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What we can learn from second animal neuroscience

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Abstract

There are several facets of second person neuroscience that can benefit from comparisons with animal behavioral neuroscience studies. This commentary will address the challenges involved in obtaining quantitative data from second person techniques, the role of stress in inducing robust responses, the use of interactive functional magnetic resonance imaging (fMRI), and the value of applying interactive methods to studies of aggression and depression.

A comparison of second person neuroscience with animal behavioral neuroscience reveals several common facets between these fields. Discussion of these similarities may lead to improvements in second person neuroscience techniques. One facet is the experimental challenges involved in obtaining quantitative data from second person techniques. Quantitative data is necessary in the study of disorders that involve disrupted social behavior. The use of virtual interactors will be valuable in this regard, but there is also a need for interpersonal interactions. Screening of interactors will reduce some of the variability, but there is more inherent variability in quantitative second-person techniques compared to current social neuroscience methods. However, observational studies in animals or humans may not be able to identify relevant differences between experimental groups as a result of the confounds imposed by the observational process or the fact that observation does not trigger the responses necessary to identify significant differences. Although Schilbach et al. compare adult second person neuroscience with studies of infants as an example of a successful application of second person neuroscience, the personal psychological history of two adults will generate greater variability than interactions between an adult and an infant. In animal studies, more ethologically and ecologically relevant social interactions have been used in stress studies for many years (Tamashiro et al. 2005). With investigations where social defeat is the objective, the use of larger and/or more dominant animals is key to inducing social defeat and generating consistent and reliable data, but effects are gender specific (Haller et al. 1998). If social conflict, but not defeat, is the objective then similarly sized or smaller animals with a consistent social ranking may be more effective (Nephew & Bridges 2011).

Another key benefit to socially interactive animal studies is the role of stress in inducing robust and relevant responses, especially in the study of depression. Exposure to chronic social stress is a strong predictor of the development of depressive disorders (Hammen 2005), and emphasis on the second person neuroscience approach in humans could be a powerful tool in exploring the etiology of affective disorders through the investigation of changes in social interaction over time during exposure to chronic social stress. The use of stressful stimuli has been valuable in rodent fMRI.

A third facet of second person neuroscience addressed in animal studies is interactive fMRI. Functional MRI work in conscious rodents has illustrated the necessity of using robust stimuli. Rodent fMRI work from the labs of Marcelo Febo and Craig Ferris have used ethologically relevant interactions between rat dams and their pups (Febo et al. 2005; Ferris

et al. 2005), and also rat dams and threatening male intruder rats (Nephew et al. 2009). These studies have provided a wealth of information on the real time neuroanatomy of maternal care and aggression, and highlight some of the challenges to interactive imaging studies. Stimuli such as direct suckling by pups and the presence of a male intruder rat elicit robust blood oxygen level dependent (BOLD) responses. Although consistent data has been collected from rat dams actively nursing their pups, this interaction is extremely complex and simultaneously activates brain areas involved in reward, sensation, and lactation. Efforts to tease apart the motivational brain regions involved in BOLD responses have been challenging, as presenting novel objects or pups without contact between the dam and pup does not produce substantial changes in BOLD activity. In contrast, novel objects and the presence pups produce reliable behavioral responses in the home cage. The lack of BOLD responses to these stimuli is hypothesized to be a result of the strength of the stimulus relative to the basal level of response to the imaging procedures, despite acclimatization. In human imaging, it is likely that there is a certain degree of basal BOLD response to the imaging procedure, and the use of robust, ethologically relevant stimuli will produce significant and consistent data. Although virtual imaging paradigms provide control and consistency, are the limitations of this technology any less than the limitations involved in observational or hyperscanning studies? A necessary component with the use of fMRI work in both animals and humans is supporting data from other experimental paradigms. In animals, interactive BOLD data can be supported by electrophysiology, neuroendocrine, and behavioral studies (Caffrey et al. 2010; Febo & Ferris 2007), and similar combinations can be used in human neuroscience. The challenge of collecting consistent data from two interacting humans can be attenuated by the use of large sample sizes and/or carefully chosen research groups and experimental paradigms. For studies using interpersonal interactions, it will be advantageous to use interaction paradigms that create responses greater than the noise introduced by variations in psychological background.

Two fields of social neuroscience in addition to autism where interactive methods would be valuable are aggression and depression. Although second person neuroscience studies of high-functioning autism (HFA) patients certainly have merit, the lack of specificity in autism diagnoses may be limiting to this area of research, and studies of aggression or depression may not involve as many confounds. For both human and animal studies of aggression, observational studies are limited in what they can address. Interactive animal studies on the neurocircuitry of aggressive behavior have generated a wealth of data, which are translationally relevant for disorders involving altered aggressive responses, such as post-traumatic stress disorder (PTSD) (Ferris et al. 2008). The comments by Schilbach et al. on the importance of reward circuits and social interaction suggest that second person neuroscience is a valuable addition to the study of depression as well. Anhedonia and attenuated social interaction are common features of depression, and the second person neuroscience method can address both features in studies of depression in males and females. In humans, Lane Strathearn and others have shown that it is possible to record differences in fMRI responses to stimuli such as infant cry or infant pictures in healthy mothers (Strathearn et al. 2009), but the most relevant BOLD differences are from studies comparing healthy and depressed mothers (Laurent & Ablow 2011). Strong collaborations between animal and human researchers focused on developing ecologically and ethologically relevant second person neuroscience experimental paradigms will advance the development of social neuroscience.

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