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Purpose and Background of the Research

● Outline of the Research

For successful social interactions, each agent observes the actions of others, uses this information to infer their mental states, and then makes appropriate decisions about one's own actions. Our group has discovered single cells in monkey medial and lateral frontal cortical regions that selectively or preferentially respond to the actions of others. However, it remains unknown (1) how such "other cells" distinguish between the actions of the self and others, (2) what information about others' actions is processed by other cells, and (3) what might be the role of coordinated activity between the frontal cortical regions in social interactions. In this study, we will address these issues by combining behavioral studies, electrophysiological recordings, and viral vector mediated pathway-selective blockade.

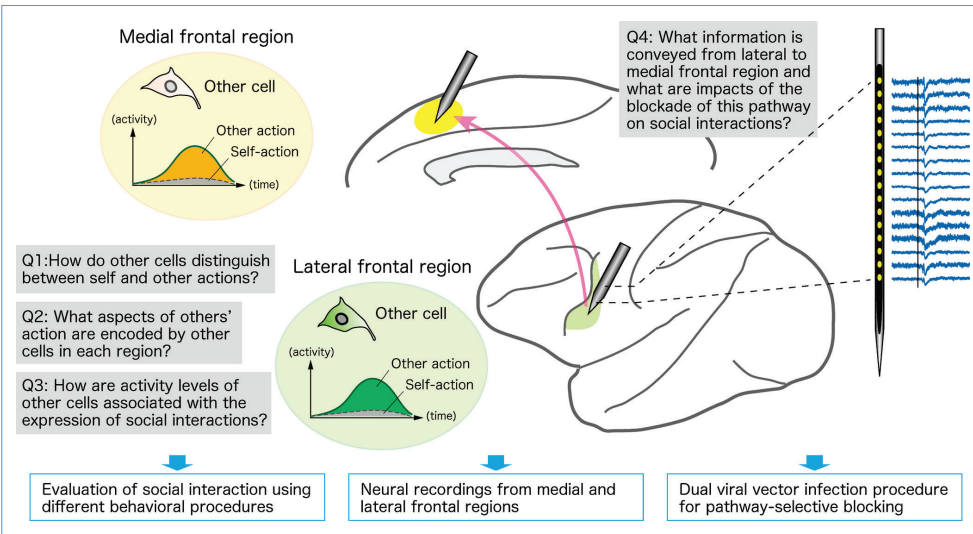


Figure 1. Outline of research plan

● Behavioral procedures

Two monkeys facing each other perform structured tasks or interact freely in a large cage environment.

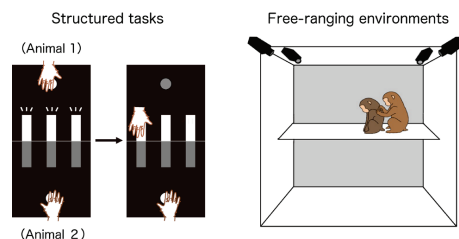


Figure 2. Behavioral experiment

● Electrophysiological procedures

Using microelectrodes, neural activities are monitored with high spatiotemporal resolution. By recording from two target regions simultaneously, functional coordination and information flow can be determined between them.

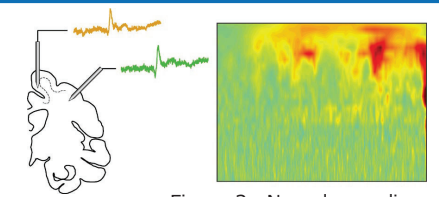


Figure 3. Neural recordings

● Viral vector mediated pathway-selective blockade

Using viral vectors as gene carriers, any given pathway can be blocked. In this experiment, a retrograde vector is injected into the medial region, and an anterograde vector is injected into the lateral region. With this procedure, the pathway from the lateral to the medial region is selectively blocked.

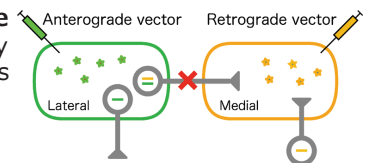


Figure 4. Dual viral vector infection

Expected Research Achievements

● How do other cells distinguish between the actions of self and others?

We will record from other cells in the two target regions while monkeys perform behavioral tasks. We will analyze effects on neural activity of differences between planned and executed actions. This will clarify at the individual neuron level what factors are most responsible for the distinction between self- and other-actions.

● What information regarding others' actions is processed by other cells?

The action of others has multiple pieces of information. We will analyze whether and how activity of other cells in the two target regions is influenced by predictability as well as prediction error of others' actions. We expect that this analysis will clarify the similarities and differences between the two regions. We will also determine how information processing in the two regions is affected by the selective blockade of the pathway linking the two regions.

● What is the role of coordinated frontal cortical activity in social interactions?

In addition to structured tasks, use of free-ranging environments that enable the monitoring of spontaneous social behaviors is also important. We will examine how the pathway-selective blockade affects the expression of social behaviors and related neural activity in a large play cage. We will also test beneficial effects of physiologically active substances on deficient social behaviors.

● Significance of expected outcomes

This study will contribute to a better understanding of social cognitive function by developing experimental psychology of self and other using monkeys. Results obtained from this study will provide important insights into brain mechanisms of autism spectrum disorder, which is characterized by persistent deficits in social interactions.

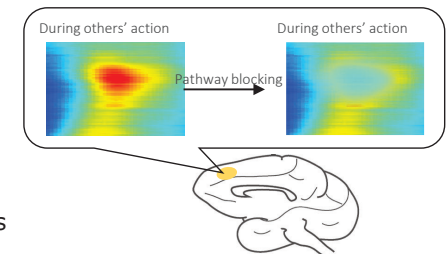


Figure 5. Schematic of neural activity changes after pathway-selective blocking