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Perceptual adaptation to speech input statistics is driven by predictions from category representations

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Prior research demonstrates that the 'perceptual weight'of acoustic input in signaling speech categories shifts rapidly when statistical distributions of speech input deviate from expectations, as when you encounter a foreign accent. What drives this perceptual adaptation is debated. One possibility is that accented or otherwise distorted speech carries enough information to partially activate an internal speech representation, like a speech category for /b/ or /p/. This activation, in turn, may generate predictions about the statistical regularities of speech input typically associated with the representation (e.g., higher fundamental frequencies tends to pair with /p/, not /b/). When the actual speech input statistics mismatch these predictions (as for accents), an error signal may drive rapid adjustments to the effectiveness, or perceptual weight, of an acoustic dimension in signaling the speech, with mismatched dimensions down-weighted. This internal-error driven learning account makes predictions that we test across five experiments. First, the magnitude of perceptual adaptation should be predicted by the strength of phonetic category activation (that generates a prediction), as estimated by categorization responses reliant on the dominant acoustic dimension (Exp 1). Further, signal manipulations that flip which of two acoustic dimensions best conveys category identity are expected, correspondingly, to shift which dimension effectively activates a speech representation –and therefore which dimension's perceptual weights are adjusted, as well (Exp 2). Experiments 3-5 introduce a new paradigm that conveys short-term speech distributional speech regularities across brief sequences and examines their impact on perceptual adaptation to ascertain whether the category activation hypothesized to drive the perceptual adaptation must be supported by trial-by-trial overt category decisions to be effective. The results align with error-driven learning account predictions. Both the direction and magnitude of perceptual adaptation are predicted by graded measures of category activation. Moreover, accumulation of speech input regularities across passive listening elicits perceptual adaptation that is just as robust as when there are overt category decisions. The data are consistent with an error-driven model whereby perceptual adaptation arises from speech category activation, corresponding predictions about the statistical distributional patterns of acoustic input that align with the category, and rapid adjustments in subsequent speech perception when input mismatches expectations. At the broadest level, this series of experiments demonstrates that 'statistical'learning –even across passive exposure –can be guided by explicit error signals determined from internal phonetic category activation to adjust perception and behavior.

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