

# Neuroanatomic Correlates of Automatic and Effortful Processes in Verbal Fluency

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**Objective:** On tests of verbal fluency, clustering refers to the automatic generation of words within a sub-category. Switching to a new cluster after exhausting a sub-category is a more effortful process. Evidence from diverse patient populations suggests clustering and semantically-guided fluency are related to temporal lobe integrity, whereas switching and phonemically-guided fluency depend on the frontal lobes. Here we investigate the neuroanatomic correlates of automatic and effortful processes among healthy adults.

**Participants and methods:** Participants ( $n = 25$ ) completed tests of phonemic and semantic fluency and underwent structural brain imaging. Productions were coded according to the Cog-Neuro scoring system, deriving measures of overall generativity, numbers of clusters/switches, and mean cluster size. We correlated fluency scores with regional grey matter (GM) densities using voxel-based morphometry after adjusting for age, handedness, and global GM volumes.

**Results:** More frequent clustering/switching during phonemic fluency was associated with greater GM densities in the left middle temporal gyrus ( $p < 0.0001$ ). Overall productivity during semantic fluency correlated positively with GM densities in the left temporal pole and inferior temporal cortex, bilateral anterior prefrontal cortex, and inferior and middle temporal gyri ( $p < 0.0001$ ).

**Conclusions:** In contrast to evidence from patient groups, clustering/switching by healthy adults during phonemic fluency was associated with tissue densities in temporal regions subserving auditory processing and language, but not the frontal lobes. On tests of semantic fluency, productivity was associated with the integrity of brain regions underlying strategic processes related to memory retrieval, auditory processing and language, word recognition, and within-category identification.

Word Count = **250 with** headings (limit 250 words, 2000 characters)