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Cog Neuro
Week 5.5

Badre et al. were interested in how we learn diverse task sets. For example, 'hierarchical' rules, sometimes called abstract rules or "task sets" are easily and flexibly learned and rearranged over time. A common assumption is that the pFC is responsible for dealing with abstract rules and potentially is involved in the acquisition of new rules. The authors designed a task in which participants saw a stimulus and guessed at the response, learning over time the mappings between objects. They contrast learning a hierarchical rule set with a 'flat' one, where each stimulus has a unique mapping. They looked at task related activation of the cortex and found activation correlated with improvement in behavior, especially in the premotor cortex. Using a Granger causality analysis they show that the putamen may be influencing premotor cortex, while the caudate is influenced by changes in motor cortex. They suggest that their findings indicate that the frontal cortex may be responsible for learning of 'flexible' action rules. I would want to see this study complemented by EEG results that might help us understand the actual timing of the activity that is being 'changed' in frontal cortex. For example, it would be useful to know whether visual areas are being modified as well, or if only the frontal cortex is experiencing changes. Do these changes map into top-down modulations or does all of the relevant processing feed-forward into these modified regions?

Fedorenko et al. searched for common activation across multiple tasks to help understand whether there are parts of the brain that are used for multiple tasks or if the brain is highly specialized in 'modules'. They showed participants a series of tasks in either a hard/easy configuration. Within subjects they then looked for activation related to the hard – easy contrast, which should reflect processing required for completing that particular task. The authors show that a large region, which they call the multiple-demand system, is activated across all of the tasks they used. They suggest that this shows the generality of cortex and that there is little 'modularity' of the kind older authors had presupposed might exist. I actually don't think this study is particularly conclusive. By smoothing their data a LOT and doing their analysis in the volume it's basically impossible to know exactly what regions of cortex were really being activated. It's entirely possible that there are small modular regions for certain tasks that, when smoothed, appear as part of a larger major network. As a side note, it's interesting that they acquire 4x2.1x2.1 voxels, but resample them into a smaller size at 2x2x2, is this related to their use of GRAPPA?