Is gradient phonotactic knowledge lexical or grammatical? Evidence from a serial recall experiment

Experimental studies indicate that phonotactic knowledge is not only categorical, but also gradient. In wordlikeness judgment tasks for example, speakers choose nonwords to be more word-like when they were composed of frequently occurring phoneme sequences (e.g. Scholes 1966; cf. also Bailey & Hahn 2001). The question is, whether these gradient judgments can be accounted for by lexical effects, or whether there is evidence that the phonotactic grammar by itself produces gradient effects.

Categorical phonotactic knowledge is traditionally assumed to be part of grammar, and has been proposed to be represented outside the lexicon at a sub-lexical level in models of speech processing (e.g. Merge, Norris, McQueen & Cutler 2000). This study aims at providing psycholinguistic evidence that also gradient phonotactic knowledge is grammatical by nature, and thus needs to be mentally represented sub-lexically. A study by Roodenrys and Hinton (2002) suggests the opposite. Gradient phonotactics did not influence the recall performance of CVC nonwords, while lexical factors did.

For this study, it was hypothesized that this result might have been caused by the simple syllable structure of the stimuli. Consonant clusters in syllable margins are subject to stronger co-occurrence restrictions than CV or VC strings. Based upon this observation it was predicted that sub-lexical (i.e. grammatical) phonotactic effects should increase with syllable complexity.

This was tested in a short-term memory recall experiment that compared recall performance on nonwords of simple versus complex syllable structures composed of high versus low frequent bi-phones. The lexical neighborhood density was controlled. Therefore, the results could not have been caused by the frequencies of similar words in the lexicon. Frequency data calculations were based on the CELEX lexical database (Baayen, Piepenbrock & Gulikers 1995).

The present findings are in line with the predictions. As can be seen in table 1 and 2, phonotactic effects on processing are modulated by syllable complexity. The gap in recall performance measured in reaction times (table 1) and error rates (table 2) between high and low bi-phone frequency nonwords increased with increasing structural complexity.

The interaction of syllable structure and bi-phone frequency supports the hypothesis that the gradient phonotactic effects found here reflect gradient phonotactic knowledge represented at a sub-lexical level. The effects of syllable structure indicate that gradient phonotactics are grammatical in nature, because the effects arise from stronger co-occurrence constraints within than across syllabic constituents.

By demonstrating that speakers use gradient phonotactics in processing, this study indicates the need to integrate non-lexical gradience in future models of grammar.

template	frequency high	frequency low	difference
CVC	1143.925	1134.234	-9
CVCC	1145.131	1204.531	+59
CCVC	1117.383	1213.361	+96
CCVCC	1160.449	1263.010	+103

Table 1: Reaction time means for each category in ms measured from the target onset.

Template	frequency high	frequency low	difference
CVC	7%	7%	0%
CVCC	6%	8%	2%
CCVC	5%	10%	5%
CCVCC	4%	10%	6%

Table 2: Error rates in relation to the correct responses for each category and the difference between high and low bi-phone frequency.

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