

FINAL REPORT FOR INTERNAL LRDC RDF AWARD

PIs: Julie Fiez and Walter Schneider

Title: "The Cerebellum and Language"

Funding period: 7/1/11-6/31/12

The goal of this internal RDF award was to provide pilot funds to investigate the functional loops that interconnect the cerebellum and the cerebral cortex. Although there is clear evidence that cerebro-cerebellar processing loops are a general feature of brain organization, most of what is known has come from studies of motor areas and motor functions in non-human species. New imaging techniques -- most notably functional connectivity and diffusion-weighted imaging -- are now providing new windows onto the connective architecture of the human brain. For this RDF award, we proposed to apply these techniques to the domain of language, by investigating whether functionally distinct loops can be identified for different aspects of language processing (speech, phonological, and semantic processing).

The scope and research questions of LRDC award have been influenced by the success of the research team in garnering NSF support for a 3-year project. This allowed us to expand our focus to include the study of patients with focal brain injury to the cerebellum. To date, using the combination of the LRDC and NSF grant support, we have submitted 3 conference abstracts detailing functional specializations for different language functions in the cerebellum. A review and empirical paper discussing the contributions of the cerebellum to adaptive speech perception were published in early 2014. An article describing functional sub-regions of the cerebellum involved in phonological analysis and inner speech will be submitted in November, for a special issue on the cerebellum in the journal *Brain and Language*. Additional manuscripts from the project are planned, especially those involving connectivity analyses with Schneider. We have completed the collection of the diffusion-weighted imaging data, but for a variety of reasons we are only in the early stages of data analysis.

As noted above, one longer-term result of the project was its interface with NSF funding. As this NSF funding is coming to an end, we have begun to seek new avenues of funding that would allow for continued collaboration. One potential source is a career development award (K18) that was submitted by Fiez (PI) in July 2014, with Schneider as a mentor for the project. This award would provide additional resources for studying a cerebro-cerebellar loop that we believe plays a critical role in inner speech processes involved in mathematical problem-solving, reading acquisition, and verbal working memory.

External applications related to the LRDC RDF award:

NSF 1125719 9/01/2011-8/31/14

The Cerebellum and Language

Total costs: \$593,228

PI: Fiez; Co-PI: Schneider

NIH K18 (pending)

Training in lesion-symptom mapping and multimodal MR imaging for speech-language research

Total costs: 12 months of salary support for Fiez + \$40,000 in research costs

PI: Fiez; Mentor: Schneider

Publications involving the LRDC/NSF support:

Lopresti C, Alvarez TA, Durisko C, Tremel J, Fiez JA (2013). The cerebellum and phonological processing: Common activation across verbal working memory and rhyme judgment tasks. *Annual meeting of the Society for Neuroscience*, San Diego.

Alvarez TA, Lopresti C, Durisko C, Tremel J, Fiez JA (2013). The cerebellum and cognition: Investigating functional specialization within the cerebellum. *Annual meeting of the Society for Neuroscience*, San Diego.

Lopresti C, Alvarez TA, Fiez JA (2014). Motor sequencing in the human cerebellum: How movement predictor and effector influence activity. *Annual meeting of the Society for Neuroscience*, Washington, DC.

Guediche S, Blumstein SE, Fiez JA, Holt LL (2014). Speech perception under adverse conditions: Insights from behavioral, computational, and neuroscience research. *Frontiers in Systems Neuroscience*, 7:126.

Guediche S, Holt L, Laurent P, Lim SJ, Fiez JA (2014). Evidence for cerebellar contributions to adaptive plasticity in speech perception. *Cerebral Cortex*, in press.