

Toward a modulation phonology

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The essence of modulational phonology is that a speech signal is a modulated carrier in which modulations to—or deviations from—the carrier convey the linguistically relevant information in the speech signal (Ohala 1992, Traunmüller 1994, 2005). The carrier, which is more or less a continuous schwa-like vowel, conveys a great deal of extralinguistic information about the speaker, their attitude, and their environment. The carrier conveys no linguistic information, however, that role being left to the modulations. In principle, the modulations could be combined with a different carrier, resulting in a signal with the same linguistic content but seemingly spoken by a different speaker.

Traditional phonetic and phonological representations conflate the carrier and the modulations, resulting in representations that indiscriminately encode both linguistically relevant and linguistically irrelevant information. Features, for example, encode the entirety of the speech signal, including the carrier. Similarly, spectrograms suggest that all of the energy in the signal is relevant in some way. However, because much of the energy in the speech signal is linguistically irrelevant, it ought not be represented phonologically. Only the modulations to the underlying carrier are relevant and thus worthy of phonological representation.

Since listeners must be able to demodulate the signal, meaning to separate the modulations from the carrier, a new computer-based analysis technique known as modulography has been developed by the author in order to demonstrate how signals are demodulated. A modulographic analysis starts by automatically synthesizing a carrier signal using a formant synthesizer. The carrier can then be removed from the signal, leaving behind only the modulations that encode the linguistically relevant information in the signal. The final result of the analysis is a modulogram, a display which is visually similar to a spectrogram but that depicts only the modulations in a signal and not the carrier. Because modulograms show only what is linguistically relevant in the signal, they show only what ought to be represented in the phonology.

Using modulograms, this talk discusses how consonants are represented in terms of modulations and how phonological processes involving consonants are seen in this new light. For example, voicing assimilation in Modern Greek leads to the phrase /pes mu/ ('tell me') becoming [pɛzmu]. The assimilation of voicing in this case is actually a reduction in the amount of modulational information. The voicing of [z] is provided by the carrier and is not therefore encoded modulationally, whereas the lack of voicing in [s] requires greater modulation. Similarly, manner dissimilation in Modern Greek is seen to entail a reduction of modulational information. Thus, in the pair of alternants /ɛpta/ and /ɛfta/ (both 'seven'), the second form has fewer modulations than the first. In this case, [p] entails a significant drop in amplitude and perhaps a burst of noise, both of which are lacking in [f]. In both cases, a traditional analysis using features implicitly suggests that the amount of information is the other way around, i.e., /z/ is [+VOICE] as opposed to [-VOICE] in /s/, and /f/ is [+CONTINUANT] as opposed to [-CONTINUANT] in /p/. Put simply, modulational phonology says that the + and – are the wrong way round.

References

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