# How nature and nurture interact increase the severity and likelihood of developin...

Science, Genetics

Sally Dunwoodie, head of the Embryology Laboratory at the Victor Chang Cardiac Research Institute in Sydney, and a professor at the University of New South Wales together with Kenro Kusumi, an associate professor in the School of Life Sciences in ASU’s College of Liberal Arts and Sciences and clinical collaborators in Philadelphia and Toronto have shown how nature and nurture interact to increase the severity and likelihood of developing congenital birth defects, including abnormalities in the heart, kidneys, brain, limbs and cranio-facial regions – cleft palate (Arizona State University College of Liberal Arts and Sciences, 2012).

They show how hypoxia – a period of low oxygen during pregnancy, combined with a genetic risk factor of having only one functioning copy of a gene, dramatically increases the chances of a baby being born with congenital scoliosis, a malformation of the spine that affects about 3% of the general population. They discovered that the combination of the genetic risk as well as exposure to low oxygen, resulted in our subjects being up to 10 times more likely to develop congenital scoliosis, than those that only had the genetic risk factor. Hypoxia during pregnancy can be caused by various conditions including smoking, use of recreational or prescription drugs, anemia and incorrect control of sugar levels in diabetics. This brief period of low oxygen fundamentally disrupts the pathway that is responsible for development of the spine, which is also used in the development of limbs and many organs (heart, kidneys, brain and facial region).

Another example is Schizophrenia – a disease that includes symptoms of delusions, hallucinations, paranoia, social isolation as well as many others.

There is no doubt that Schizophrenia has a significant genetic component, as people with close degree relatives can be at a higher risk (Schizophrenia. com, 2004).

A tragic story but ground-breaking study conducted at the National Institute of Mental Health by David Rosenthal in the 1950's focuses on identical quadruplet girls known as the " Genain Quadruplets" – Myra, Nora, Idris and Hester. Born in 1934, all four sisters ended up suffering with Schizophrenia by the age of 34, proving that the quadruplets had a genetic disposition for the mental disorder. The degree of severity, however, differed between the sisters and this highlighted the complex environmental interactions (Mirsky AF, 1984). All four girls suffered severe abuse throughout their childhood. Their father was short-tempered, controlling and sexually abusive and their mother too had peculiar sexual preoccupations. Nora and Myra were the brightest of the four girls with Myra experiencing preferential treatment including less abuse from her father. They both experienced more success in life – with Myra being the only one to avoid hospitalization and the last to experience schizophrenic symptoms. Although the genetics of the Genains are presumed to be identical, the phenotypic expression of the Schizophrenia disease is relatively unique in each of the sisters. This serves as a reminder that this kind of diversity must include the contribution of a number of environmental factors and that an appropriate genetic model would most likely be similar to that of other complex human disorders, such as heart disease, diabetes, and cancer and so on. (Allan F. Mirsky, 2000)The remarkable complexity of such diseases must be understood before

satisfactory progress can be made in understanding, predicting and preventing the course of schizophrenia.

The study of the quadruplets can be re-enforced, as the Lieber Institute for Brain Development (LIBD) published a study in Nature Neuroscience titled Mapping DNA methylation across development, genotype and schizophrenia in the human frontal cortex, that revealed that one's environment affects brain changes linked to schizophrenia only during early development usually in childhood, and not during adulthood when symptoms begin to occur. (MentalHealthInformationCentreSA, 2015)

## PHYSIOLOGY AND SKILL

An article published in The Scientific American states that 60%-80% of the differences in height between individuals is determined by genetic factors, whereas 20%-40% can be credited to environmental effects – mainly nutrition (ScientificAmerican, n. d.). These statistics are emphasized through the work of Peter M. Visscher of the Queensland Institute of Medical Research in Australia, who recently reported that the heritability of height is 80%, based on 3, 375 pairs of Australian twins and siblings. Another study of 8, 798 pairs of Finnish twins concluded that heritability of height was 78% for men and 75% for women.

Height heritability can vary from one population to another – even from men to woman – because different populations have different genetic backgrounds and live in different environments. When an environment maximizes the genetic potential of a population for a specific trait, this

population tends to have a higher heritability for that trait. In more developed countries, there is strong nutrition for childhood development, which then maximizes the genetic potential for height, therefore the heritability is higher, and visa versa for less-developed countries.

With regards to skill, a study published in the Journal Psychonomic Bulletin & Review, reviewed 850 sets of twins and discovered that genes and the environment work together to help people become accomplished musicians. It found a gene–environment correlation, because although it was found that accomplished musicians practiced more than those who weren’t accomplished, the inclination to practice was driven by genetics. (Hambrick, 2015) “ Genetic potentials for skilled performance are most fully expressed and fostered by practice”.