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RESEARCH NEWS

NOVEMBER 07, 2004

# Sexual Competition Drives Evolution of a Sex-Related Gene

In what could be termed a truly seminal discovery, researchers have shown that when females are more promiscuous, males have to work harder—at the genetic level, that is. More specifically, they determined that a protein controlling semen viscosity evolves more rapidly in primate species with promiscuous females than in monogamous species. The finding demonstrates that sexual competition among males is evident at the molecular level, as well as at behavioral and physiological levels.

The researchers, led by Howard Hughes Medical Institute investigator Bruce Lahn at the University of Chicago, published their findings in the November 7, 2004, issue of *Nature Genetics*.

Lahn's group studied semenogelin, a major protein in the seminal fluid that controls the viscosity of semen immediately following ejaculation. In some species of primates, it allows semen to remain quite liquid after ejaculation, but in others, semenogelin molecules chemically crosslink with one another, increasing the viscosity of semen. In some extreme cases, semenogelin's effects on viscosity are so strong that the semen becomes a solid plug in the vagina. According to Lahn, such plugs might serve as a sort of molecular “chastity belt” to prevent fertilization by the sperm of subsequent suitors, though they might also prevent semen backflow to increase the likelihood of fertilization.

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> **- Bruce T. Lahn**

Lahn and his colleagues compared the *SEMG2* gene, which contains the blueprint for semenogelin, from a variety of primates. They began by sequencing the *SEMG2* gene in humans, chimpanzees, pygmy chimpanzees,

gorillas, orangutans, gibbons, macaques, colobus monkeys, and spider monkeys. These species were chosen because they represent all the major mating systems. These include those in which one female copulates with one male in a fertile period (such as gorillas and gibbons); those in which females copulate highly promiscuously (such as chimpanzees and macaques); and those in which mating practices fall somewhere in between (such as orangutans where a female will copulate with the dominant male, but may also copulate with other males opportunistically).

“When we plotted data on the evolution rate of the semenogelin protein against the level of female promiscuity, we saw a clear correlation whereby species with more promiscuous females showed much higher rates of protein evolution than species with more monogamous females,” said Lahn. The researchers measured protein evolution rates by counting the number of amino acid changes in the protein, then scaling it to the amount of evolutionary time taken to make those changes.

“The idea is that in species with promiscuous females, there's more selective pressure for the male to make his semen more competitive. It's similar to the pressures of a competitive marketplace. In such a marketplace, competitors have to constantly change their products to make them better, to give them an edge over their rivals—whereas, in a monopoly, there's no incentive to change.”

The finding constitutes the first specific evidence that different levels of sexual competition produce different genetic effects, said Lahn. It had been established previously that levels of polyandry—the mating of one female with more than one male—affected physiological traits. For example, more polyandrous species have larger testes capable of producing more sperm. There is a metabolic cost to such adaptation, Lahn said, and in species where there is no competition, the cost is not worth the effort.

“Now, for the first time, we show such competitive effects, not only at the level of physiology, but of individual genes,” said Lahn. “The genes have to adapt faster for any given male to gain an edge over his competitors.”

According to Lahn, while other studies have indicated that male reproductive genes in general tend to evolve more rapidly than other genes, “this study extends those observations to a more quantitative level, showing that the rate of evolution actually correlates with how intense the sexual selection is.”