From computation to automization: How practice alters initial neural response to familiar arithmetic problems

Caitlin Tenison
Carnegie Mellon University, Pittsburgh, PA, USA

John Anderson
Carnegie Mellon University, Pittsburgh, PA, USA

Abstract: Building and validating models of skill acquisition that explain speedup effects has been limited by difficulty distinguishing quickly executed cognitive processes (e.g. Anderson, 1982; Logan, 1988; Rickard, 1997). In this experiment, magnetoencephalography (MEG) data are collected from participants solving a repeated math problem set. We use MEG signal to test the three-phase model of skill acquisition that describes the transition from problem-solving strategies of computation, to retrieval, to an automatic stimulus-response process (Fitts & Posner, 1967). We hypothesize that the processes of familiarity and recollection are early features that distinguish the three phases of skill acquisition. Analyzing event-related fields, we test two predictions. First, early frontal activation (akin to the FN400 old-new effect of ERP studies) should diminish in strength with each successive phase transition. Second, parietal activation (corresponding to the ERP P600 old-new effect) should be present in the second phase, but not in the first or last phase.