C-Fos and Reelin Protein Localization: Brain Fluorescence Imaging of Activity Pathways in Mice During Sensory Behavior Tasks

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Organisms detect sensory stimuli through peripheral neurons and transmit the information to cortical brain regions for processing: creating an internal neural map of the external environment. The olfactory and visual cortices communicate to form the basis of cognition, learning, and memory. Yet the involved neural pathways remain unknown at the cellular level. This experiment determined anatomical brain functioning in mice by mapping the neural circuitry that underscores cognitive behavior. 10-12-month-old CD1 mice (n=5) spatially navigated a linear arena, with olfactory or visual stimuli cues, for one hour. The exploratory behavior of each mouse, induced by sensory stimuli, was computed using Deep Lab Cut and AnyMaze neural network software with 2 metrics: cognitive navigation and zone exploration. Mice exhibited increased navigation and exploration with olfactory cues compared to visual, providing a novel sensory task for future research. Each mouse was then subjected to post-mortem brain tissue extraction and immunofluorescence staining 90 minutes post-cognitive stimulation. DAPI, Reelin, and C-Fos protein fixation visualized the anatomical location of neurons active during the sensory task, in specific brain regions of interest. The quantity and cell-type-specificity of excitatory C-Fos and Reelin protein-tagged neurons per cortex was determined with intensity analysis from ImageJ ($p<0.05$). Significant results were shown in the excitation of the hippocampal, motor, ectorhinal, and piriform cortices with olfactory cues (~7,800 neurons > ~2,300 control neurons). No significant results were generated by the visual cues. Thus, this study identified a potential pathway between olfaction, memory, and spatial navigation for the juncture of the mind, brain, and body.