# Phonological encoding and the nature of segments

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Recent studies have brought the nature of segments into focus. Many models of speech perception demonstrate that features, rather than phones, are the crucial component of phonological encoding.[4,8] Similarly, current research in phonological theory suggests that smaller units of representation better capture attested phonological patterns.[7, 5, 12] However, others (e.g.[6]) posit the phoneme as a level of representation in speech processing, arguing that phonemes are integral in lexical access. Central to this debate are the findings of Damian and Dumay[1], showing that repeated phonemes in short utterances (e.g. 'green goat', 'red goat') had a facilitatory effect on response time of those utterances. Furthermore, this facilitatory effect extends to segments occurring in different syllabic positions within the word (e.g. 'blue crab', 'green crab'). The authors attribute this effect to phonological encoding, as articulatory encoding doesn't predict facilitatory effects of phonemes occurring in different positions within the word.[1]

While a strict articulatory account may not account for the data, recent research showing the relationship between segments and features or segments and gestures indicates that fully abstract phonological representations devoid of reference to physical qualities may not be realistic.[3,9,11] If a pure abstract phonological encoding account is responsible for facilitatory effects in naming, we expect all phonemes, regardless of position, allophonic variation, or gestural composition, to pattern the same. However, a more fine-grained analysis of priming based on featural or gestural composition predicts variation across phones dependent on sub-segmental composition as features/gestures may vary in their priming effect.

To test this question, we conducted a picture naming task following Damian and Dumay[1] to measure naming latencies of color-noun pairs that varied on whether they had repeated phonemes ('pink purse' [related] vs. 'green purse' [unrelated]) and whether the phoneme in the target noun was initial ('pink purse') or final ('green flag'). To test the possible differences among phonemes, we included target items [g], [b], [p] (replicating stimuli[1]), and [ɹ] (new stimuli), as [ɹ] has been found to vary depending on both position and following vowel.2,10,13 Stimuli included 5 tokens per phoneme per condition, for a total of 80 unique pairs (4 phonemes x 4 conditions x 5 tokens). 40 native speakers of English completed a picture-naming task where they were randomly presented the 80 test pairs. Naming latency was recorded from the onset of the picture to the onset of the target noun. Responses >1500ms and < 250ms were excluded (9% of tokens). A series of linear mixed effects models were fit to the data, with log duration of naming latency as the dependent variable and random intercepts for speaker and target noun. Independent variables and interactions were added in a stepwise fashion, comparing AIC.

The best fit model includes a three-way interaction between phoneme, position, and repetition/relatedness. In the aggregate, we replicate a repetition priming effect for the initial-initial condition (e.g., 'blue bag'), but find no significant facilitation in the initial-final condition. Furthermore, the lack of effect in the initial-final condition cannot be attributed to the addition of <r>, as dividing the data by phone reveals that the only initial-final facilitatory priming we observe is in the <r> stimuli. These results suggest that an abstract phonological priming analysis is not wholly consistent with the attested data. While the facilitation of response time in the initial-initial condition extending to <r> provides support for an analysis of phonological priming, as demonstrated by Damian and Dumay, the lack of significant effect in the initial-final condition overall, and the variability between segments in the initial-final condition is counter to this analysis. Nonetheless, the findings of Damian and Dumay along with the results of the present study call for a model of priming that captures the full range of attested results. Thus, we argue that a more fine-grained featural/gestural based model of psychological representations may better capture the attested facilitatory effects across varying segment positions and types. In such a model, different features or gestures may have different priming strengths based on position and featural/gestural composition, thus allowing for variability across positions and segment types. These results offer significant insights both for research on encoding of segments, but more broadly for the nature of segments and phonological representations of segments.

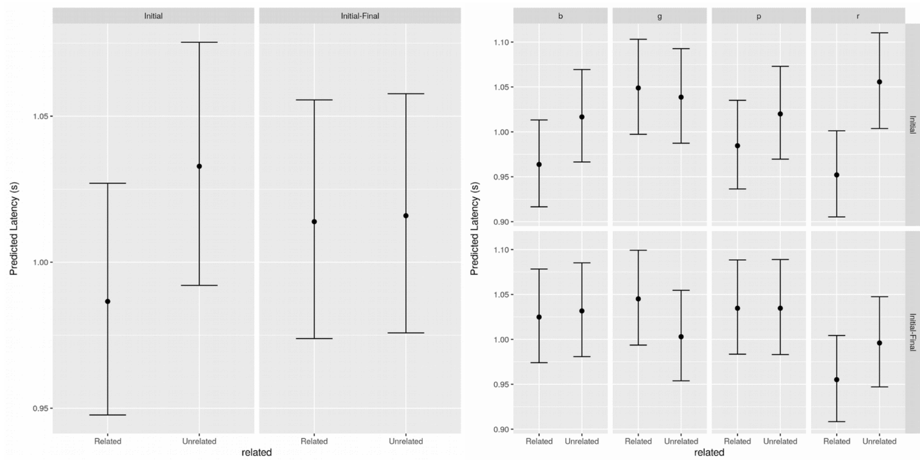


**Figure 1:** Model Results

a. Left - Duration by Position and Relatedness/Priming

b. Right - Duration by Position, Relatedness, and Target Phone

**References**

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