Mitochondrial genes move to the nucleus -- but it's not for the sex

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Why mitochondrial genes ditch their cushy haploid environs to take up residence in a large and chaotic nucleus has long stumped evolutionary biologists, but Indiana University Bloomington scientists report in this week's *Science* that they've uncovered an important clue in flowering plants.

"Plants that reproduce clonally or are capable of self-pollinating have transferred more genes from the mitochondrion to the nucleus," said graduate student Yaniv Brandvain, lead author of the paper.

That discovery, Brandvain explained, is unexpected. The most obvious benefit of being part of the nuclear genome is recombination, after all, but little recombination takes place in self-pollinating species. So what, exactly, might be luring mitochondrial genes to the nucleus?

"We're not quite sure why yet, but we've hypothesized that successful mitochondrial genes are pairing up with related nuclear genes," Brandvain said. "When you have two successful genes that depend on each other, it's best for them not to be in an environment in which they will recombine. It would be like breaking up a good musical duo."

Mitochondrial and nuclear genomes replicate separately, and a new and beneficial mutation in the mitochondrion could be separated from partner genes in the nucleus -- in the production of eggs or pollen, via meiosis. But the mating system determines whether or not this separation is permanent. With self-pollination, the components separated by

meiosis are brought back together. In contrast, the components are further separated if they mix and match haphazardly during out-crossing.

Brandvain said the finding contradicts the expectation that mitochondrial genes migrate to the nucleus because of the evolutionary benefits conferred by sexual recombination. "The benefits of sex could have driven the transfer," he said. "There are powerful arguments out there for that. But that's just not what we saw."

Brandvain, fellow graduate student Michael Barker, and their advisor, IUB evolutionary biologist Michael J. Wade, examined papers that identified the sexual properties of plants that show evidence of mitochondrial-nuclear transfer. In all, the scientists collected data from plant species representing 170 genera.

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