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When is a cluster not a cluster?

KATHLEEN M. O'CONNOR

Indiana University, Bloomington, IN, USA

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Consonant clusters remain a continuing concern of acquisition research. A recent proposal from the domain of second language acquisition comes from Archibald (1998). He proposes an implicational universal, whereby the presence of consonant + liquid (C + L) clusters implies the presence of an underlying contrast between /l/ and /r/. This is interesting, because it has never before been proposed that the contrasts in which a segment is involved may affect whether or not it may occur in a cluster. The purpose of this paper is to present the results of an archival study designed to evaluate Archibald's proposal for first language acquisition.

Archibald's claim makes certain predictions about the liquids and the types of clusters that learners might produce. Specifically, his hypothesis predicts that a learner may have one or no liquids in his/her phonemic inventory and not produce C + L clusters. It also predicts that a learner who has a liquid contrast may or may not produce such clusters. What one would not expect to find is a learner who does not have a liquid contrast and yet produces C + L clusters.

In order to test these predictions, an archival database containing data for 119 children with functional (non-organic) phonological delays was consulted. Of the 119 children, 113 were consistent with Archibald's proposal in one of three ways: seven children had the contrast and produced C + L clusters, three children had the contrast yet did not produce C + L clusters, and 103 children did not evidence the contrast, nor did they produce C + L clusters. It is important to note that, of the 103 subjects who failed to evidence the contrast between /l/ and /r/, 34 had one liquid in their phonemic inventory. Thus, although these 34 subjects were able to produce one liquid in singletons, they did not produce it in clusters. The remaining six subjects appeared to be counterexamples. These children all produced C + L clusters, yet did not have both /l/ and /r/ in their phonemic inventory. A summary of the results is given in table 1.

Given these results, it appears that Archibald's claim is largely correct. The majority of subjects comply with it in accordance with the predictions outlined above. Therefore, one is led to wonder how the six apparent counterexamples may

Address correspondence to: Kathleen M. O'Connor, Department of Linguistics, Memorial Hall 322, 1021 East 3rd Street, Indiana University, Bloomington, IN 47405, USA. e-mail: kaoconno@indiana.edu

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Table 1. *Summary of results*

	/l/ vs. /r/ contrast	No /l/ vs. /r/ contrast
Produce C + L clusters	7	6
Fail to produce C + L clusters	3	103

be reconciled with Archibald's claim. To further explore this question, the data for one of these counterexamples, S(ubject)106 (aged 4;3), will be examined.

As shown in table 2, S106 uses [w] as a substitute for both /l/ and /r/ in singletons, but produces target stop + liquid clusters as stop + [l]. Target fricative + liquid clusters, on the other hand, are reduced to the fricative. Also shown are data for target affricates, which, like the target stop + liquid clusters, are produced as a sequence of stop + [l].

Given the similarity between S106's production of stop + liquid clusters and affricates, it is proposed that these two categories are represented underlyingly not as clusters, but rather as complex segments similar to affricates. Target fricative + liquid clusters, on the other hand, could be represented target-appropriately as sequences of two segments, thus explaining the asymmetry between the stop and fricative clusters.

This conclusion is supported by cross-linguistic and experimental evidence. First of all, cross-linguistically, the first element of a complex segment is typically a stop (Ladefoged and Maddieson, 1996), which accounts for why target stop + liquid but not target fricative + liquid clusters are represented as complex segments. In addition, the release of an affricate may be either a fricative, as in target English affricates, or a lateral, as is seen in S106's data. This explains why S106 substitutes [l] for /r/ in target consonant + /r/ clusters. Finally, several experimental studies have concluded that children initially represent some or all of their clusters as complex segments (e.g. Barton, Miller and Macken, 1980).

The analysis presented above poses an interesting challenge for optimality theory (OT; McCarthy and Prince, 1995), since an OT account must permit liquids to surface in complex segments, but not in singletons or clusters. It must also prevent [w] as a substitute for liquids in target C + L clusters. What follows is a brief sketch of how this may be accomplished; for a fuller account of this child's data within OT, see O'Connor (1999).

In order to account for the data, at least the constraints in table 3 are required. *CS&*W prevents complex segments containing a [w]. The constraint *CS&*FRIC prevents fricatives from being produced as either the first or second element of a complex segment. *CONS is a well-formed constraint that militates against onset

Table 2. *S106*

Liquid singletons	[wif]	'leaf'
	[wɪn]	'ring'
Stop + liquid clusters	[pleɪn]	'plane'
	[tli]	'tree'
Fricative + liquid clusters	[sip]	'sleep'
	[fɔd]	'frog'
Affricates	[tlɪp]	'chip'
	[dlus]	'juice'

Table 3. *Constraints and ranking*

*CS&*W:	Avoid complex segments and [w] in the domain of the same onset
*CS&*FRIC:	Avoid complex segments and fricatives in the domain of the same onset
*CONS:	Avoid branching onsets
*R:	Avoid /r/, s
Parse:	Preserve the input structure of branching segments in the output
*L:	Avoid /l/, s
*Fric:	Avoid fricatives

Ranking: *CS&*W, *CS&*FRIC, *CONS, *R≫ PARSE≫ *L, *FRIC.

clusters. *R is another well-formed constraint against /r/, s. These four constraints must be undominated. The faithfulness constraint PARSE requires complex segments in the input to be represented as such in the output. *L is a well-formed constraint against the liquid /l/, while *FRIC militates against fricatives. PARSE must be ranked below *CONS, since it is better to preserve complex segments than to realize clusters, but it must outrank *L because it is better to preserve complex segments in the output than it is to avoid /l/s. *FRIC must also be low ranked, because these segments do surface in target singletons.

Tableau 1 and 2 demonstrate how these constraints and ranking select the correct output candidates for a target stop + liquid cluster (table 4) and a target fricative + liquid cluster (table 5). In tableau 1, *R eliminates candidate (a), which preserves the /r/ of the input, while (c), with an initial cluster, is eliminated by *CONS. Candidate (d) violates *CS&*W, because the second element of the initial complex segment is a [w], and is eliminated. Candidate (e) violates PARSE, because the input structure of the complex segment has not been preserved in the output,

Tableau. 1. *Target stop + liquid cluster: /(tr) i/ realized as [(tl) i] 'tree'*

	/(tr)i/	*CS&*W	*CS&*FRIC	*CONS	*R	PARSE	*L	*FRIC
(a)	(tr)i				*!			
(b)	(tl)i!						*	
(c)	twi			*!		*		
(d)	(tw)i	*!						
(e)	ti					*!		

☞ optimal output.
* = constraint violation; *! = fatal violation.
( ) = complex segment.

Tableau 2. *Target fricative + liquid cluster: /slip/ realized as [sip] 'sleep'*

	/slip/	*CS&*W	*CS&*FRIC	*CONS	*R	PARSE	*L	*FRIC
(a)	slip			*!			*	*
(b)	(sl)ip		*!				*	*
(c)	swip			*!				*
(d)	(sw)ip	*!	*					*
(e)	sip☞							*

☞ optimal output.
* = constraint violation; *! = fatal violation.
( ) = complex segment.

allowing (b), which only violates the low-ranked *L, to be chosen as the winner. In tableau 2, candidates (a) and (c), with initial clusters, are eliminated by *COns. Candidate (b), with an initial complex segment consisting of a fricative + [l] is eliminated by *CS&*Fric. This same constraint, along with *CS&*W, is violated by candidate (d), allowing (e) to emerge as the winner.

This brings up the question of how Archibald's claim can be translated into OT. This may be accomplished by assuming a conjoined constraint *COns&*Liquids that militates against clusters and liquids in the domain of the same onset. In the case of constraint conjunction, the two individual conjuncts of the constraint, here *COns and *Liquids, must always be ranked below the conjoined constraint. Thus, in the account sketched above, this constraint would outrank all of the other constraints.

Adoption of this conjoined constraint has certain implications for treatment. It suggests that, for children who present with one or no liquids and who do not produce C + L clusters, the most effective treatment target is a C + L cluster. Treatment of a C + L cluster is predicted to force demotion of *COns&*Liquids. Since the conjoined constraint must always outrank its two conjuncts, demotion of the conjoined constraint will force the demotion of the conjuncts, predicting the emergence of liquids and complex onsets, followed by C + L clusters. Treatment either of clusters that do not contain a liquid or of liquid singletons would encourage demotion of one of the two conjuncts, but is not expected to have an effect on the conjoined constraint, so that C + L clusters are not necessarily predicted to emerge after such treatment. These predictions have yet to be tested experimentally, however, and, thus, await further research.

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