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EVOLUTIONARY GENETICS

Red Queen dynamics in fruit fly sex

Research in *Drosophila melanogaster* has provided the first direct evidence that animals increase the proportion of recombinant offspring that they produce in response to infection.

Plastic recombination describes environment-induced alterations in the proportion of recombinant progeny that parents produce, and it has long been known to occur in *D. melanogaster* in response to environmental factors such as temperature, nutritional availability and stress. In particular, the Red Queen hypothesis posits that dynamic antagonistic co-evolutionary interactions — such as those between parasites and hosts — promote the diversification of offspring through sexual reproduction in order to combat rapidly changing threats. Although plastic recombination in response to infection has been demonstrated in plants, no such phenomenon had been described in animals.

Singh *et al.* first tested whether infectious agents increase the frequency of recombination in *D. melanogaster*. To estimate recombination rates, females heterozygous for visible recessive mutations in the *ebony* and *rough* genes were backcrossed to double-mutant males, and the resultant progeny was phenotypically scored for recombination between the two genes. Adult females infected with the opportunistic bacterium *Serratia marcescens* and mated 4 days later produced a significantly greater proportion of recombinant offspring than did mock-infected controls. The same effect was produced when females were infected with the parasitic wasp *Leptopilina clavipes* as larvae and successfully fought-off the infection prior to mating.

This plasticity is probably due to transmission distortion — the unequal contribution of gametes with different genotypes to the next generation — rather than through increases in meiotic or mitotic recombination rates. Experiments using double heterozygous males, which do not undergo meiotic recombination, indicated that mitotic mutation rates in *D. melanogaster* were below detection limits. When females were infected with either *S. marcescens* or another bacterium, *Providencia rettgeri*, the increases in recombinant progeny were observed before any possible contribution of altered meiotic recombination frequency, indicating that transmission distortion is probably the main process by which these increases in recombinant progeny are produced.

Animals therefore have the ability to alter the genetic variability of their offspring in response to pathogens. Further work will be aimed at identifying the mechanisms that underlie this plasticity — be they asymmetric cell divisions during meiosis, changes in viability between recombinant and non-recombinant offspring or an as-yet-unidentified process — and examining whether the Red Queen effect holds true across the genome.

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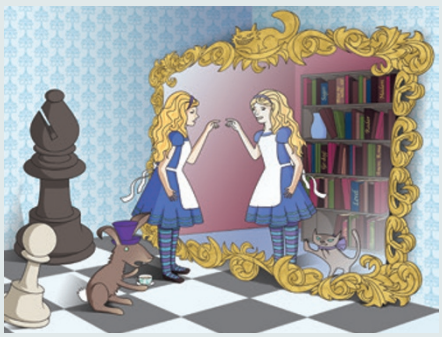
Nature Reviews Disease Primers

ORIGINAL RESEARCH PAPER Singh, N. D. *et al.* Fruit flies diversify their offspring in response to parasite infection. *Science* **349**, 747–750 (2015)



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