

HOW MUCH INFORMATION IS ENOUGH FOR THE PHONEMIC RESTORATION TO OCCUR? EVIDENCE FROM MANDARIN CHINESE

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Abstract *There is a consensus among researchers that speech perception utilises both bottom-up and top-down mechanisms (Caron, 1992). The phenomenon of phonemic restoration (PhR) is robust evidence for the utilisation of the top-down process in speech perception and is commonly observed in everyday speech communication. The PhR is defined as: when a speech segment is substituted by another sound, listeners still report the utterance as being intact because their brains perceptually restore the missing speech (Samuel, 1996). Although previous studies have suggested that linguistic units of the missing speech sounds (consonant, vowel, and syllable) and the amount of semantic information lost in relation to the meaning of the whole word may impact the PhR effect, the effects of these factors and the potential interaction effects have not been examined systematically. Specifically, most prior studies did not manipulate linguistic units but instead used noise generators to induce interruption to a continuous speech with only a few exceptions (Samuel, 1981; Warren, 1970; Warren & Obusek, 1970), leading to the question that they blurred how much information is needed to restore missing phonemes.*

The present research, therefore, took advantage of the unique morpho-syllabic structures of Mandarin Chinese, which enabled researchers to manipulate the listening materials on the phonemic level and weigh their corresponding semantic meanings simultaneously, and investigated whether 1) masking different linguistic units of speech sounds, and 2) the morphological structure of Chinese words lead to different PhR effects, and 3) whether there is an interaction effect between these two factors on the PhR effect.

18 participants were recruited to complete a phonemic restoration task following the discrimination paradigm. In the experiment, participants were asked to discriminate between noise-superimposed items and noise-replacing items. On each item, either a consonant, a vowel or a syllable was masked or replaced. The data (participants' error rates) was subjected to ANOVAs. The results showed that the types of linguistic units being masked led to different PhR effects: masking consonants resulting in the strongest effect, whereas masking syllables leading to the weakest effect. Importantly, the effect of masked linguistic units was qualified by its interaction with the amount of missing semantic information. That is, the PhR effect was stronger in the one-morpheme word condition than in the two-morpheme word condition if a vowel was masked. The same trend was not observed for consonant or syllable conditions.

The present study is the first to examine the PhR effect using Mandarin Chinese and provides fine-grained evidence that the PhR effect is a function of the missing information and the remaining information at the word level. We discuss the implications of our findings for the existing theories on the PhR effect. The occurrence of the PhR when a consonant is masked is consistent with the existing findings that consonants share striking similarity in acoustic properties with noise (Samuel, 1981), and typically have much shorter durations compared to vowels, thus the acoustic cues provided by consonants initially appear redundant for listeners' perception (Wang & Chen, 2021). Furthermore, the significant effect of the morphological structure on the PhR when a vowel was masked enriches the current theories in that it revealed the difference in the amount of missing semantic information carried by a vowel would predict significantly different possibilities for the occurrence of the PhR, thus suggesting a threshold at which the remaining information can be considered "sufficient" for listeners to generate the intact perception.