Absence makes the brain do wonders: What can we learn about brain organization from people born blind, deaf or without hands?

How does being born blind, deaf, or without arms, affect brain structure and function? What can we learn from such people about the principles that guide brain organization? Is our brain a sensory-motor machine, dependent on sensory information during critical developmental periods and embodiment of sensory-motor components for its proper formation? Or is brain development robust to such deficits, potentially enabling rehabilitation?

In this talk, I present several studies which show that no single sensory or motor system is critically required for visual cortex organization. Instead these data suggest that cortex organization is highly dependent on innate connectivity constraints and task preferences.

To show that the visual cortex functional layout is not critically dependent on visual experience, I taught a cohort of congenitally blind, to "see" complex pictures with sensory substitution (a transformation of images into sounds). fMRI studies on this cohort show that the visual cortex functional layout is retained. The data suggests that in blindness, cortex organization is greatly affected by preferred pre-existing connectivity patterns to downstream functional networks, such as the fronto-parietal action and language networks. I also show that motor connectivity and experience are not critical on their own either, since in a different cohort, of people born without arms and hands, visual cortex organization for a highly motor-relevant areal specificity is also retained, based on visual experience. Therefore, no one specific modality is required for intact brain formation to emerge but rather visual cortex organization is derived by conjoined connectivity constraints and task- or computation- selectivities. Evidence for sensory-independent development based on connectivity constraints was also found beyond the visual domain, in the auditory cortex of people born deaf.

These findings will be discussed with regard to theoretical models of amodal brain structure and embodied cognition, and as well as potential clinical rehabilitative implications for sensory restoration.

Thursday, February 4, 4 pm
Refreshments served at 3:45
108 West Village G