



## How Gene-Environment Interaction Affects Children's Anxious and Fearful Behavior

### NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD

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A review of a recent study combining DNA analysis and behavioral observations to determine the root causes of fearful behavior such as extreme shyness in children.

**Why was the study done?** How do heredity and environment interact to shape children's characteristics? Scientists have long recognized that genes do not "lock in" traits or behaviors—the environment a child engages with helps determine how (or whether) those genes are expressed. But how does this interaction between genes and environment occur? This study used sophisticated methods of DNA analysis and careful measures of environmental influences to understand why some children become fearful and inhibited, and others do not. The investigators examined the interaction of a gene known to be associated with anxiety in adults, and the influence of environmental stress (indexed by a lack of social support for the mother) in children's shyness and social reticence.

**How was the study conducted?** First, 153 young children were observed at 14 months of age in laboratory situations to assess their fearful behaviors in response to social challenges. At age 4, DNA samples were obtained from these children using saliva samples, and these were analyzed for the presence of the serotonin transporter gene (5-HTT), which has two variants, one associated with anxiety and fear in adults. At the same time, mothers completed a questionnaire assessing whether they received emotional support from important people in their lives. Later, when the children were 7 years old, they were observed in peer play groups. Their shy, anxious behavior with peers was scored. This allowed the investigators to evaluate whether children were consistent in their anxious or shy behaviors from 14 months to 7 years, compare those who had the gene variant to those who didn't, and assess the influence on children's shyness of the mother's social support, which can reduce stress for children as well as mothers.

**What did the study find?** First, children who were the most anxious and shy at age 7 were not necessarily the same children who were shy at 14 months. Shyness and social reticence sometimes changed over time. Second, children who were the most anxious and shy at age 7 were those who had the variant of the 5-HTT gene that is associated with anxiety in adults and whose mothers reported lacking social support. It was, in other words,



## SCIENCE BRIEFS

summarize the findings and implications of a recent study in basic science or clinical research. Studies are selected for review based on their scientific merit and contributions to understanding early development. No single study is definitive, of course. Understanding of early development is based on many studies that, taken together, permit broad conclusions and human applications. Generalizing to human children the results of studies with animals, for example, must be done cautiously and confirmed by research with children and their families. The National Scientific Council rests its work on a rigorous discussion of the validity of many studies like these conducted over many years and using different methodologies and samples.

the *interaction* of a genetic tendency toward anxiety and environmental stress that best predicted which children would be most socially reticent, shy and reserved at age 7.

**What do the findings mean?** These findings illustrate how individual characteristics arise through an interaction of hereditary potential and environmental stress or support. When both factors—a genetic predisposition to anxiety and a lack of social support for mothers—are present, a child is much more likely to develop fearful, inhibited behaviors. An inherited predisposition to anxiety need not result in fearful behavior if children and their parents are provided with the kind of social support that appears to reduce children's anxiety. In other work, these investigators have proposed that children who develop anxious, fearful behaviors become *more* anxious over time because they begin to perceive situations as threatening that others would perceive as benign—their sensitivity to threatening challenges is heightened. This conclusion emphasizes the importance of reducing the chances that a child will develop these behaviors in the first place. This study demonstrates the contribution that social supports for parents and children can make to long-term developmental outcomes, especially for those children with inherited vulnerabilities to anxiety, to cope with stress.

Title and Authors: Fox, N. A., Nichols, K. E., Henderson, H. A., Rubin, K., Schmidt, L., Hamer, D., Ernst, M., & Pine, D. S. (2005). Evidence for a gene-environment interaction in predicting behavioral inhibition in middle childhood. *Psychological Science*, 16: 921-926.