

# Morphological processing impairments in Parkinson's disease: effects of regularity, disease progression, and sex

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Substantial research has examined the neural bases of morphology, and how morphological processing is affected in brain disorders. Parkinson's disease (PD), in which frontal/basal-ganglia circuits undergo degeneration, may elucidate these issues. Ullman et al. (1997) reported that higher right-side hypokinesia, which reflects left frontal/basal-ganglia degeneration, predicted worse performance at producing regular but not irregular English past-tense forms. The paper suggested that rule-governed computation of regular forms depends on frontal/basal-ganglia circuits underlying procedural memory, whereas irregular forms are stored in declarative memory. Subsequently, several studies of regular/irregular inflection in PD reported different patterns, challenging the paper's conclusions. However, these studies differed from the original study, including by examining patients at lower levels of disease progression (rule-governed deficits may only arise at higher levels), and by including high percentages of females (who may depend less on procedural memory for rule-governed computation, due to compensation by declarative memory, which shows female advantages). Experiment 1 tested English past-tense production in male and female PD patients with a wide range of disease progression. In mixed-effects regressions, right-side hypokinesia predicted accuracy at regulars in males but not females, and not irregulars in either sex, with interactions between hypokinesia and sex for regulars but not irregulars. Experiment 2 examined Farsi past-tense production in male and female PD patients at advanced stages. Male patients showed deficits (relative to healthy controls) at regulars compared to irregulars, while female patients did not show this pattern, and were least impaired at regulars. Overall, the findings suggest that PD, and degeneration of left frontal/basal-ganglia circuits in particular, is indeed associated with a particular impairment at producing rule-governed inflectional forms, but that factors such as disease progression and sex modulate this deficit.

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