

Immediate early gene expression indicates olfactory sensory detection of physiologically relevant stimuli

Abstract

The main and vomeronasal olfactory systems detect chemical cues of broad ranges of complexity and intensity. Characterization of the precise olfactory circuitry responsible for the processing of different ligands requires the observation of stimulus-associated neuronal activity. Significant controversy exists as to whether the expression of immediate early genes, induced after membrane depolarization, is indicative of stimulus-specific chemosensation.

I performed a series of assays designed to quantify the response of immediate early gene expression in the olfactory and vomeronasal systems of male mice to stimuli of varied physiological significance. I observed that c-Fos expression is indicative of the neuronal response to male urine in the accessory olfactory bulb, Paraventricular nucleus of the hypothalamus, and medial amygdala. Furthermore, the expression of both Egr-1 and Nurr77 is indicative of the neuronal response to predator urine in the main olfactory bulb, piriform cortex, paraventricular nucleus and the medial--anterodorsal, medial-posteroventral, central, and cortical amygdaloid nuclei. The absence of Egr-1 and Nurr77 expression in the VNO and AoB of mice responding to predator urine suggests that these immediate early genes may not be appropriate markers of this stimulus within the vomeronasal system. The induction of immediate early gene expression in the paraventricular nucleus and the medial amygdala elicited by both conspecific and predator urine suggest that these nuclei may be involved in the modulation of aggression and fear. That fear is evoked by predator urine is supported by behavioural observations of initially hesitant olfactory investigations and increased retreat responses in mice exposed to this stimulus. No conclusions can be drawn regarding the immediate early gene response to pheromonal organic compounds isolated from male urine.