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# People / Faculty

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## Next-generation brain imaging

My laboratory is developing a new generation of brain imaging methods that combine the specificity of electrophysiological and optical neural recording techniques with the noninvasiveness and whole-brain coverage of functional magnetic resonance imaging (fMRI). These innovative techniques will have potentially transformative significance in neuroscience, and some will have broader impact in biology and medicine. Our own long term goal is to apply "molecular fMRI" to study neural mechanisms of behavior in alert animals. Our research has included development of novel genetic and nongenetic MRI sensors for molecular targets in the nervous system, among them probes for calcium and other ions, protein phosphorylation, and neurotransmitters. We have validated several probes *in vitro*, and are now using some of the agents for molecular neuroimaging studies in live animals. We continue to improve our technologies and expand the range of neural targets we can detect, using a mixture of protein and genetic engineering methods and more traditional chemical approaches.

## Whole-brain analysis of neural function and plasticity

In parallel with our development of molecular tools, we are interested in studying the dynamics of neural systems as they form and function at the whole-brain level. We use brain imaging methods in combination with other neural recording and perturbation techniques in rodents. We have a strong interest in combining new behavioral paradigms with functional imaging methods to study animal learning and analogs of cognition. Ongoing work focuses on reinforcement learning and the process of reward integration in rats. In addition, we recently used conventional fMRI in developing rats to follow neural plasticity and characterize changes in neurovascular coupling occurring after birth. This work lays a foundation for interpreting further fMRI studies in juvenile animals. We are also applying both conventional and molecular MRI techniques to study perturbation of neural systems in mouse models of neurodegenerative disease.

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Shapiro MG, Westmeyer GG, Romero PA, Szablowski JO, Küster B, Shah A, Otey, CR, Langer R, Arnold FH and Jasanoff A. (2010) Directed evolution of an MRI contrast agent for noninvasive imaging of dopamine. Nat Biotechnol 28: 264-70.

Faas H, Jackson WS, Borkowski A, Wang X, Ma J, Lindquist S, and Jasanoff A. (2009) Context-dependent perturbation of neural systems in transgenic mice expressing a neurotoxic prion protein. Neuroimage 49: 2607-17.

Colonnese MT, Phillips MA, Kaila K, Constantine-Paton M, and Jasanoff A. (2008) Development of hemodynamic responses and functional connectivity in rat somatosensory cortex. Nat Neurosci 11: 72-9.

## Additional Publications

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