WHY DO FERTILIZED EGGS KEEP PARENTAL GENOMES APART

After fertilization, the egg and sperm do not immediately merge their chromosomes. The maternal and paternal genomes remain enclosed in two separate pronuclei for roughly 10–12 hours in mice and 16–20 hours in humans. This prolonged separation has long been considered a mechanical byproduct of fertilization. A new study in Nature shows it is functionally essential (1)

To test this, the authors developed a novel ICSI approach: by injecting the sperm adjacent to the maternal chromosomes rather than away from them, they generated zygotes where both parental genomes are enclosed in a single enlarged pronucleus from the start (1PN). The result: without a rival pronucleus to compete with, the single structure grows too large, disrupting histone trimethylation patterns and sharply reducing developmental potential to term, even though early cleavage looks normal in vitro.

The finding is counterintuitive: the two pronuclei don't cooperate, they compete for cytoplasmic resources, and that competition is what keeps epigenetic regulation on track. It is a striking example of intragenomic conflict co-opted as a developmental mechanism.

Clinically, 1PN zygotes arise in 2–8% of IVF/ICSI cycles and are increasingly used in transfer. This study provides the first mechanistic explanation for their lower success rates, and hints at possible pharmacological rescue.

1. https://www.nature.com/articles/s41586-026-10417-7