PREDICTIVE MECHANISMS SUPPORT RAPID ADAPTATION AND SLOW CONSOLIDATION IN LEARNING TO UNDERSTAND SPEECH

Matthew H. Davis

University of Cambridge

Processes of learning and adaptation are key to successful perception and comprehension of the degraded, novel, and ambiguous speech that we encounter in our everyday life. I will here contrast two forms of learning: (1) rapid adaptation processes that operate over the course of minutes to enhance comprehension of ambiguous or degraded speech, and (2) episodic encoding and overnight consolidation processes that integrate novel input into longer-term knowledge during overnight sleep. Behavioural and neuroimaging evidence shows both learning processes operate at phonetic, lexical, and semantic levels. I will argue, however, that key neural computations supporting these different forms of learning are distinguished not by the level of the comprehension system that is modified, but rather by the accuracy of prior prediction at the time that variant input is heard. Rapid adaptation is achieved by reinforcing accurate predictions and suppressing inaccurate predictions for upcoming speech sounds, words or meanings. Thus, adaptation is enhanced when prior knowledge permits more accurate predictions: if listeners hear degraded spoken words after seeing their written form (cf. Sohoglu et al, 2012, J Neuroscience), or ambiguous words are presented after disambiguating contexts (Rodd et al, 2012, Cerebral Cortex). In contrast, novel and hence unpredicted speech sounds, words or meanings are encoded by hippocampal, episodic mechanisms (Davis & Gaskell, 2009, Philosophical Transactions), and online predictions are only modified after overnight consolidation (Gagnepain et al, 2012, Current Biology). I will propose a predictive coding account of speech perception and learning that unifies these different neural mechanisms.