Autism struck by surprise

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Quinn, an autistic boy, and the line of toys he made before falling asleep. Repeatedly stacking or lining up objects is a behavior commonly associated with autism. Credit: Wikipedia.

A new study shows that social and sensory overstimulation drives autistic behaviors. The study, conducted on rats exposed to a known risk factor in humans, supports the unconventional view of the autistic brain as hyper-functional, and offers new hope with therapeutic emphasis on paced and non-surprising environments tailored to the individual's sensitivity.

For decades, autism has been viewed as a form of mental retardation, a brain disease that destroys children's ability to learn, feel and empathize, thus leaving them disconnected from our complex and ever-changing social and sensory surroundings. From this perspective, the main kind of therapeutic intervention in autism to date aims at strongly engaging the child to revive brain functions believed dormant. Researchers at the Swiss Federal Institute of Technology in Lausanne (EPFL) completed a study that turns this traditional view of autism completely around.

The study demonstrates that, in rats exposed to a known autism risk factor, unpredictable environmental stimulation drives autistic symptoms at least as much as an impoverished environment does, and that predictable stimulation can prevent these symptoms. The study is also evidence for a drastic shift in the clinical approach to autism, away from the idea of a damaged brain that demands extensive stimulation. Instead, autistic brains may be hyper-functional and thus require enriched environments that are non-surprising, structured, safe, and tailored to a particular individual's sensitivity.

"The valproate rat model used is highly relevant for understanding autism, because children exposed to valproate in the womb have an increased chance of presenting autism after birth," says Prof. Henry Markram, co-author of the study and father of a child with autism. Accordingly, rats exposed to valproate in early embryonic development demonstrate behavioral, anatomical and neurochemical abnormalities that are comparable to characteristics of human autism.

The scientists here show that if rats are exposed to this prenatal autism risk factor and reared in a home environment that is calm, safe, and highly predictable with little surprise—while still rich in sensory and social engagement—do not develop symptoms of emotional over-reactivity such as fear and anxiety, nor social withdrawal or sensory abnormalities.

"We were amazed to see that environments lacking predictability, even if enriched, favored the development of hyper-emotionality in rats exposed to the prenatal autism risk factor", says Henry Markram.

The study critically shows that in certain individuals, non-predictable environments lead to the development of a wider range of negative symptoms, including social withdrawal and sensory abnormalities. Such symptoms normally prevent individuals from fully benefiting from and contributing to their surroundings, and are thus the targets of therapeutic success. The study identifies drastically opposite behavioral outcomes depending on levels of predictability in the enriched environment, and suggests that the autistic brain is unusually sensitive to predictability in rearing environment, but to different extent in different individuals. The results were received with enthusiasm by the autism community, which consistently reports the high sensitivity of people with autism to change and to sensory stimulation.

The study is strong evidence for the Intense World Theory of Autism, proposed in 2007 by neuroscientists Kamila Markram and Henry Markram, both co-authors on the present study. This theory is based on recent research suggesting that the autistic brain, in both humans and animal models, reacts differently to stimuli. It proposes that an interaction—between an individual's genetic background with biologically toxic events early in embryonic development—triggers a cascade of abnormalities that create hyper-functional brain microcircuits, the functional units of the brain. Once activated, these hyper-functional circuits could become autonomous and affect further brain functional connectivity and development. These would lead to an experience of the world as intense, fragmented, and overwhelming; while differences in severity between persons with autism would stem from the system affected and the timing of the effect. The authors acknowledge the need to test these ideas in humans.

If children with autism are indeed more neurobiologically sensitive to the environment than other children as a result of early brain hyper-function, then predictable environmental stimulation tailored to an individual's specific hyper-sensitivity could significantly improve quality of life, by preventing or ameliorating the debilitating autistic symptoms of sensory overload and anxiety or fears, and allow the child to flourish.

"A stable, structured environment rich in stimuli could help children with autism, by providing a safe haven from an overload of sensory and emotional stimuli. In contrast, an environment with many unpredictable, changing stimuli could make their symptoms worse, raising anxiety and fear and making these children retract into a bubble," says Kamila Markram.

"Importantly, such constructive interactions with a safe and predictable world at key developmental sensitive periods early on could enhance coping and succeeding in subsequent less structured or unfamiliar contexts, and give place to a harmonious individual development," says Monica Favre, first author of the study.

This study has immediate implications for clinical and research settings, because enhanced brain processing and sensitivity to environmental surprises need to be considered as possible defining characters of autism. This breakthrough suggests that if brain hyper-function can be diagnosed soon after birth, at least some of the debilitating effects of a supercharged brain can be prevented, not by environmental enrichment per se, but by highly specialized environmental stimulation that is safe, consistent, controlled, announced and only changed very gradually at the pace determined by each child.

The research is published in the journal *Frontiers in Neuroscience*.

More information: Predictable enriched environment prevents

development of hyper-emotionality in the VPA rat model of autism, *Frontiers in Neuroscience*, DOI: 10.3389/fnins.2015.00127 , journal.frontiersin.org/articl … nins.2015.00127/full

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