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Complementary Genes Hypothesis

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Synonyms

Complementation; Genetic Inheritance; Intergenic Complementation; Intragenic Complementation; Multiple Gene Inheritance

Definition

Genes may produce different phenotypic effects when they are present together in an organism than either of the genes would have produced if they were present separately in an organism.

Complementary genes combine to produce unique phenotypic effects that would not be expressed if either of the genes were isolated in a separate organism. Complementary genes often exist at distinct genetic loci, either on different genes or on different sites within the same gene.

Simple examples of the effects of complementary genes include innocuous phenotypic effects such as the purple grain coloration in wheat observed by Dobrovolskaya et al. (2006). Additionally, White et al. (1996) showed the complementary effects of genes for eye color in *Drosophila melanogaster*. Further, Cornel et al. (1997) observed that the gene for red eye pigmentation in *Drosophila melanogaster* has a complementary effect in white eye strains of *Aedes aegypti*, resulting in red eye pigmentation. In this sense, complementary genes may only appear to be a chance occurrence, resulting when an offspring happens to inherit a particular combination of genes from each of its parents, and which usually generates no significant fitness benefits. However, some research has focused on fitness benefits that may be a result of complementary genes and the ways in which individuals of some species might select mates based on their potentially complementary genes.

Mate Selection

Research has focused on the potential for complementary genes to result in offspring who bear an immune resistance to a unique array of pathogens from either of that offspring's parents. In a meta-analysis observing the effects of constrained mate choice in several species (e.g., cockroaches, fruit flies, mallards), Gowaty et al. (2007) found that offspring viability was higher when parents were allowed to mate with their preferred partners than when mate choice was experimentally constrained. The researchers explained that, in addition to selecting mates based on physical indicators of good genes, individuals may also select mates based on the possible complementary

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gene effects of immune resistance, thus resulting in offspring that are less likely to die of infection.

Complementary Genes and Mate Selection in Humans

Roberts and Little (2008) reviewed studies that investigated the ways in which humans select mating partners, and specifically, aspects of human mate selection that may have evolved as a way of selecting immune resistant partners. In particular, Thornhill et al. (2003) observed that men preferred the scent of women who had dissimilar (relative to similar) major histocompatibility complexes. Although the researchers did not observe a similar preference for women, they did observe a preference for the scent of men with high facial symmetry in ovulating women. The results suggest the possibility that men may use olfactory cues to select as mating partners women with a distinct immune resistance from themselves. Selecting mates with a dissimilar major histocompatibility complex may increase the likelihood of producing offspring with an increased resistance to infectious diseases.

At a glance, complementary genes might simply refer to the resulting phenotypic expression produced by two or more genes that, separately, would produce different phenotypes than when they occur in the same body. However, research investigating the selection of mating partners that is potentially based on complementary genes suggests greater complexity. Namely, individuals of some species may use cues to complementary genes in potential mates to produce offspring with an advantage in the form of increased pathogen resistance.

Cross-References

▶ Additive Genetic Variance
▶ Nonadditive Genetic Variance
▶ Polygenic Inheritance

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