Comparing representations: Towards a strong generative capacity for phonology

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Within and across frameworks, many different theories of phonological representations exist. The exact differences and predicted behavior between them, as in feature matrices versus autosegments (Goldsmith 1976; Hayes 1986), one geometry versus another (e.g. Halle, Vaux & Wolfe 2000), binary versus unary features (Sagey 1986), features versus gestures (Clements 1992), and so forth, are often myriad and obscure, beyond the (seemingly) obvious. Additionally, these different representations are couched in different methods of computation, from ordered rules to parallel constraints to dynamic systems of gesture. With this variety of computation, the difference between two representations in one framework may be neutralized, obscured, or amplified, in a different framework. This makes precise, formal claims about how theories differ markedly difficult.

In recent years, however, insights from logic and model theory have been used in the formal definitions and comparisons of phonological representations (Strother-Garcia 2019; Danis & Jardine 2019; Oakden 2020). Thus, a formal definition of notational equivalence among phonological representations is given: those representations whose models are bi-interpretable under some restricted type of logic (usually first-order or quantifier-free). This work argues that this bi-equivalence is not a sufficient condition for notational equivalence, and further restricts this definition in phonology to include those transductions that are also *natural class preserving*.

Essentially, two theories of representation are natural class preserving if each predicts the same set of extensions of segments to be natural classes under the structural and featural assumptions of each. What is surprising is *not* that theories predict different natural classes—this is often by design in the definition of those theories—but that two theories can be quantifier-free bi-interpretable under logical transduction, yet *not* be natural class preserving. From a logical point of view, the models might be equivalent, but from a linguistic point of view, the two models still make different predictions based on how phonological processes are often assumed to behave.

Two assumptions in phonology lay the groundwork for comparing theories in this way: that a representational theory of phonology organizes segments in to natural classes, and that the computational theory of phonology targets natural classes for phonological processes. Thus, even if two theories of representation are shown to be logically equivalent, different extensions of natural classes predicts differing phonological behavior. By focusing on these assumptions, and using natural classes in the representation as a proxy for how a theory of computation would operate over such representations, a notion of *strong generative capacity* for phonology emerges (cf. Dolatian, Rawski & Heinz 2021).

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