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## Sexual Antagonism Hypothesis

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### Synonyms

[Sexual conflict](#)

### Definition

Sexual antagonism (or sexual conflict) arises between the sexes when the evolutionary interests of males and females differ. Conflict can arise over the expression of a trait shared by both sexes, or over the outcome of reproductive interactions between males and females.

### Introduction

Sexual antagonism (or sexual conflict) arises between the sexes when the evolutionary interests of males and females differ (Parker 1979; Chapman et al. 2003; Arnqvist and Rowe 2005). It can be separated into two main forms, known as intralocus and interlocus sexual conflict, which differ in whether the target of selection is a single trait shared by both sexes, or different traits in

either sex that interact to influence fitness, respectively. Conflict is the result of selective processes acting differently between the sexes, and may arise due to differences in the strength or direction of sexual selection, natural selection, or both. Sexual conflict ultimately arises when there are fundamental differences in reproductive roles between the sexes (Parker 1979). For example, female mammals carry young during pregnancy, and then suckle infants with milk until they are able to fend for themselves. Male mammals do none of this, and so have a much higher potential reproductive rate than females. Therefore, the best reproductive strategy for females is to focus on rearing healthy offspring, whereas for males it may be to contribute little to parental care, and instead father offspring with as many females as possible. These biological differences thus lead to very different optimal reproductive strategies. Recognition of these evolutionary conflicts of interest between the sexes allows us to explain a variety of adaptations in males and females, especially those relating to reproduction and parental care (Arnqvist and Rowe 2005).

### Intralocus Sexual Conflict

Intralocus sexual conflict arises when the optimal expression of a trait that is shared by both sexes differs (Arnqvist and Rowe 2005; Bonduriansky and Chenoweth 2009). For example, male elephant seals compete with each other for access

to females, and so benefit from having a very large body size, whereas females do not. In other words, sexual selection acts to increase body size in males but not in females. This means that selection on body size will act in opposite directions in either sex. This form of conflict is likely to be widespread, given that males and females have many shared traits with a common genetic basis. The outcome of such divergent selection depends on the extent to which gene expression is constrained between the sexes. If plasticity in gene expression is limited in some way, then the trait may be expressed at an intermediate, and thus suboptimal, level in both sexes (Bonduriansky and Chenoweth 2009). Alternatively, gene expression may become decoupled between the sexes, leading to sexual dimorphism. The fact that males and females are dimorphic in most species suggests that such differential expression is achieved often, and indeed we should expect it to evolve quickly when selection is strong. Therefore the evolutionary importance of intralocus sexual conflict remains unclear, and will ultimately depend on the importance of genetic constraints on trait evolution.

### Interlocus Sexual Conflict

Most theoretical and empirical work has instead focused on interlocus sexual conflict, which arises over the outcomes of interactions between males and females (Arnqvist and Rowe 2005). This form of conflict is most relevant when studying animal behavior, given that it arises primarily due to behavioral interactions between the sexes. Interlocus sexual conflict can arise in two ways (Arnqvist and Rowe 2005). First, conflict will arise for any sexual interaction for which the optimal outcome differs between the sexes. This includes conflict over aspects of the mating system such as mating rate, remating behavior, and parental roles. Second, conflict may arise whenever males and females need to cooperate during reproduction. This occurs for example in birds, in which both males and females provision young. Though both parents may benefit from sharing provisioning (as this should result in the greatest

chance of offspring survival), each parent will also benefit if its partner does more work. This means that tasks previously seen as cooperative are more appropriately viewed as a form of negotiation, with each parent trying to exploit the efforts of the other (Trivers 1972).

Interlocus sexual conflict is most commonly studied in relation to reproductive traits, and can occur before, during, and after mating. This includes conflict over mating frequency, fertilization, female remating behavior, and female reproductive rate. For example, in many species there is conflict between the sexes over whether females should be monogamous or polygamous (Arnqvist and Rowe 2005). For a male, the optimal outcome is for each female to mate only with him, as this will ensure that he fertilizes all of her eggs. However, females can often benefit by mating with multiple males during each breeding bout, for a variety of reasons. Therefore the optimal level of polyandry may be higher for females than for males. This conflict has led to the evolution of male adaptations in many species that prevent females from remating. These include behavioral adaptations such as mate guarding, anatomical adaptations such as mating plugs that block the female reproductive tract, and physiological adaptations such as male seminal fluid compounds which delay female remating (Arnqvist and Rowe 2005).

Another common form of sexual conflict arises over mating itself. Given that sperm are relatively cheap to produce, males can generally benefit most by mating with every female they encounter. In contrast, female reproductive rate is more restricted, and so females benefit most by mating with only the highest-quality males, either in terms of resource-holding potential or genetic quality. This has led to the evolution of female choice based on the assessment of male phenotype. However, sexual conflict means that selection on males will favor any adaptation that allows a male to circumvent female choice, either before or after mating. This conflict can explain a variety of antagonistic male mating behaviors, such as forced matings (Clutton-Brock and Parker 1995).

In some cases, sexual conflict may lead to one sex being directly harmed by adaptations in the

other sex. For example, harassment and coercion by males may lead to the drowning of female waterfowl (Clutton-Brock and Parker 1995). Females may also be physically harmed by male grasping structures, or by sharp spines found on the male genitalia (Arnqvist and Rowe 2005), and in some species this harm may significantly reduce female fitness and fecundity (e.g., Dougherty et al. 2017). In these cases harming of females does not seem to benefit males directly, but rather arises as a by-product of selection on male traits that increase male mating or fertilization success (Morrow et al. 2003). In such species, selection on females to evolve counter-adaptations to reduce harm is particularly strong. Examples of such counter-adaptations include the thickened reproductive tracts and increased immune activity seen in female seed beetles (Dougherty et al. 2017).

Males and females also have to interact when raising offspring, and this leads to a variety of conflicts between the sexes over parental care strategies and behaviors (Trivers 1972; Arnqvist and Rowe 2005). Though both parents have equal relatedness to the offspring, and so would benefit equally from offspring survival, parents are generally unrelated to each other. This means that each parent can gain by allowing the other to contribute more to care: the “cheating” parent will then have more resources available to allocate to future breeding attempts (Trivers 1972). Conflict can thus arise over the amount of care each sex provides in monogamous species. Theory predicts that biparental care is evolutionarily stable when reduced care by one parent leads to increased care in the other, but not so much that it completely compensates for the reduction, a pattern which is supported by experimental data (Harrison et al. 2009). There is also conflict over the optimal reproductive strategy of each sex in relation to parental care. This is because males usually benefit from mating with many females, and getting someone else (either the female or another male) to rear his offspring. In contrast, females usually gain most from the male staying and exclusively helping her with caring. This conflict has for example led to the evolution of female behaviors that prevent males from soliciting extra-

pair matings, such as showing high levels of aggression to rival females, or to males when they exhibit display behaviors (Arnqvist and Rowe 2005).

## Sexually Antagonistic Coevolution

One important consequence of sexual conflict is that any adaptation that moves a shared trait or outcome closer to the fitness optima of one sex necessarily moves it away from the fitness optima of the other. This leads to strong selection on the other sex to resist or counteract such change. This results in a process called sexually antagonistic coevolution (SAC), whereby males and females are locked in an evolutionary “arms race,” with adaptations which increase fitness in one sex being countered by adaptations in the other (Parker 1979; Arnqvist and Rowe 2005). SAC can be distinguished from other forms of coevolution (such as the Fisher runaway process) by the fact that it is driven directly by a reduction in fitness in the opposite sex. However, SAC has been historically difficult to detect. This is because during conflict selection will strongly favor counter-adaptations, which should therefore evolve rapidly. This means that in most species, even those characterized by strong sexual antagonism, males and females should be at a fitness equilibrium, with the fitness costs of conflict essentially hidden from view (Arnqvist and Rowe 2002, 2005). However, this problem can be overcome by considering male and female traits simultaneously, allowing signs of SAC to be detected when there is a relative imbalance in male and female trait expression (Arnqvist and Rowe 2002; Dougherty et al. 2017). SAC has the potential to generate rapid phenotypic divergence, and has been suggested to have driven the evolution of elaborate behavioral and anatomical traits in a range of species.

## Conclusion

The development of the theory of sexual conflict in the 1970s revolutionized our understanding of

how males and females interact with each other, and how reproductive behavior and anatomy may evolve. It is now clear that male and female interests are rarely exactly aligned, and that there may be conflict between the sexes at almost all stages of reproduction. Only by recognizing the presence of conflict can we understand the evolution of a variety of male and female behaviors, including mate choice, polyandry, and parental care. More broadly, this recognition of the importance of conflict has required a change in perspective when thinking about sexual interactions. Reproduction is now more rightly seen as a careful negotiation between two independent and self-interested parties, rather than as a completely cooperative endeavor.

## Cross-References

- ▶ [Promiscuity](#)
- ▶ [Sneaky Copulator](#)

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