Heredity

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Heredity is the sum of biological processes that result in the transmission of genetic traits from parents to their offspring, making each individual unique. Through the transmission of genetic traits, heredity is responsible for each individual's genotype, as well as his or her phenotype. The genes that are passed down from generation to generation have a considerable influence on psychological characteristics including intelligence, personality, mental health, and patterns of behavior. However, when considering psychological characteristics passed down through heredity, it is vital that environmental aspects are also considered.

Within a few hours after fertilization, a zygote is formed. The newly formed zygote contains 46 chromosomes, 23 from each parent. The chromosomes are paired, one from each parent, based on the genetic function they serve. Each chromosome contains thousands genes, which are stretches of deoxyribonucleic acid (DNA). DNA, which is protein containing genetic information, is the foundation of heredity. DNA has the ability to replicate itself through a process called mitosis. This ability of DNA to replicate itself through mitosis allows the single-celled zygote to develop into complex multicellular human beings.

In addition to promoting the multiplication of cells, genes also play key roles in development. For example genes regulate all production of amino acids, which form proteins that are necessary for the functioning of new cells. Genes also promote cell differentiation, which determines the parts of the body that cells will belong to. On top of cell differentiation, genes are also responsible for determining developmental timing. However, it is important to note that the

environment plays an important role in influencing how genes function. For example, a child may inherit genes that give him the potential to be above average height, but without proper nutritional supplies, the child may only grow to be average height or even below average height.

More important than how genes function is how they are expressed. The expression of genes is dependent upon the pattern of genetic inheritance on the chromosomes. The first pattern is the single gene inheritance pattern, which is a pattern in which only one pair of genes, called alleles, is responsible for human characteristics. In single-gene inheritance, one gene in the pair is dominant and the other is recessive. For example, consider the ability to see objects clearly from a distance. The gene associated with normal vision is a dominant allele, whereas the gene associated with nearsightedness is a recessive allele. In single gene inheritance, the dominant allele will always be expressed, and the only case in which a recessive allele would be expressed is in the presence of two recessive alleles. In cases where both alleles inherited from parents are dominant or recessive, that trait is considered homozygous. For genes in which one inherited allele is dominant and one is recessive, that trait is considered heterozygous. Because of recessive and dominant genes, two individuals with normal vision may in some cases produce a child who is nearsighted. For example, if both parents were heterozygous for that gene, the child may end up receiving a recessive allele from each parent, resulting in nearsightedness. The example of nearsightedness is just one of thousands of human traits that follow the simple gene inheritance pattern.

Another pattern of gene expression is co-dominance. For example, blood type genes are co-dominant, producing a combination of the two co-dominant alleles. When determining blood types, neither type A or B dominates the other. Thus the expression of the combination of genes in the offspring will represent a compromise between the two, which is type O. Another type of

co-dominance is incomplete dominance, or when one of two heterozygous alleles is stronger than the other but fails to mask the other. Such an example is the sickle-cell gene.

Sex-linked inheritance is a form of genetic expression in which the expressed allele is located on the sex chromosome. The majority of sex-linked genetic expression comes from recessive traits that are present on the X chromosome. Because males have both X and Y chromosomes, any recessive trait located on the X chromosome will automatically be expressed because there is no corresponding trait to suppress its expression.

Outside of single gene patterns, polygenic inheritance is based on the interaction of many different alleles. Examples of polygenic traits include height, intelligence, skin tone, and temperament. In polygenic inheritance, as the number of alleles involved in the traits expression increase, the number of possible expressions increases exponentially. Therefore, polygenic traits are not binary, but rather have many possible outcomes depending on the complete genetic makeup of the individual. These multiple forms of gene expression collectively form what is known as heredity.

Further Reading

Plomin, R., DeFries, J., Knopik, V., & Neiderhiser, J. (2016). Top 10 replicated findings from behavioral genetics. *Perspectives On Psychological Science, 11*(1), 3-23. http://dx.doi.org/10.1177/1745691615617439

Shaffer, D., & Kipp, K. (2013). *Developmental Psychology* (9th ed., pp. 45-88). Belmont CA: Wadsworth.