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IGSN - SYMPOSIUM

Monday, September 21st 2020 • 15.00 (3 pm)

Auditory processes in communication and the effect of hearing loss on the brain connectome

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Rodent Ultrasonic Communication: Brain and Behavior

Mice and rats are highly social animals, with a rich social behavior repertoire, including the emission of ultrasonic vocalizations (USV). In rats, typically three main types of USV are distinguished: (I) Isolation-induced 40-kHz USV in pups, as well as (II) aversive 22-kHz USV and (III) appetitive 50-kHz USV in juvenile and adult rats. Specifically, 22-kHz USV occur in aversive situations, such as predator exposure and fighting, while 50-kHz USV occur in appetitive situations, such as social play and mating, or in response to psychostimulants, e.g. amphetamine. Evidence from selective breeding, devocalization, and playback studies suggests that 22-kHz and 50-kHz USV serve as situation-dependent socio-affective signals with distinct communicative functions, e.g. 50-kHz USV as social contact calls. While 22-kHz USV fulfill an alarming function and induce freezing in the receiver, 50-kHz USV evoke a social approach response. The opposite behavioral responses are paralleled by distinct brain activation patterns. Freezing elicited by alarming 22-kHz USV is accompanied by increased neuronal activity in brain areas regulating fear and anxiety, e.g. amygdala. In contrast, social approach evoked by pro-social 50-kHz USV is paralleled by reduced amygdala activity, but enhanced activity levels and dopamine release in the nucleus accumbens, a brain area implicated in reward processing. In a recent series of studies, we assessed the validity of 50-kHz USV as a marker for mania-like elevated mood and hypersociability. We showed that amphetamine treatment leads to enhanced 50-kHz USV emission and increased social approach behavior in response to 50-kHz USV playback. Importantly, the amphetamine-induced increase in 50-kHz USV can be blocked by the 5-HT2c receptor agonist CP 809,101 as well as lithium, the gold standard for treating bipolar disorder in humans. Moreover, we showed that a novel genetic rat model for *Cacna1c* haploinsufficiency displays deficits in pro-social 50-kHz USV. Specifically, 50-kHz USV levels emitted by the sender during social play as well as social approach behavior elicited by 50-kHz USV playback in the receiver were found to be reduced in *Cacna1c* haploinsufficient rats. *CACNA1C* is a cross-disorder risk gene strongly implicated in multiple neuropsychiatric disorders, including autism spectrum disorder and bipolar disorder. Together, 50-kHz USV might therefore serve as a novel marker for deficits in socio-affective functioning with relevance for neuropsychiatric disorders.

Host:

GABRIELE RUSSO
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Guests are welcome!

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