLI are more vulnerable to competition from other high-frequency items. Since lower-frequency items generate less competition, children with SLI can process them more efficiently.

