

Polygenic Inheritance

One trait controlled by many genes

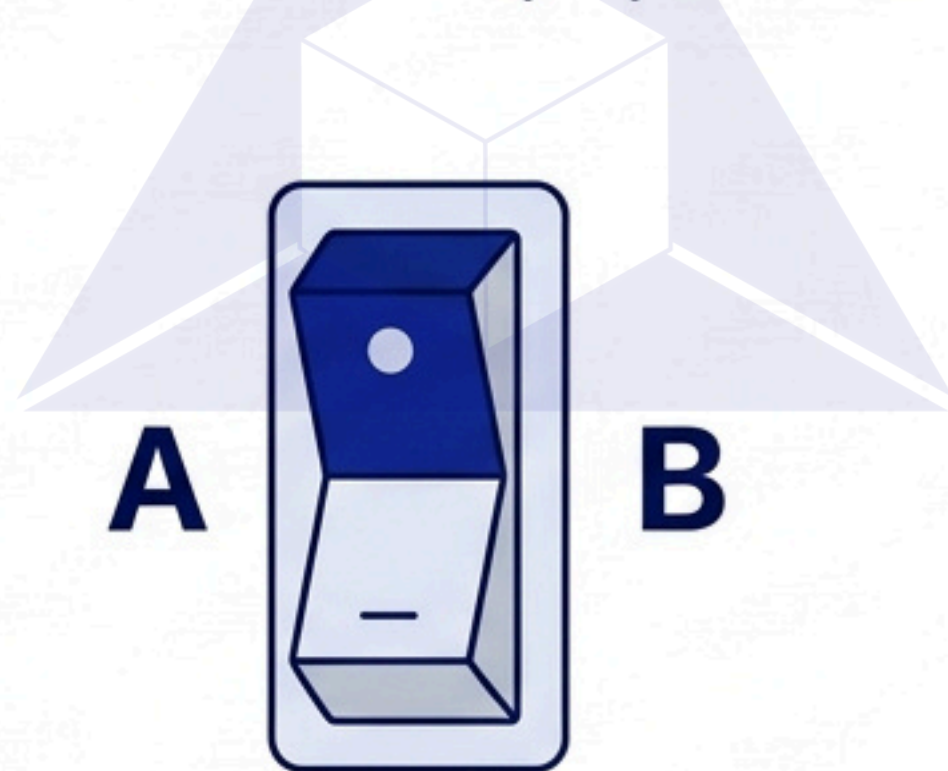


The limitation of Mendelian binary traits



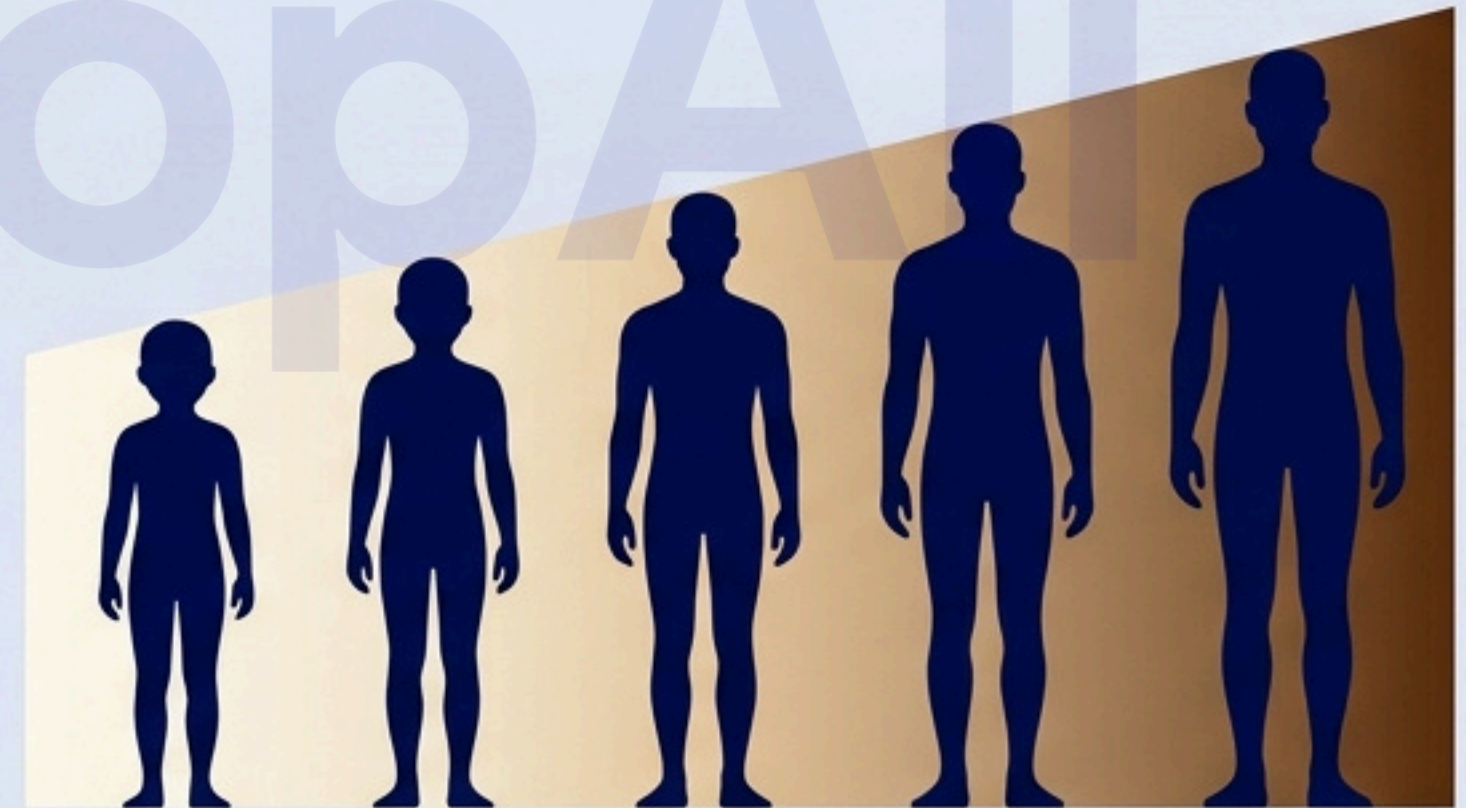
The Binary Fallacy

Assuming all genetic traits have distinct alternate forms (e.g., a plant is either tall OR dwarf; a flower is either purple OR white).



Continuous Gradient in Nature

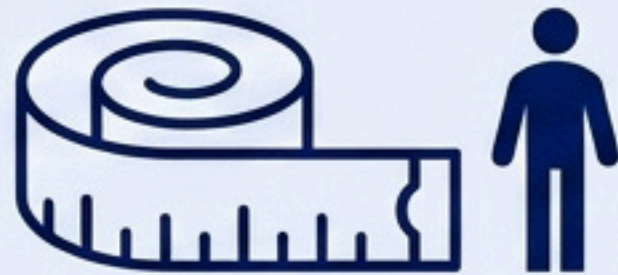
Most natural traits are not distinct categories—they are spread across a continuous gradient.



Defining Polygenic Inheritance

A polygenic trait is a single phenotypic characteristic controlled by three or more genes.

These multiple genes interact to produce a wide spectrum of possible phenotypes.





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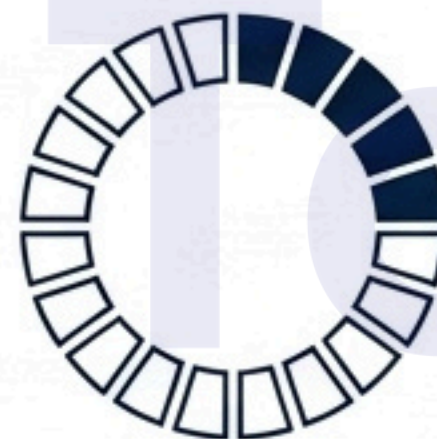
The mechanics of the Additive Effect

Rule of Additive Effect: The final phenotype reflects the contribution of each allele. They do not mask each other; they stack.

The Allele Abacus



Gene A



Gene B



Gene C

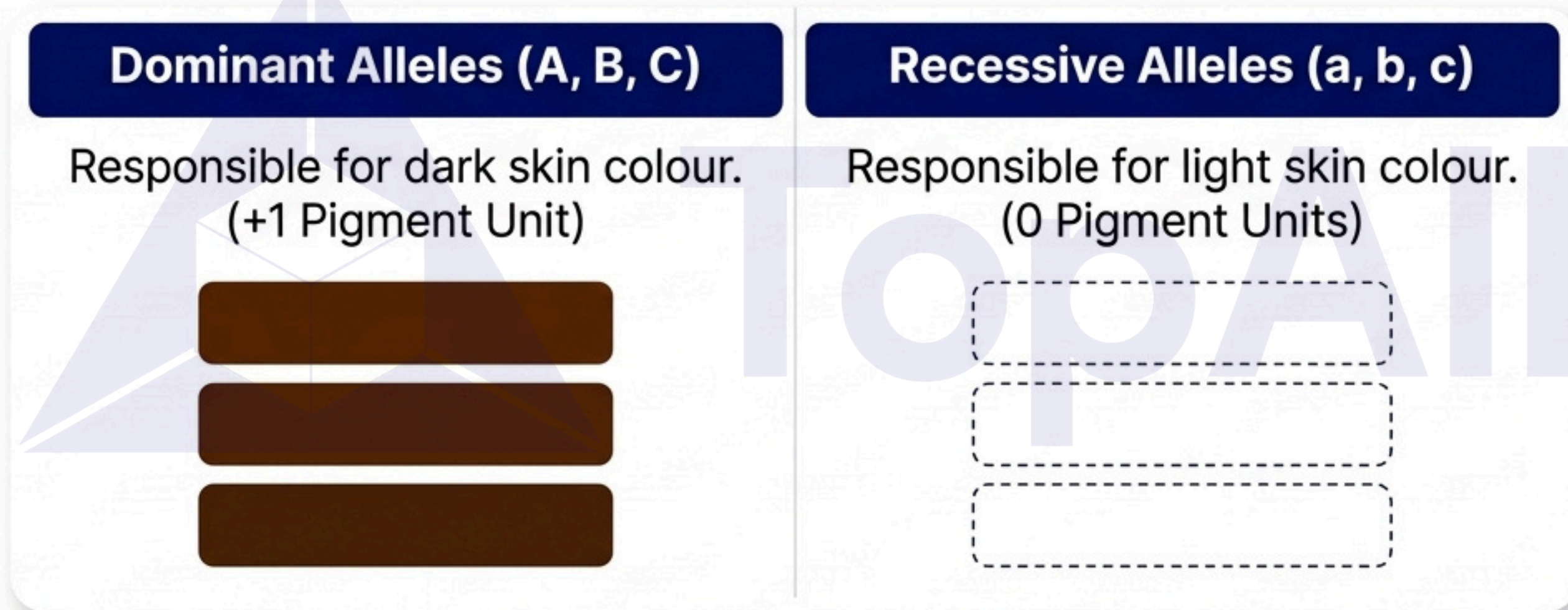
■ Dominant Alleles (A, B, C) = +1 Unit of Expression

□ Recessive Alleles (a, b, c) = 0 Units

It is not about which dominant gene is present, but exactly how many total dominant alleles an individual possesses.

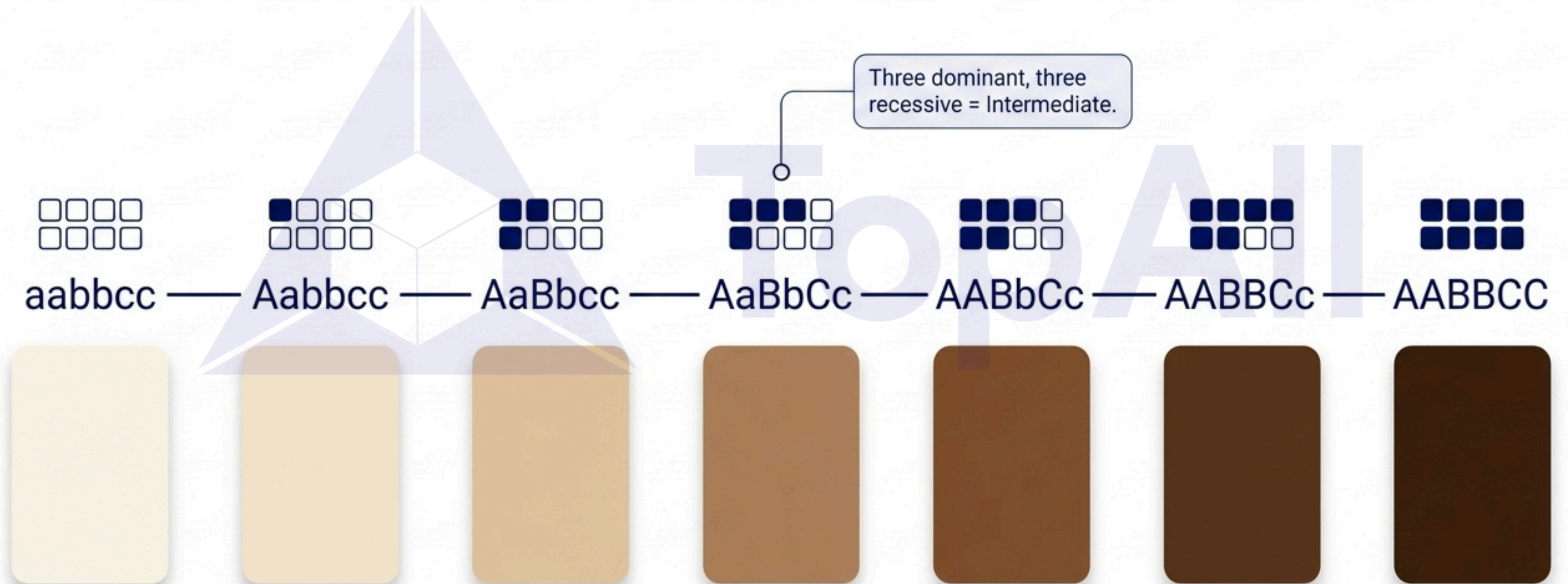
Assume human skin color is controlled by three genes (A, B, and C). Every individual inherits two alleles per gene (one from each parent), resulting in a **6-letter genotype**.

Modeling human skin colour via three genes



Because there are 6 total allele slots, an individual can have anywhere from 0 to 6 dominant alleles, creating 7 possible pigmentation baseline states.

The Genotype Gradient: From aabbcc to AABBCC

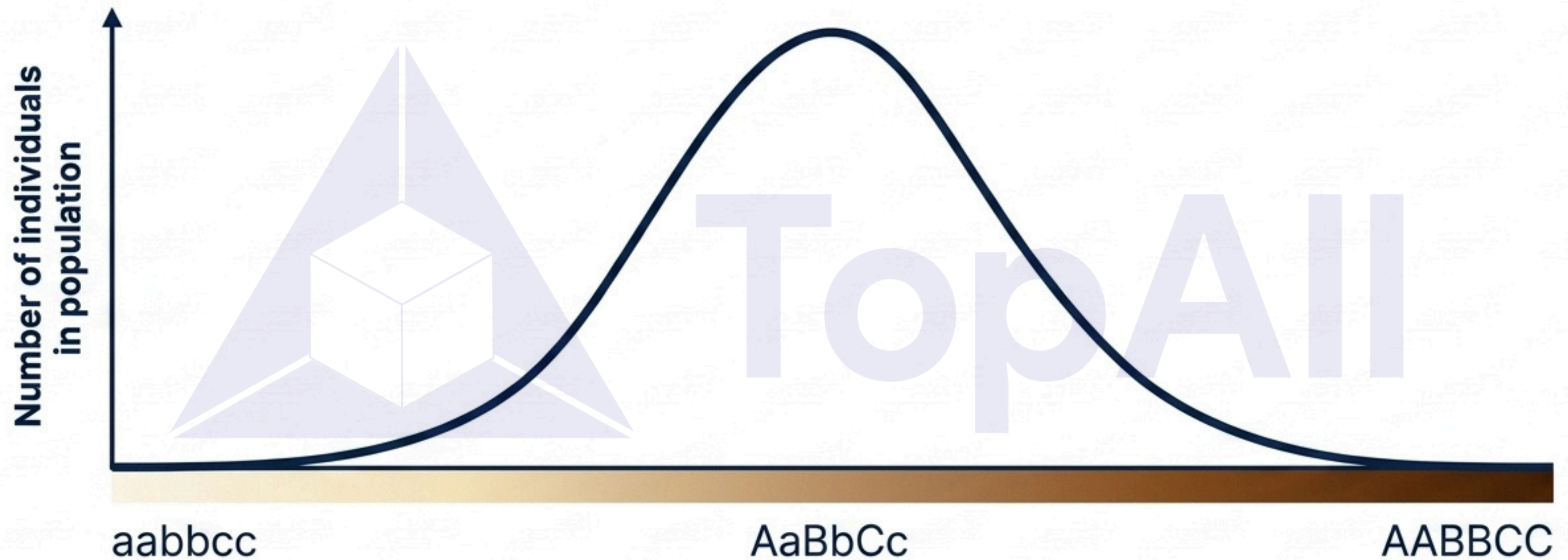


The final variable: Environmental influence



Polygenic inheritance uniquely takes into account the influence of the environment. Environmental factors smooth out the genetic steps, creating true, infinite continuous variation.

Population distribution of polygenic traits



Key Takeaway: Polygenic traits show continuous variation.



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