Phonemic restoration in Alzheimer’s disease and semantic dementia

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Abstract
Background: In daily life, spoken messages are often interrupted by extraneous sounds. However, we generally perceive such messages as continuous: our brains automatically and efficiently ‘repair’ interrupted speech signals by phonemic restoration, a fundamental physiological process whereby speech sounds that are obscured by noise are ‘filled-in’ perceptually to reconstitute the underlying signal. As a dynamic, integrative process, phonemic restoration is potentially affected by neurodegenerative pathologies but this has not been clarified.

Method: Here we studied this phenomenon in patients with typical Alzheimer’s disease and semantic dementia, relative to healthy age-matched controls. Participants heard isolated sounds, spoken real words and pseudowords in which noise bursts either overlaid a consonant or replaced it; a tendency to hear replaced (missing) speech sounds as present signified phonemic restoration.

Result: All groups perceived isolated noises normally and showed phonemic restoration of real words, most marked in the Alzheimer’s disease group. For pseudowords, healthy controls showed no phonemic restoration, patients with Alzheimer’s disease showed a marked suppression of phonemic restoration and patients with semantic dementia showed phonemic restoration comparable to real words.

Conclusion: Our findings provide the first evidence that phonemic restoration is preserved or even enhanced in neurodegenerative diseases, with distinct syndromic profiles that may reflect the relative integrity of bottom-up phonological representation and top-down lexical disambiguation mechanisms in different diseases. This work has theoretical implications for predictive coding models of language and neurodegenerative disease, and for understanding cognitive ‘repair’ processes in dementia.