Behavioural Profiling: Can Mice Help to Predict Mental Illnesses in People?

Research shows that environmental stress can increase the risk of mental illnesses such as schizophrenia. Stressors, such as living in a large and noisy city and illicit drug use, are particularly harmful during adolescence and increase the risk for schizophrenia in later life.

Prof. Moritz Rossner and doctoral candidate Dorota Badowska, from the Ludwig-Maximilians-University in Munich and the Max-Planck-Institute of Experimental Medicine in Göttingen, are exploring methodologies to assess the effect of stressors such as social isolation and daily aggression from a dominant mouse (social defeat) as risk factors for psychopathologies in adolescent mice. These findings may help medical researchers understand how exposure to environmental stress during adolescence contributes as a risk factor for people developing schizophrenia later in life.

Their innovative approach to evaluating stressed-mouse behaviours produced a reliable “psychological profiling” protocol. In addition, their research showed that mice developed different kinds of psychopathologies depending on the type of stressor. Social isolation induced more schizophrenia-like symptoms, while stress of social defeat evoked a state resembling depression.

Modelling mental illnesses in rodents requires complex analysis of behaviour to determine if the test animals develop symptoms, such as anxiety and declines in motivation and cognition that are applicable to human psychiatric pathologies. However, psychiatric diseases are complex syndromes and not isolated symptoms. For example, the hallmarks of schizophrenia include hallucinations, reduced motivation, social withdrawal and cognitive impairments. Some symptoms, e.g. cognitive impairments, are associated with several psychiatric diseases. Therefore, to model psychiatric disease in rodents, it is essential to use more than one behavioural assessment tool.

The analysis of such complex and large data sets is challenging. In the course of their study, Rossner and Badowska developed a novel approach, in which complex statistical data resulting from multiple behavioural tests allowed them to create murine “psychological profiles” that are analogous to those already available for mental illnesses in patients.

Rossner and Badowska examined the psychological profiles of adolescent mice housed in social isolation or exposed to stress of social defeat. After four weeks of social isolation the animals displayed several schizophrenic-like symptoms e.g. excessive locomotor activity, pain insensitivity and cognitive impairments. The stress induced by social defeat produced depressive-like profiles that included reduced motivation and even more pronounced cognitive impairments.

These findings show that different stressors produce observable and measurable behavioural psychopathologies in mice. Similarly, stress may trigger psychiatric diseases in people. This study may help elucidate influence of stress on the brain functions associated with increased incidence of psychiatric diseases.

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Fig. Behavioural profiles of mice upon social isolation (blue) and social defeat (red) in comparison to controls (black). Deviations towards the centre of the graph indicate increasing levels of psychopathologies. Isolated mice show features typical for schizophrenia: cognitive impairment, pain insensitivity and altered locomotor activity. Defeated mice show features characteristic for depression: cognitive impairments, strongly reduced motivation and curiosity.

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